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Uranium Mill Tailings Remedial Action Project

UMTRAP

United States Department of Energy

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

UMTRA-DOE/ALO-164

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July 1981

THE URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT

TECHNOLOGY DEVELOPMENT PROGRAM

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ABSTRACT

This report describes the Uranium Mill Tailings Remedial Action Project (UMTRAP) Technology Development Program and the R&D activities that support the program. Individual program tasks are categorized as to their relevance to Cover Technology, Liner Technology or Conditioning/Reprocessing Technology. For convenience, each task is summarized in a standardized format.

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THE URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT TECHNOLOGY DEVELOPMENT PROGRAM

Introduction

Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978, makes the Department of Energy responsible for remedial action programs at inactive uranium mill tailings sites. These programs are managed by the DOE Uranium Mill Tailings Remedial Action Project Office (UMTRA-PO), which was established at Albuquerque, New Mexico, in October 1979. Richard H. Campbell is Project Manager.

The Project Office is responsible for negotiating agreements with the affected states and Indian tribes, preparing environmental documents, and formulating and implementing a specific remedial action plan for each of the 25 designated inactive tailings sites and the associated off-site properties. Mark L. Matthews directs the technology development program that supports these activities. Pending selection of a Technical Assistance Contractor, Sandia National Laboratories assists Mr. Matthews in the administration and monitoring of the eleven individual contracts which comprise the UMTRAP technology development program. This report describes the status of the program in mid-FY81.

Technology Development Program Structure

Proposed EPA standards for tailings disposal establish limits for radon exhalation and for groundwater contamination.[1] There are three possible methods of controlling effluents to meet these standards: (1) the tailings can be covered with a material or a sequence of materials chosen to impede the migration of radon and solid contaminants to the surface, and to prevent precipitation from infiltrating the tailings; (2) disposal sites can be isolated from the underlying soil by liner materials that inhibit water movement and/or absorb contaminants leached from the tailings; (3) the tailings can be processed or "conditioned" to stabilize or remove the contaminants. The UMTRAP technology development program, therefore, is logically separated into three principal areas of investigation: Cover Technology, Liner Technology, and Conditioning/Reprocessing Technology.

For each of these areas, there is a Technology Task Group made up of experimenters and consultants from the participating

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1. The proposed standards specify that disposal must be carried out in a manner that provides reasonable assurance that for at least a thousand years following disposal, (1) the average annual release of Radon-222 from the surface of a tailings pile will not exceed 2 pCi/m^2-sec, and (2) contamination of underground drinking-water sources will not exceed limits established (in the standards) for specific radionuclides and nonradioactive contaminants.

organizations. Quarterly meetings are held to review progress and discuss possible changes in program emphasis. The chairmen of the task groups report to the UMTRAP Technology Working Group, which in turn recommends future program direction and funding levels to the Project Office. Membership of the four advisory groups is shown in Figure 1.

Under the provisions of PL 95-604, remedial actions at the 25 designated inactive mill tailings sites must be completed within seven years after the final EPA standards for tailings disposal are promulgated, probably about January, 1983. Thus, less than nine years are available in which to formulate and execute a specific remedial action plan for each of the 25 sites. This schedule imposes a severe time constraint on the technology development effort, and contractors have been directed to reach decision points as early as possible in their programs. It was originally intended that all R&D work would be essentially finished by end of FY82, so that a more-or-less complete technology package would be available as input for the remedial action designs of the four highest-priority tailings sites (Canonsburg, Pennsylvania; Durango, Colorado; Salt Lake City, Utah; and Shiprock, New Mexico). Information developed during the early phases of the technology program, however, has necessitated some change in emphasis and the addition of one major new task (a hydrology/geochemistry program to characterize contaminant transport mechanisms and rates). Under the present schedule, most of the UMTRAP technology development programs will be completed in FY83, but a few will be carried into FY84.

