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Information Division

NUCLEAR FACILITY DECOMMISSIONING AND SITE REMEDIAL ACTIONS

A SELECTED BIBLIOGRAPHY VOLUME 3

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Remedial Action Program Information Center
Information Center Complex

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CONTENTS

ABSTRACT

This bibliography contains 693 references with abstracts on the subject of nuclear facility decommissioning, uranium mill tailings management, and site remedial actions. Foreign, as well as domestic, literature of all types—technical reports, progress reports, journal articles, conference papers, symposium proceedings, theses, books, patents, legislation, and research project descriptions—have been included in this publication. The bibliography contains scientific (basic research as well as applied technology), economic, regulatory, and legal literature pertinent to the U.S. Department of Energy's Remedial Action Program. Major chapters are Surplus Facilities Management Program, Nuclear Facilities Decommissioning, Formerly Utilized Sites Remedial Action Program, Uranium Mill Tailings Remedial Action Program, Grand Junction Remedial Action Program, and Uranium Mill Tailings Management. Chapter sections for chapters 1 and 2 include: Design, Planning, and Regulations; Site Surveys; Decontamination Studies; Dismantlement and Demolition; Land Decontamination and Reclamation; Waste Disposal; and General Studies. The references within each chapter are arranged alphabetically by leading author. References having no individual author are arranged by corporate author or by title. Indexes are provided for (1) author; (2) corporate affiliation; (3) title; (4) publication description; (5) geographic location; and (6) keywords.

An appendix of 202 bibliographic references without abstracts or indexes has been included in this bibliography. This appendix represents literature identified but not abstracted due to time constraints.

INTRODUCTION

The staff of the Remedial Action Program Information Center (RAPIC) provides technical information support to the U.S. Department of Energy's (DOE's) Remedial Action Program under the cosponsorship of the program's four major constituents:

- Surplus Facilities Management Program
  Lead Field Office—DOE Richland Operations Office
  Lead Field Contractor—UNC Nuclear Industries, Inc., Office of Surplus Facilities Management (OSFM)
- Formerly Utilized Sites Remedial Action Program
  Lead Field Office—DOE Oak Ridge Operations Office
  Lead Field Contractor—Bechtel National, Inc.
- Uranium Mill Tailings Remedial Action Program
  Lead Field Office—DOE Albuquerque Operations Office
  Lead Field Contractor—Jacobs Engineering
- Grand Junction Remedial Action Program
  Lead Field Office—DOE Grand Junction Area Office
  Lead Field Contractor—Bendix Field Engineering Corporation

The Nuclear Facility Decommissioning and Site Remedial Actions data base was developed and is maintained by RAPIC, which is part of the Information Center Complex (ICC), Information Division, located at Oak Ridge National Laboratory. Administratively, RAPIC's communications with the U.S. DOE's Remedial Action Program are coordinated through the Office of Surplus Facilities Management, UNC Nuclear Industries, Inc., Richland, Washington.

RAPIC serves as a central clearinghouse for information concerning scientific, regulatory, and socioeconomic aspects of radioactively contaminated facility/site remedial actions. This includes both domestic and foreign publications. For both government and industry, these remedial actions encompass such activities as:

- Performing characterization surveys of radioactively contaminated facilities/sites.
- Conducting ongoing security and surveillance programs.
- Performing preventive maintenance actions to ensure containment of radioactivity while awaiting permanent disposition.
- Assessing environmental and engineering aspects of proposed disposal alternatives
- Drafting detailed disposal plans and procedures.
- Removing contamination and restoring facilities/sites for unlimited or limited new uses.

This bibliography of 693 references is the third in a series to be prepared by RAPIC. Volumes 1 and 2, which were published in 1980 and 1981, respectively, had the same title and same subject coverage. Subsequent volumes, incorporating newly identified items of relevance, will be issued on an annual basis. The contents of this publication are stored in a computer-retrievable data file which undergoes periodic updating. It is preferred that researchers use this bibliography as their "first-line" reference tool; however, the data file can be accessed through RAPIC for more current literature listings or for a comprehensive subject search of the entire data base.

CONTENTS OF THE BIBLIOGRAPHY

The subject matter of this bibliography is presented in six chapters: Surplus Facilities Management Program, Nuclear Facilities Decommissioning, Formerly Utilized Sites Remedial Action Program, Uranium Mill Tailings Remedial Action Program, Grand Junction Remedial Action Program, and Uranium Mill Tailings Management.