UMTRA PROJECT OFFICE

UMTRAP TECHNOLOGY WORKING GROUP

M. L. Matthews (DOE) - Chairman
P. D. O'Brien (Sandia) - Vice Chairman, Secretary
T. A. Shepherd (Colorado State U)
J. N. Hartley (Battelle PNL)
V. C. Rogers (Rogers & Associates Engineers)
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COVER TECHNOLOGY TASK GROUP

G. W. Gee (Battelle PNL) - Chairman
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J. N. Hartley (Battelle PNL)
N. D. Kretz (Argonne)
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LINER TECHNOLOGY TASK GROUP

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Figure 1 - UMTRAP TECHNOLOGY ADVISORY GROUPS

Disposal configurations for the early sites, therefore, will necessarily be based on the technology available at the time the remedial action is initiated.

To the extent that it is practical to do so, UMTRAP technology development is coordinated with a counterpart program under NRC. W. M. Shaffer, of the NRC Licensing Branch, serves on the UMTRAP Technology Working Group, and a representative of the NRC Office of Research is invited to attend meetings of the three UMTRAP technology task groups. In addition, special briefings are occasionally held to keep NRC personnel informed of progress in individual UMTRAP programs. This cooperation has an obvious long-term payoff to DOE in the licensing of UMTRAP disposal sites. The benefit to DOE of NRC-sponsored technology development is less direct: the emphasis in this work is more on environmental impact and site verification than on the engineering aspects of tailings disposal. Also, the timing of the NRC program is inconsistent with the UMTRAP schedule for remedial action planning. UMTRAP monitoring of NRC technology development activities is, therefore, more or less informal.

Individual programs in the three areas of technology development are discussed in the following sections. Program tasks are summarized in a standardized format designed for easy reference. Yearly funding levels for the various tasks are summarized in the table on page 34; the amounts shown for FY82 through FY84 are current as of Juy 1, 1981.

Cover Technology

The cover over a tailings impoundment serves three purposes: in addition to its primary role of sealing toxic materials in and water out, the cover must prevent intrusion of the tailings by plant roots and burrowing animals, and it must limit surface erosion. No single material of practical thickness and cost can meet all these requirements; the emphasis in the cover technology program, therefore, is on composite covers. Five major contracts support this program.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE

MULTILAYER BARRIERS FOR SEALING OF URANIUM TAILINGS

CONTRACTOR Battelle Pacific Northwest Laboratory

DOE CONTRACT NUMBER DE-AC06-76RLO, 1830

CONTRACTOR'S CONTROL NUMBER 80323

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	310	1475	590	200	200

PUBLICATIONS

Nelson, R. W., G. W. Gee, and C. A. Oster, 1980. "Radon Control by Multilayer Earth Barriers." 1. Modeling of Moisture and Density Effects on Radon Diffusion from Uranium Mill Tailings Third Symposium on Mill Tailings Management, Ft. Collins Co. Civil Engr. Dept., Colorado State University.

Nelson, R. W., G. W. Gee, and D. W. Mayer, 1981. "Control of Radon Emissions from Uranium Mill Tailings by Multilayered Earth Barriers." American Nuclear Society Ann. Mtg. June 1981.

Rogers, V. C., G. M. Sandquist, and K. K. Nielson, 1981. "Radon Attenuation Effectiveness and Cost Optimization for Uranium Mill Tailings and Composite Covers." RAE-9-1. Salt Lake City, Utah.

PROGRAM SUMMARY:

The multilayer cover concept is based on the use of wet clay as a radon seal. The essential feature of such a cover is "hydraulic isolation" of the clay layer, so that it remains moist without active maintenance of the tailings pile. A typical sequence of materials in a complete cover system is (1) tailings, (2) a mixture of wet clay and rock, (3) washed rock fill, (4) overburden (with bioharriers), (5) topsoil, and (6) riprap and/or vegetation; in this sequence, the washed rock above the clay/rock layer acts as a capillary barrier and thus prevents the loss of moisture from the radon seal. The total thickness of the cover system described here is of the order of 1 meter, as compared with a minimum of 3 meters for an earthen cover. Material choice, relative layer thickness, and even the order of the layers can be very important in optimizing the effectiveness and cost of a multilayer cover.