The Surplus Facilities Management Program (SFMP) chapter contains references pertaining to the SFMP or to the program sites as well as other U.S. sites for which decommissioning is either planned or underway. The Nuclear Facilities Decommissioning chapter contains foreign site-specific information as well as any decommissioning technology information that is not domestic site-specific. Because of the size and diversity of the first two chapters, it has been necessary to subdivide each of these chapters into the following sections: Design, Planning, and Regulations; Site Surveys; Decontamination Studies; Dismantlement and Demolition; Land Decontamination and Reclamation; Waste Disposal; and General Studies.

The Formerly Utilized Sites Remedial Action Program (FUSRAP) chapter contains references pertinent to the FUSRAP or to FUSRAP sites. These sites were used by the Manhattan Engineer District or by the Atomic Energy Commission from the 1940s through the 1960s for the processing, handling, storage, or shipment of radioactive materials.

The Uranium Mill Tailings Remedial Action Program (UMTRAP) chapter contains information pertinent to the UMTRAP or to approximately 25 program sites, located primarily in the western United States. These sites are inactive uranium milling sites that were operated under government contract.

The Grand Junction Remedial Action Program chapter contains information pertinent to the remedial actions that are underway in Grand Junction, Colorado, structures that have uranium mill tailings in, under, or adjacent to their walls or foundations. Studies pertaining to the control of radon in building atmospheres are also included in this chapter.

The Uranium Mill Tailings Management chapter contains foreign site-specific information, as well as any basic or applied research, not domestic site-specific, that is pertinent to the management of uranium mill tailings.

INDEXES

It is suggested that readers familiarize themselves with the color-coded indexes, which are essential to finding needed references in this bibliography. The citations in this bibliography are grouped by broad subject categories; locating references on specific topics requires the use of these indexes. The numbers appearing after each listing in the indexes are citation numbers which are in ascending order. The author index (pink pages) is organized alphabetically by the last name of each author listed in this bibliography. All authors for a citation are indexed. The corporate affiliation index (blue pages) is an alphabetical listing of the corporate affiliation of all authors. The title index (yellow pages) is a permuted index of individual title words. There are a number of title words that have been suppressed from this index (e.g., conjunctions, prepositions, articles, and auxiliary verbs, as well as a number of words that frequently appear in document titles on this subject coverage, such as *decommissioning, decontamination, mill, and tailings*). There is a separate listing for each word in the title with the indexed title word appearing at the left margin of the page. The publication description index (green pages) lists alphabetically all report numbers, journal citations, conference descriptions, or other descriptions that would identify the publication. The geographic location index (gold pages) is an alphabetical index of the geographic descriptions of sites referenced in the bibliography. The index is divided into two sections, domestic sites and foreign sites. The keyword index (orange pages) is an alphabetical index of specific terms selected from a controlled thesaurus.

CITATION FORM

The references within each chapter are arranged alphabetically by first author, corporate affiliation, or title of the document. When the author is not given, the corporate affiliation will appear first. If these two levels of authorship are not given, the title of the document is used as the identifying level.

As a result of computer limitations in indicating superscripts and subscripts in the standard manner, certain conventions have been established in this bibliography:

1. X sub t (X being a variable) means X_t or X subscript t.
2. For chemical compounds and elements, NaIO3 (for example) means $NaIO_3$.
3. 10(E+3) or X(E-3) (E denoting exponent) means 10^3 or X^{-3}.

SERVICES

RAPIC provides information support to a large number of researchers who are involved in the nuclear technology field. Such services as performing topical searches of RAPIC data bases, performing computerized literature searches of the commercially available data bases, and providing assistance in locating hardcopies of documents referenced in the bibliography are provided free of charge to the U.S. DOE's Remedial Action Program personnel or their subcontractors. Copies of most documents referenced in this bibliography can be obtained through either the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, or the Technical Information Center, U.S. Department of Energy, P.O. Box 62, Oak Ridge, Tennessee 37830.

All inquiries for information services should be addressed to:

Remedial Action Program Information Center
Oak Ridge National Laboratory
P.O. Box X, Building 2001
Oak Ridge, Tennessee 37830

Telephone: *FTS 624-7764 [(615)574-7764]*
or
FTS 626-0568 [(615)576-0568]

ACKNOWLEDGMENTS

Staff of the Office of Surplus Facilities Management (OSFM), UNC Nuclear Industries, closely guided this project and contributed many of the publications referenced in this bibliography.