The first field test under this program was initiated at Grand Junction, Colorado, during the summer of 1980. Four different composite clay covers were emplaced over 100-foot-by-50-foot areas of tailings. Although radon attenuation in these covers has proved to be less than expected, the principle of hydraulic isolation has been verified--at least on a short-term basis. Three more multilayer cover systems will be tested at Grand Junction in 1981; one of these is an improved clay composite cover, and two are "gel" systems in which an alum/lime mixture is added (as a water solution) to increase the water capacity of the clay.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE
ASPHALT EMULSION SEALING OF URANIUM TAILINGS

CONTRACTOR Battelle Pacific Northwest Laboratory

DOE CONTRACT NUMBER DE-AC06-76RLO, 1830

CONTRACTOR'S CONTROL NUMBER 80379

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	770	450	600*	500*	500*

*These figures assume continued asphalt development

PUBLICATIONS

Koehnstedt, P. L., J. N. Hartley, and D. K. Davis, 1977. Use of Asphalt Emulsion Sealants to Contain Radon and Radium in Uranium Tailings. BNWL-2190, Pacific Northwest Laboratory, Richalnd, WA.

Hartley, J. N, et al, 1980. Asphalt Emulsion Sealing of Uranium Mill Tailings 1979 Annual Report. PNL-3290, Pacific Northwest Laboratory, Richland, WA.

Hartley, J. N., et al, 1981. Asphalt Emulsion Sealing of Uranium Mill Tailings 1980 Annual Report. PNL-3752, Pacific Northwest Laboratory, Richland, WA.

Hartley, J. N., et al, 1980. "Uranium Mill Tailings Stabilization" R. G. Post, ed. Waste Management '80, 1:193-204.

Hartley, J. N., et al, 1980. "Asphalt Emulsion Sealing of Uranium Mill Tailings," C. J. M. Northrup, Jr., Ed. In Scientific Basis for Nuclear Waste Management, 2:681-698, Plenum Press, NY.

PROGRAM SUMMARY:

A promising "thin" cover system features an asphalt emulsion radon seal in a configuration which is otherwise similar to that described for the moist clay cover. In this cover, a thin layer of road-base gravel separates the asphalt layer from the tailings to provide a stabilized base on which to operate the heavy asphalt application equipment, and to provide barrier against chemical interactions between the tailings and the asphalt. Early efforts under this program were directed toward the evaluation of emplacement techniques and the selection of asphalt formulations (which, incidentally, contain three to four times as much asphalt as ordinary road-type asphalts). Grand Junction field tests in 1979 and 1980 have demonstrated, at least on a short-term basis, the technical feasibility of the asphalt cover system.

A technology review panel was convened in December 1980 to assess the asphalt cover program and its applicability to the UMTRA Project. It was concluded that there are no fundamental technical reasons why a properly formulated and emplaced asphalt emulsion seal cannot provide the required radon attenuation for an indefinitely long time. In a subsequent review by NRC, it was determined that there are no legal or administrative obstacles to the licensing of an asphalt cover system. However, the NRC was emphatic in pointing out that considerably more development work is necessary before a license application can be considered.

The next step in the program is a large-scale (about 1 acre) demonstration of the most promising asphalt cover system; this will be carried out at Grand Junction, as part of the 1981 Joint Field Test. Development beyond that point is not assured. PNL estimates that about three years (and 1.5 million more dollars) will be required to produce detailed engineering specifications for use by the Remedial Action Contractor. Under the present schedule, therefore, asphalt cover technology will not be available for the first (highest-priority) UMTRAP tailings sites. Applicability to the lower-priority UMTRAP sites and to presently active sites (which are not UMTRAP's concern) must be weighed against the remaining development cost in the Project Office's decision for or against continued support for the asphalt program. That decision will be made late in FY81.