Special thanks are extended to Renee Brewster of the Hazardous Materials Information Center (HMIC), Information Center Complex (ICC), Oak Ridge National Laboratory, for abstracting and editing and to Elinor Trotter, also of HMIC, for assistance in document control. We would also like to thank staff members of the ICC Information Sciences and Operations Department for the computer production of this document and staff members of the ICC Publications Office for their assistance in final publication preparations.

SAMPLE REFERENCE

This is an example of the format for the descriptive fields used in this bibliography:

1—*Chapter Heading*
2—*Section Heading*
3—*Record Number*
  (Sequential Number of Reference)
4—*Author(s)*
5—*Corporate Affiliation*
6—*Document Title*
7—*Publication Description*
8—*Publication Date*
9—*Abstract*
10—*Abstract Credit*

CHAPTER 2. [1]NUCLEAR FACILITIES DECOMMISSIONING
[2]DESIGN, PLANNING, AND REGULATIONS

[3]191
[4]Anderson, R. C., and D. T. Dexheimer
[5]Bechtel Power Corporation, San Francisco, CA

[6]INCORPORATING DECOMMISSIONING REQUIREMENTS INTO THE DESIGN PROCESS FOR NUCLEAR POWER PLANTS

[7]CONF-800359; Decommissioning Requirements in the Design of Nuclear Facilities, Proceedings of a Nuclear Energy Agency Specialist Meeting, Paris, France, March 17-19, 1980, (pp. 123-134), 285 pp. [8](1980)

[9]As a first step in incorporating decommissioning requirements into the design process, greater effort should be made to optimize designs and select alternatives to facilitate decommissioning without adding to the initial cost of the plant. In this regard, the concept of designing to minimize the plant's bulk quantities of concrete, piping and electrical cables offers a significant opportunity to make the ultimate decommissioning easier. A major design objective should be to build "smaller and lighter" to facilitate decommissioning through the simple reduction of the amount of equipment and structures requiring decontamination, dismantlement, demolition, and disposal. (Auth)[10] (JMF)

Chapter 1

SURPLUS FACILITIES MANAGEMENT PROGRAM

- Design, Planning, and Regulations
- Site Surveys
- Decontamination Studies
- Dismantlement and Demolition
- Land Decontamination and Reclamation
- Waste Disposal
- General Studies

2

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

1

Alexanderson, E.L., Detroit Edison Company, Detroit, MI

Decommissioning of Fermi-I

CONF-7811109; American Nuclear Society 1978 Winter Meeting, Proceedings of a Conference, Washington, DC, November 12-16, 1978, (pp. 551-553); Transactions of the American Nuclear Society 30:551-553 (1978)

The plan to retire the plant consisted of: shipping off site all fuel and blanket elements, all bulk nonradioactive sodium, and contaminated or irradiated materials except from restricted areas; securing some of the reactor building penetrations; draining and sealing the primary system and secondary sodium system out to welded pipe caps, and passivating the residual sodium; revising the site boundary; implementing a postretirement surveillance plan; and leaving the turbine generator in place for continued service. Later activities, delayed for lack of disposal plans, are described. The total cost of decommissioning was over $6 million. Although decommissioning took longer than estimated, additional expenses incurred were offset by rapidly reducing the work force and retiring buildings and equipment as soon as they were not needed. It was recommended that engineers should anticipate decommissioning and design accordingly. (CAJ)

2

Amorosi, A., J.R. Honekamp, and H.O. Monson, Argonne National Laboratory, Argonne, IL

Decommissioning of a Large Central-Station LMFBR Power Plant: A Comparison with the PWR

ANL-80-40; Fast Breeder Reactor Studies, C.E. Till, et al., (pp. 359-408), 410 pp. (1981, July)

The decommissioning of a liquid metal fast breeder reactor (LMFBR) is qualitatively compared with that of a more conventional pressurized water reactor (PWR). The PWR and LMFBR are examined for differences which might impact the total station decommissioning costs, and the primary systems of both reactor types are compared to determine if design differences in their radioactive portions would substantially alter the overall balance of costs evaluated in earlier comparative studies of decommissioning alternatives. Consideration of the ease of disassembly, relative quantities of structural material to be treated, and the special aspects related to the sodium coolant indicated that, for otherwise equivalent circumstances, dismantling operations are of corresponding difficulty, decommissioning costs are comparable, and, if the primary sodium is reused in another reactor and proper credit taken, the sodium coolant does not add to the cost of decommissining. If the sodium must be converted for disposal, the LMFBR decommissioning costs would be somewhat higher than those of the PWR. (Auth)(CAJ)

3

Bair, W.J., Battelle Pacific Northwest Laboratories, Richland, WA

Decommissioning of Retired Hanford Facilities - Technology

Research Project; Contract No. EY-76-C-06-1830 (1980)

The objectives of this project are to conceive, develop, and test advanced technology applicable to the Hanford decommissioning effort. This project is divided into several tasks that encompass the extremely diverse technology applicable to the Hanford decommissioning effort. Technology assessments were made on: concrete decontamination and concrete properties; dry ice blasting; arc saw evaluation; burial ground stabilization; instrumentation development; electro polishing/vibratory finishing application; and fixatives (contamination). (SSIE)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

4
Barcelo, H., Center for Energy and Environment Research, Caparra Heights, PR

Decontamination Project

Research Project (1980)

With the implementation of the ERDA Administrator's Action Memorandum dated April 11, 1976, DOE GOCO operations at CEER, University of Puerto Rico (UPR), are to be discontinued by early FY 1980. Continuing DOE programs at CEER are to be executed through some other contractual mechanism. The action memorandum provides for the transfer of government-owned real and personal property at CEER to the University of Puerto Rico with the university obtaining NRC licenses for those nuclear facilities to be retained by the university. Nuclear facilities not retained by the university are to be removed and the associated properties are to be decontaminated to levels consistent with unrestricted use release to the UPR. The research reactor facility and associated hot cells, rad-waste systems, and research laboratories will not be retained by the university. This facility housed the five megawatt TRIGA FLIP Reactor which was shut down for decommissioning on September 30, 1976. This facility and associated support areas will be decontaminated to levels suitable for unrestricted use and restored to functional utility. No remodeling as such is scheduled under this project. (SSIE)(PTO)

5
Barcelo, H., University of Puerto Rico, Mayaguez, PR

Decommissioning of Center for Energy and Environmental Research (CEER) - Mayaguez Facility

Research Project (1981)

The reactor facility will be decommissioned and decontaminated to levels suitable for release for unrestricted use. The approaches used consist of: (1) preparation of an engineering assessment; (2) preparation of the site for disposition operations; (3) removal of reactor core tower and support structures; (4) removal of radioactive or contaminated pool structures, such as beam ports and thermal column Pb window; (5) removal of radioactive pool concrete and embedments; (6) removal of contaminated components of the cooling systems; (7) decontamination of hot cells, laboratories, and other work areas; (8) removal and decontamination of hot waste storage components of the cooling system; and (9) final radiation survey of CEER to be incorporated in the writing of a final report. (SSIE)(PTO)

6
Bermanis, H., United Engineers and Constructors, Philadelphia, PA

How Will the Cost of Decommissioning Be Funded

Nuclear Engineering International 24(292):21-23 (1979, November)

The U.S. NRC favors the complete dismantling of nuclear power plants at the end of their service lives and is concerned that adequate funding will be available to cover the costs when the time comes. The advantages and disadvantages of different methods of funding are discussed. (EDB)(PTO)

7
Bermanis, H., United Engineers and Constructors, Philadelphia, PA

Recovery of Decommissioning and Spent Fuel Charges

Nuclear Engineering International 26(318):45-47 (1981, September)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

The financial and regulatory aspects of the costs of decommissioning and spent fuel storage and disposal in the United States are still uncertain and the official policies inconsistent. These areas are discussed in the article. (INSPEC)(RHB)

8

Brynda, W.J., R. Karol, and R.W. Powell, Brookhaven National Laboratory, Division of Operational and Environmental Safety, Upton, NY

Decommissioning of Reactor Facilities

BNL 50831-6; Design Guide for Category 6 Reactors Air-Cooled Graphite Reactors, W.J. Brynda, Sec. 3.14, (pp. 3.31-3.33), 400 pp. (1979, February)