Publications (continued)

Hartley, J. N., et al, 1979. "Asphalt Emulsion of Uranium Mill Tailings" in Proceedings of the Second Symposium on Uranium Mill Tailings Management, November 19-20, 1978. Pgs. 157-170, Fort Collins, CO.

Hartley, J. N., et al, 1980. "Application of Asphalt Emulsion Seals to Uranium Mill Tailings" in Proceedings of the Third Sympoisum on Uranium Mill Tailings Management. November 24-25, 1980. Fort Collins, CO.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE APPLICATION OF LONG-TERM CHEMICAL BIOBARRIERS FOR U-TAILINGS

CONTRACTOR Battelle Pacific Northwest Laboratory

DOE CONTRACT NUMBER DE-AC06-76RLO, 1830

CONTRACTOR'S CONTROL NUMBER 80340

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	210	350	125	50	0

PUBLICATIONS

Cline, J. F. and V. A. Uresk, 1979. Revegetation of Disturbed Grounds in the Semi-Aird Climate of Southcentral Washington. Health Physics, 36:289-294.

Cline, J. F., K. A. Gano, and L. E. Rogers, 1979. Loose Rock as Biological Barriers in Shallow Land Burial. Health Physics, 39:497-504.

Cline, J. F., D. A. Cataldo, W. E. Skiens and F. G. Burton, 1981. Biobarriers Used in Shallow Burial Ground Stabilization. J. of Nuc. Tech. (in press).

Cline, J. F., 1981. Effects of Aging of Strontium and Cesium in Field Soils on Plant Uptake. Health Physics (in press).

Burton, F. G., D. A. Cataldo, J. F. Cline and W. E. Skiens, 1981. Application of Controlled Release Technology to Uranium Mill Tailings Stabilization (to be published in Proceedings in Waste Management '81 Symposium, Amer. Nuc. Soc.).

PROGRAM SUMMARY:

The term "biobarrier" has been applied to the layer or layers of material included in a composite tailings cover to prevent intrusion of the tailings by plant roots or burrowing animals. Biobarrier development was initiated--or, rather, continued from earlier work on radioactive waste repository design--as an adjunct to the asphalt cover program, but it has obvious application to all cover systems.

Early in the program, a number of plant antimetabolites were compared on the basis of their ability to inhibit root growth without destroying plant life. A pre-emergent herbicide called Treflan (trifluralin) was selected as the basic ingredient of the root barrier, and subsequent activity has been concentrated on finding a suitable slow-release carrier for the Treflan. At present, 100-to-300-year release appears to be attainable; 1000-year release is less certain.

Graded gravel (finer toward the surface) is being considered as both a root and animal barrier, and other mechanical and chemical deterrents to animal intrusion are under investigation. Some field testing has been carried out at Grand Junction; this will be continued during the 1981 Joint Field Test.

Publications (continued)

Cline, J. F. and W. H. Rickard, 1973. ,Herbage Yields in Relation to Soil Water and Assimilated Nitrogen. J. of Range Manage., 26:295-298.

Cline, J. F. and W. H. Rickard, 1972. Radioactive Strontium and Cesium in Cultivated and Abandoned Field Plots. Health Physics, 23:317-324.

Uresk, D. W., J. F. Cline and W. H. Rickard, 1979. Growth Rates of a Cheatgrass Community and Some Associated Factors. J. Range Manage., 32:168-170.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE REVEGETATION/ROCK COVER FOR STABILIZATION OF INACTIVE U-TAILINGS SITES

CONTRACTOR Battelle Pacific Northwest Laboratory

DOE CONTRACT NUMBER DE-AC06-76RLO, 1830

CONTRACTOR'S CONTROL NUMBER 80368

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	61	400	200	150	0

PUBLICATIONS

None

PROGRAM SUMMARY:

Surface stabilization, as a means of minimizing wind and water erosion, is an essential element of any cover system. Although the NRC recognizes both rock cover (riprap) and self-sustaining vegetative cover as candidate stabilization media, rock cover is preferred because its long-term durability is more readily demonstrable. Vegetative cover is being studied as an alternative for sites where the use of riprap poses a serious logistic problem, or where riprap may increase the infiltration of water through the tailings and compromise ground and surface water quality.

This program involves the development and testing of both riprap and vegetative covers. Differences in soils and climates in the various disposal areas require that the covers be studied for a wide range of environmental conditions. On the basis of information developed under this program, the UMTRAP Technical Assistance Contractor and Remedial Action Contractor will develop site-specific stabilization cover designs.

A revegetation test area was established on the Grand Junction tailings site in the autumn of 1980. Evaluation of the vegetation and its compatibility with various radon attenuation media will continue through FY83.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE ASSESSMENTS OF URANIUM MILL TAILINGS STABILIZATION METHODS

CONTRACTOR Ford, Bacon & Davis Utah

DOE CONTRACT NUMBER DE-AC04-76GJ01658

CONTRACTOR'S CONTROL NUMBER UC-359

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	74	235	0	0	0

PUBLICATIONS

None

PROGRAM SUMMARY:

This program provides input for the design of earthen cover systems. The central task is characterizing the effect of porosity, particle size, and moisture content on the radon diffusion coefficients of candidate cover materials. Laboratory test results will be used to verify (or modify) theoretical models of radon diffusion through earthen covers. This work is closely related to work being done by Rogers and Associates Engineers under contract to PNL. Under PNL sponsorship, four earthen cover configurations will be tested during the 1981 Joint field Test. Soil column tests of the same four cover systems will be conducted to provide scaling data for other laboratory tests.

Recently, FB&DU was asked to investigate "well-pump dewatering" as a preliminary to the handling and transportation of mill tailings. This involves pumping from multiple points within a pile to reduce the water content of the tailings. FB&DU will conduct a field test of this process at the Salt Lake City Vitro site during the late summer of 1981. Water will be pumped from approximately 50 "well points" over a test area of about one acre; headers on the surface of the pile will direct the water to a remote evaporation pond.

Liner Technology

The purpose of a tailings impoundment liner is to prevent the movement of contaminants from the tailings to surface waters or acquifers. Absolute containment of the leachates which will inevitably be present in the tailings is desirable, but difficult to engineer and impossible to guarantee for a thousand years. Therefore, the UMTRAP liner technology program takes into consideration the sorption of contaminants in liner materials and in the soils underlying the tailing piles. Emphasis to date has been on clay composite and asphaltic liners. Recently, increased emphasis has been placed on the development of criteria to determine whether or not a liner is required at a given disposal site. Four major activities make up the liner technology program.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE

LINER EVALUATION FOR URANIUM MILL TAILINGS

CONTRACTOR Battelle Pacific Northwest Laboratory

DOE CONTRACT NUMBER DE-AC06-76RLO, 1830

CONTRACTOR'S CONTROL NUMBER 80395

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	90	300	300	200	150

PUBLICATIONS

Buelt, J. L., S. Barnes, V. Q. Hale, D. Silviera, "An Evaluation of Liners for a Uranium Mill Tailings Disposal Site - A Status Report," PNL-3679. Also an UMTRAP report: DOE-UMT 0200.

PROGRAM SUMMARY:

Under the program, PNL is evaluating candidate liner materials, developing emplacement techniques and conducting laboratory and field tests of promising liner configurations. Cost effectiveness is a major consideration in the selection of candidate liner materials.

Eight materials have been identified and are undergoing accelerated testing in 2-foot-diameter test columns. To date, only clay composites and asphaltic liners have reached the field-test stage of development: in 1980, a bentonite/sand/gravel system and a catalytic airblown asphalt liner were laid down in shallow (30-inch-deep) trenches at the Grand Junction test area. The trenches were filled with supersaturated tailings and covered with plastic sheeting (to prevent evaporation) and a few inches of soil. Water, leachate, and radionuclide transport through the liners are being monitored, but runoff from the nearby cover test area has perturbed the experiment and made data interpretation difficult. A second field test will be initiated at Grand Junction in the late summer of 1981--in a section of the tailings pile that is well removed from other test areas. Again, a clay liner and an asphaltic liner will be tested.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE
LINER EVALUATIONS FOR URANIUM MILL TAILINGS