The ERDA Manual, Chapter 0540, "Safety of AEC-Owned Reactors," requires that reactors be decommissioned in a manner that gives adequate consideration to health and safety factors. Chapter 0524, Part 5, "Guidance on Maintaining Exposures to as Low as Practicable," further requires that decommissioning requirements be considered in the design of a reactor facility. The four major alternatives for the retirement of a reactor facility are mothballing, in-place entombment, removal of radioactive components and dismantling, and conversion to a new nuclear system. Reactor facility design should include provisions which will facilitate the eventual decommissioning of the facility and, in the process, assist in maintaining occupational radiation exposures as low as reasonably achievable. Such provisions may include: (1) Fluid system design to minimize the buildup of radioactive contamination; (2) Provisions for flushing contaminated systems; (3) Adequate fixed or movable shielding; (4) System design to facilitate the use of remote handling devices; and (5) Use of ventilation systems to control airbone contamination. Procedures for decommissioning should assure that occupational and off-site radiation exposures are maintained as low as reasonably achievable. Any unreviewed safety issues or changes in technical specifications necessary to accomplish decommissioning should be reviewed and approved by DOE prior to the retirement of a reactor facility. Finally, it is recommended that before the decommissioning of reactor facilities, the guidance in 10 CFDR 50.82, "Application for Termination of Licenses" be considered. (Auth)(JMF)

9

Brynda, W.J., P.R. Lobner, R.W. Powell, and E.A. Straker, Brookhaven National Laboratory, Upton, NY; Science Applications, Inc., La Jolla, CA

Design Guide for Category 3 Reactors - Pool Type Reactors

BNL 50831-3 (1978, November)

This design guide deals principally with the design and functional requirement of pool-type (category 3) reactor structures, components, and systems. The purpose of this design guide is to provide additional guidance to aid the Department of Energy (DOE) facility contractor in meeting the requirement that the siting, design, construction, modification, operation, maintenance, and decommissioning of DOE-owned reactors be in accordance with generally uniform standards, guides, and codes comparable to those applied to similar reactors licensed by the Nuclear Regulatory Commission (NRC). This design guide has been written to provide a designer with standardized guidelines and recommendations pertinent to the design of new reactor facilities and to the modification of significant portions of existing facilities. For each system, the design guide provides guidance for determining if the system is required at a particular facility and, if the system is required, the design guide recommends major safety concepts and design philosophies and the codes, standards, and guides to be considered in system design and/or modification. (Auth)(PTO)

10

Brynda, W.J., P.R. Lobner, R.W. Powell, and E.A. Straker, Brookhaven National Laboratory, Upton, NY

Decommissioning of Reactor Facilities

BNL 50831-2; Design Guide for Category 2 Reactors Light and Heavy Water Cooled Reactors, W.J. Brynda, P.R. Lobner, R.W. Powell, and E.A. Straker, Sec. 3.14, (pp. 102-104), 330 pp. (1978, May)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

The ERDA Manual, Chapter 0540, "Safety of AEC-Owned Reactors", requires that reactors be decommissioned in a manner that gives adequate consideration to health and safety factors. Chapter 0524, Part V, "Guidance on Maintaining Exposures to as Low as Practicable," further requires that decommissioning requirements be considered in the design of a reactor facility. Four major alternatives for the retirement of a water cooled reactor with a closed primary coolant system are evident: mothballing; in-place entombment, removal of radioactive components and dismantling; and conversion to a new nuclear system. Reactor facility design should include provisions which will facilitate the eventual decommissioning of the facility and, in the process, will assist in maintaining occupational radiation exposure as low as reasonably achievable. Such provisions may include: Fluid system design to minimize the buildup of radioactive contamination, provisions for flushing contaminated systems, adequate fixed or movable shielding, system design to facilitate the use of remote handling devices, and use of ventilation systems to control airborne contamination. (Auth)(JMF)

11

Brynda, W.J., P.R. Lobner, R.W. Powell, and E.A. Straker, Brookhaven National Laboratory, Upton, NY; Science Applications, Inc., La Jolla, CA

Decommissioning of Reactor Facilities

BNL 50831-5; Design Guide for Category 5 Reactors Transient Reactors, W.J. Brynda, Sec. 3.14, (pp. 3.28-3.30), 425 pp. (1979, March)