CONTRACTOR Oak Ridge National Laboratory

DOE CONTRACT NUMBER W 7405-ENG-26

CONTRACTOR'S CONTROL NUMBER ONL-WDX5(42)

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	0	100	150	150	

PUBLICATIONS

None

PROGRAM SUMMARY:

ORNL is extending technology developed in earlier liquid waste disposal programs to investigate changes in clay liner characteristics that may occur as a result of prolonged leachate movement through the liner. It is known that the sorptive properties of soils, including clays, are influenced by the acidity, oxidation potential, and ionic strength of leachates passing through the materials. In time, chemical changes such as lime dissolution and fouling of the reactive surfaces of the soil particles may cause significant degradation of the liner as a contaminant barrier. ORNL's knowledge of these phenomena will be used as the basis for generic criteria which determine whether or not a liner is required at a given disposal site. Site-specific liner design will be the reponsibility of the UMTRAP Technical Assistance Contractor and Remedial Action Contractor.

At its March meeting, the Technology Working Group recommended that ORNL be given primary responsibility for liner technology associate with the disposal of the Canonsburg tailings. The unique character of these tailings and the west Pennsylvania climate combine to pose a difficult disposal problem that must be solved on a short time scale.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE
POLLUTION OF GROUNDWATER DUE TO INACTIVE URANIUM TAILINGS

CONTRACTOR University of Colorado Center for Environmental Sciences

DOE CONTRACT NUMBER DE-AC02-76ET44206

CONTRACTOR'S CONTROL NUMBER None

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	517	755	650	550	0

PUBLICATIONS

None

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PROGRAM SUMMARY:

This program was initiated in FY79, under DOE Headquarters sponsorship. Before the UMTRA Project Office was established, the program was modified to emphasize the geochemical and geotechnical characterization of the inactive tailings sites; despite the program title, the subject of groundwater pollution has not been addressed in depth.

Geochemical characterization of the 25 UMTRAP sites is being carried out by Geochemistry and Environmental Chemistry Research, Inc.; this involves one-time sampling and analysis of tailings and underlying soils, near and far off-site soils, and water from drill holes and nearby wells and streams. This characrerization has produced abundant evidence of chemical and physical disequilibria within the tailings; this evidence is supported by readily observable surface features such as heavy-metal salt encrustations which appear and disappear from time to time.

In October 1980, a technology review panel was formed to assess the significance of these phenomena in the design of tailings disposal impoundments. The panel recommended increased support of the present program and initiation of a four-season hdyrology/geochemistry investigation of one or more tailings sites to generate the data necessary to quantify contaminant transport rates within and outside a tailings pile. FY81 funding of the characterization program was subsequently increased, and the Project Office approved the proposed hydrology/geochemistry study described in page 26.

The geophysical characterization of the UMTRAP tailings sites is being carried out by Colorado State University. This involves the location of sands and slimes areas, the definition of water content profiles, and the measurement of physical properties related to pile stability. As a colateral activity, CSU is studying problems associated with the transportation, deposition, and surface preparation of tailings.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE HYDROLOGY AND GEOCHEMISTRY OF URANIUM MILL TAILINGS: AN INTEGRATED STUDY OF RELEASE AND TRANSPORT MECHANISM

CONTRACTOR Lawrence Berkely Laboratory

DOE CONTRACT NUMBER W-7405-ENG-48

CONTRACTOR'S CONTROL NUMBER None

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	0	335	385	250	150

PUBLICATIONS

None

PROGRAM SUMMARY:

This program was initiated in mid-FY81 at the recommendation of the UMTRAP geochemistry review panel. The objective of the program is to define the release mechanisms and transport rates of radionuclides and nonradioactive contaminants, both within and outside a tailings pile. Four-season hydrologic and geochemical data from two acid-leach tailings sites will be used to validate and calibrate existing models for unsaturated and partially saturated flow. The models will then be used to predict long-term compliance with EPA standards for all tailings disposal sites.