The ERDA Manual, Chapter 0540, "Safety of AEC-Owned Reactors," requires that reactors be decommissioned in a manner that gives adequate consideration to health and safety factors. Chapter 0524, Part 5, "Guidance on Maintaining Exposures to as Low as Practicable," further requires that decommissioning requirements be considered in the design of a reactor facility. The four major alternatives for the retirement of a reactor facility are: mothballing; in-place entombment; removal of radioactive components and dismantling; and conversion to a new nuclear system. Reactor facility design should include provisions which will facilitate the eventual decommissioning of the facility, and in the process, assist in maintaining occupational radiation exposures as low as reasonably achievable. Such provisions may include: (1) fluid system design to minimize the buildup of radioactive contamination; (2) provisions for flushing contaminated systems; (3) adequate fixed or movable shielding; and (4) system design to facilitate the use of remote handling devices. (5) use of ventilation systems to control airborne contamination. Procedures for decommissioning should assure that occupational and off-site radiation exposures are maintained as low as reasonably achievable. Any unreviewed safety issues or changes in technical specifications necessary to accomplish decommissioning should be reviewed and approved by DOE prior to the retirement of a reactor facility. Finally, it is recommended that before the decommissioning of reactor facilities, the guidance in 10 CFDR 50.82, "Application for Termination of Licenses" be considered. (Auth)(JMF)

12

Brynda, W.J., P.R. Lobner, R.W. Powell, and E.A. Straker, Brookhaven National Laboratory, Upton, NY; Science Applications, Inc., La Jolla, CA

Decommissioning of Reactor Facilities

BNL 50831-3; Design Guide for Category 3 Pool Type Reactors, W.J. Brynda, Sec. 3.14, (pp. 3.31-3.33), 425 pp. (1978, November)

The ERDA Manual, Chapter 0540, "Safety of AEC-Owned Reactors," requires that reactors be decommissioned in a manner that gives adequate consideration to health and safety factors. Chapter 0524, Part 5, "Guidance on Maintaining Exposures to as Low as Practicable," further requires that decommissioning requirements be considered in the design of a reactor facility. The four major alternatives for the retirement of a reactor facility are mothballing, in-place entombment, removal of radioactive components and dismantling, and conversion to a new nuclear system. Reactor facility design should include provisions which will facilitate the eventual decommissioning of the facility and, in the process, assist in maintaining occupational radiation exposures as low as reasonably achievable. Such provisions may include: (1) Fluid system design to minimize the buildup of radioactive contamination. (2) Provisions for flushing contaminated systems; (3) Adequate fixed or movable shielding; (4) System design to facilitate the use of remote handling devices; and (5) Use of ventilation systems to control airborne contamination. Procedures for decommissioning should assure that occupational and off-site radiation exposures are maintained as low as reasonably achievable. Any unreviewed safety issues or changes in technical specifications necessary to accomplish decommissioning should be reviewed and approved by DOE prior to the retirement of a reactor facility. Finally, it is recommended that before the decommissioning of reactor facilities, the guidance in 10 CFDR 50.82, "Application for Termination of Licenses" be considered. (Auth)(JMF)

13

Calkins, G.D., U.S. Nuclear Regulatory Commission, Office of Standards Development, Washington, DC

Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities

NUREG-0436 (Rev. 1, Suppl. 2); 22 pp. (1981, March)

This report supplements and updates the information presented in NUREG-0436, Rev. 1, of the same title and dated December 1978, and Supplement 1, dated August 1980. Supplement 2 repeats the new terminology for the decommissioning alternatives. It updates the status and schedules for developing the information base, the draft generic environmental impact statement, and the rulemaking. In addition, schedules for regulatory guides to support the rules are presented. (Auth)

14

Cavendish, J.H., National Lead Industries, Inc., Cincinnati, OH

Weldon Spring Site-Supervision and Decommissioning

Research Project (1981)

The objective of this project is to decommission the DOE-Weldon Spring site and return it to unrestricted use. The site consists of four pits that contain the radioactive wastes generated from the production of uranium metal at the Weldon Spring Production Center from 1957 to 1966. DOE also has possession of a quarry located four miles from the Weldon Spring Plant which was used for the disposal of contaminated rubble and thorium residues. The residues contained in the four pits are to be removed by private contractor. The National Lead Company of Ohio will monitor the removal of the sludges and pump any surface runoff as necessary back into the pits. After the sludges have been removed, the supernatant liquors will be treated and disposed of, and the site will be graded to an essentially natural contour. Background information on the quarry has been summarized; geological and risk assessments have been initiated through ORNL toward isolation of the quarry from the environment. (SSIE)