The UMTRAP sites at Maybell, Colorado, and Riverton, Wyoming, which represent extremes of groundwater conditions among the western tailings sites, have been selected for study. Systematic tailings measurements of the pertinent hydrologic and geochemical parameters are now in progress and will be continued through the summer of 1982. Existing data from other tailings sites will be used where possible to support to model development.

Conditioning/Reprocessing Technology

Conditioning is the physical or chemical treatment of tailings as a means of enhancing long-term stability and safety. Reprocessing is treatment for the purpose of mineral recovery. In the United States, conditioning has received little attention as a tailings management option, primarily because of high cost. Reprocessing, on the other hand, may be economically advantageous, and PL 95-604 requires that mineral recovery be considered before remedial action can begin at a designated tailings site.

Two conditioning processes, chemical separation of actinides and physical stabilization (e.g., by slagging), are emphasized in the UMTRAP technology development program; related work in such areas as tailings neutralization through the use of natural rock is monitored but not supported directly by the Project Office.

In general, actinide separation--specifically, radium and thorium separation--involves high-temperature processes that are carried out in special-purpose chemical reactors. By contrast, reprocessing for mineral recovery is economically feasible only in ambient-temperature heap-leach processes; thus, there is little incentive to separate radium and thorium as a follow-on stage of a reprocessing operation. On the other hand, if actinides are separated for safety reasons, mineral recovery is essentially free: uranium recovery, for example, may be attractive for tailings that would not otherwise have been considered rich enough for reprocessing.

Therefore, even though the UMTRAP reprocessing activity is funded separately from technology development, the two programs are coordinated through the Conditioning/Reprocessing Task Group.

The Project Office supports two conditioning technology programs.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE EXPERIMENTAL EVALUATION OF URANIUM MILL TAILINGS CONDITIONING ALTERNATIVES

CONTRACTOR Los Alamos National Laboratory

DOE CONTRACT NUMBER W-7405-ENG-36

CONTRACTOR'S CONTROL NUMBER A483

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BUDGET OBLIGATION (000)

FY80	FY81	FY82	FY83	FY84
91	460*	300	200	200

*Includes $10 K for neutron activation analysis of tailings samples in support of RIGEC geochemistry program.

PUBLICATIONS

None

PROGRAM SUMMARY:

LANL's areas of emphasis in conditioning technology include chemical actinide separation and thermal stabilization (slagging). Among the chemical treatments being considered are sulphuric acid leaching, sodium carbonate leaching, and brine (sodium-potassium chloride) leaching. Recently, attention has been directed toward thermal stabilization--e.g., by slagging in a coal-fired kiln--as a means of reducing radon emanation.

Decisions for or against tailings conditioning will be made on a site-specific basis and will be influenced strongly by economic considerations. LANL is developing a format for comparing the costs of the various disposal options. A preliminary analysis leads to the conclusion that, on the basis of economics alone, every option for on-site conditioning and disposal should be investigated before a decision is made to move tailings to a remote disposal site. At the Shiprock site, for example, the tailings can be calcined and covered on-site at a cost which is less than that of moving the tailings to a new disposal site only a few miles away. In other words, at tailings sites where final disposal of an upgraded waste form is possible, there may be an economic advantage in on-site disposal. An important feature of the calcination process if that it utilizes coal energy, whereas the transportation of tailings to a new disposal site inevitably involves the use of petroleum-based fuels.

The potential advantages of on-site slagging are such that LANL is now preparing a proposal for an accelerated pilot-scale demonstration (which would be carried out in an experimental cement kiln). No major extension of present technology is involved in this process, and it is reasonable to expect that it could be ready for full-scale application by late 1983.

UMTRAP TECHNOLOGY DEVELOPMENT PROGRAM

PROGRAM TITLE URANIUM MILL TAILINGS TREATMENT

CONTRACTOR Oak Ridge National Laboratory

DOE CONTRACT NUMBER W7405-ENG-26

CONTRACTOR'S CONTROL NUMBER ONL-WDX1

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BUDGET OBLIGATION (000)	FY80	FY81	FY82	FY83	FY84
	0	225	150	0	0

PUBLICATIONS

Ryon, A. D., F. J. Hurst, and F. G. Seeley, "Nitric Acid Leaching of Radium and Other Significant Radionuclides from Uranium Ores Tailings," ORNL-TM-5944 (August 1977).

Seeley, F. G., "Problems in the Separation of Radium from Uranium Ore Tailings," Hydrometallurgy, 2, 249 (1977).

Scheitlin, F. M., and W. D. Bond, 1980. "Removal of Hazardous Radionuclides from Uranium Ore and/or Mill Tailings: Progress Report for the Period October 1, 1978 to September 30, 1979. ORNL-TM-7065, Oak Ridge National Laboratory, Oak Ridge, TN.

PROGRAM SUMMARY:

This program emphasizes actinide separation by nitric-acid leaching and by the use of chelating agents. In addition, ORNL monitors Canadian work on chloride leaching.

In laboratory tests using sands from Salt Lake City tailings, it was found that three-stage leaching with three-molar nitric acid at 80°C removed over 80 percent of the radium in the tailings in one hour. Three-molar nitric acid at 25°C removed 87 percent of the radium in 24 hours; this raises the interesting possibility of heap-leaching with nitric acid, and ORNL suggests that the residual sands from such a process might be usable as cover material.

It was recognized from the outset that nitric-acid leaching is expensive and that the process wastes (nitrates) pose a serious disposal problem. The program was initiated with the hope that high actinide separation efficiences would offset these disadvantages. Progress in quantifying process parameters and costs has been slower than was anticipated, and it now appears that the program cannot be completed in time to provide design input for the remedial action at Canonsburg, Pennsylvania--the site most likely to require tailings conditioning. For this reason, the UMTRAP Technology Working Group recommended at its March 1981 meeting that ORNL concentrate exclusively on the Canonsburg tailings. This work is being delayed by the unavailability of suitable samples of Canonsburg tailings.

TECHNOLOGY DEVELOPMENT COSTS
(1981 $000)

Task	Performer	Fiscal Year 1980	1981	1982	1983	1984	1985	Total
MULTILAYER COVER	PNL	310	1,475	590	200	200		2,775
ASPHALT COVER	PNL	770	450	600	500	500		2,820
BIOBARRIERS	PNL	210	350	125	50			735
REVEGATION/ ROCK COVER	PNL	61	400	200	150			811
STABILIZATON	FBDU	74	235					309
LINER TECHNOLOGY	PNL	90	300	300	200	150		1,040
LINER TECHNOLOGY	ORNL		100	150	150			400
GROUNDWATER POLLUTION	CES	517	755	650	550			2,472
HYDROLOGY/ GEOCHEMISTRY	LBL		335	385	250	150		1,120
CONDITIONING	LANL	91	460	300	200	200		1,251
CONDITIONING	ORNL		225	150				375
RESERVE/SUPPORT				800	800	500	400	2,500
TOTALS		2,123	5,085	4,250	3,050	1,700	400	16,608

Conclusion

The UMTRAP technology development program is responsive to the statement in the legislative history of PL 95-604 that "...it is intended that the DOE not rush headlong into using technology that may be effective for a short period of time. The committee* does not want to visit this problem again with additional aid. The remedial action must be done right the first time...." At the time the program was initiated, a concerted effort was made to assure that all the important areas of technology were included and that maximum use was made of information developed in non-DOE programs.

As in most R&D programs, early progress in the various areas of investigation has revealed both omissions and "blind alleys." Corrective action has been taken through the three Technology Task Groups and the UMTRAP Technology Working Group. Thus, the technology development program is and will remain a dynamic activity. At whatever point in the UMTRAP schedule design decisions for a particular tailings site must be made, the program will provide recommendations based on state-of-the-art technology at that time.

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*U. S. House of Representatives Committee on Interior and Insular Affairs.

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