15

Chapin, J.A., and R.E. Hine, Idaho National Engineering Laboratory, Idaho Falls, ID

Decontamination and Decommissioning Long Range Plan: Idaho National Engineering Laboratory

TREE-1250 (Vol. 1); 134 pp. (1978, June)

The purpose of this document is to provide long-range planning for decontamination and decommissioning of radioactive facilities at the Idaho National Engineering Laboratory (INEL). This plan will be revised and updated annually. The information developed during the decontamination and decommissioning (D and D) program will be collected and used to develop a handbook of D and D activities that will be updated annually and made available for the nuclear D and D community. Volume I is the management plan which includes schedules, costs, priorities, criteria, alternatives, and program management plan which includes schedules, costs, priorities, criteria, alternatives, and program management philosophy. Costs are order-of-magnitude and schedules are based on program operations through FY 1984. (EDB)

16

Chernick, P.L., W.B. Fairley, M.B. Meyer, and L.C. Scharff, Analysis and Inference, Inc., Boston, MA

Design, Costs, and Acceptability of an Electric Utility Self-Insurance Pool for Assuring the Adequacy of Funds for Nuclear Power Plant Decommissioning Expense

NUREG/CR-2370; 164 pp. (1981, December)

This report summarizes a feasibility study of an electric utility self-insurance pool for assuring the adequacy of funds for nuclear power plant decommissioning expense. The feasibility study was comprised of three components: (1) the design of such a self-insurance pool; (2) the estimation of the expected costs of coverage for such a pool; and (3) the testing of the acceptability of such a pool to the electric utility industry. The conclusions drawn from this feasibility study are: (1) a self-insurance pool is an appropriate method of assuring the adequacy of funds for decommissioning; (2) the expected costs of coverage for decommissioning insurance are non-trivial in absolute terms, but are a small percentage of total nuclear power generation costs; (3) the concept of a self-insurance pool for decommissioning expense is generally acceptable to the electric utility industry, while the actual use of such a pool for accident related coverages seems more acceptable than for non-accident related coverages; (4) the degree of assurance that funds would be available for decommissioning seems to be good; and (5) the use of any type of insurance arrangement, including a self-insurance pool, for non-accident related coverages seems to raise problems of insurability and moral hazard which, while not necessarily insurmountable, require careful attention if non-accident coverages are to be offered. (Auth)(PTO)

17

Coughlan, K.P., California Public Utilities Commission, Sacramento, CA

Rate-Making of Decommissioning and Spent Nuclear Fuel

Transactions of the American Nuclear Society 38:135-136; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 135-136) (1981, June)

The rate-making treatment of decommissioning and spent nuclear fuel does not present major problems. Present rate-making procedures are capable of recovering these costs. The recovery of these costs is complicated by changing policy, amending regulations, and deferring decisions. The focus in this subject matter should not be on the recovery methodology. Rather, it should be on the expeditious development of national nuclear waste management policy. (Auth)(PTO)

18

Denham, D.H., Pacific Northwest Laboratory, Richland, WA

A Criteria Development Methodology for DOE Decommissioning Operations

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 229-235), 256 pp. (1981, February)

A study currently in progress at the Pacific Northwest Laboratory (PNL) entitled "Criteria Development for DOE Decommissioning Operations" is briefly outlined. The project uses radiation standards agreed upon with DOE in developing a radiological guide for use by DOE and its contractors to conduct decommissioning operations. The work to be performed also includes site

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

characterization, estimation of occupational and environmental radiation exposures, determination of numerical guidance, and documentation and quality assurance. A first draft of the radiological guide for DOE decommissioning operations is planned for fall, 1980. The radiological guide will be used as the controlling factor in determining the acceptability of a residual contamination level or of a decontamination method. This method is site specific, radionuclide-mix specific, and compatible with an annual dose limit. Acceptable residual contamination levels can be determined by pathway analyses in which the calculated maximum individual dose is compared with an established annual dose limit, resulting in contamination levels that can be related to risk. (CAJ)

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Denham, D.H., Battelle Pacific Northwest Laboratories, Richland, WA

DOE Decommissioning Criteria Development

Research Project; Contract No. EY-77-C-06-1830 (1980)

The primary objective of this project is to prepare guides for use by DOE and its contractors in conducting decommissioning operations. The guidelines are intended to: (1) provide a uniform basis for assessing hazards at sites to be decommissioned; (2) promote more uniform contractual requirements for decommissioning contractors; and (3) provide a *consistent basis* for certification of decommissioned sites. While initially addressed to radioactive contaminants, this task will be extended to address non-radioactive materials. (SSIE)(PTO)

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Denham, D.H., Battelle Pacific Northwest Laboratories, Richland, WA

Radiological Planning Guide for DOE Decommissioning Operations

PNL-SA-0262; 30 pp. (1981, July)

This guide is intended to promote the efficient and uniform decommissioning of the many DOE nuclear facilities and sites whose missions are complete. Since it is imperative that a consistent set of criteria and methodologies be applied to all DOE decommissioning operations, this guide attempts to provide that framework through an integrated systems approach in which all factors interact. Decommissioning is assumed to include three major phases: site characterization, remedial action, and certification. This paper discusses the PNL efforts to date in developing the draft guide, emphasizing the need for: (1) an overall management team with expertise in health physics, statistics, instrumentation and quality assurance; (2) design objectives based on ALARA; (3) selection of de minimis criteria; and (4) a methodical records search and statistically based surveys to estimate residual radionuclide inventories, and to provide a basis for additional surveys, survey instrument requirements, dose estimates, and appropriate protective measures. (ERA)(PTO)

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Denham, D.H., J.P. Corley, R.O. Gilbert, G.R. Hoenes, J.D. Jamison, R.E. Jaquish, B.J. McMurray, and E.C. Watson, Pacific Northwest Laboratory, Richland, WA

Criteria Development for DOE Decommissioning Operations

PNL-3700 (Part 5); Pacific Northwest Laboratory Annual Report for 1980 to the DOE Assistant Secretary for Environment, (pp. 53-55), 91 pp. (1981, February)

The primary objective of this project is to prepare guides for the development and use of specific criteria by DOE and its contractors in conducting decommissioning operations. These guides are intended to provide a uniform basis for assessing hazardous waste inventories, developing environmental risk analyses, making decisions for further decontamination, monitoring for compliance with federal standards, and certifying decommissioned sites. The study was initially concerned with radioactive contaminants, but has been expanded to include the identification and quantification of other contaminants.

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An overall decommissioning effort (other than the actual remedial action) is expected to involve a series of 15 to 20 steps, some of which may be repeated. A flow plan for these steps, includes the elements thought to be required to perform the complete cycle. Three decision points are shown: comparison of the calculated doses with DOE-provided dose criteria (occupational and environmental); comparison of the site survey data with the calculated maximum acceptable contamination levels (based on dose criteria and pathway analyses); and comparison of the certification survey results with the design objectives. (Auth)(PTO)

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Denham, D.H., J.P. Corley, and E.C. Watson, Pacific Northwest Laboratory, Richland, WA

DOE Decommissioning Criteria

PNL-3300; Pacific Northwest Laboratory Annual Report for 1979 to the DOE Assistant Secretary for Environment, Part 5: Environmental Assessment, Control, Health and Safety, (p. 67), 111 pp. (1980, February)

A guide for use by the Department of Energy (DOE) and its contractors in conducting decommissioning operations is being prepared which will provide a uniform basis for assessing hazard inventories, developing cost/benefit ratios and risk analyses, decision making, monitoring for compliance, and certifying of decommissioning activities. This work will probably be expanded to address non radioactive contaminants as well. The initial phase has involved review and evaluation of previous and ongoing efforts of DOE and NRC in decontamination and decommissioning. The PNL team for this project reviewed and provided comments for the authors and sponsor of Los Alamos Scientific Laboratory's recent draft, "Interim Soil Limits for D&D Projects," and helped prepare recommendations for decontamination criteria and instrument survey techniques for the old New Brunswick Laboratory site based on those interim limits. (CAJ)

23

Detorre, J.F., and K.D. Kok, Battelle Columbus Laboratories, Columbus, OH

Data Requirements for Disposition Assessments

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (pp. 106-107); Transactions of the American Nuclear Society 34:106-107 (1980, June)

Data required for the performance of two related disposition assessments (a decommissioning alternative and an engineering assessment) are identified in this paper, and limited to abandoned or inactive sites. Radiological and regulatory data are needed for all assessments; site data are required for assessment of those options other than complete removal of contamination. After the decommissioning alternatives have been assessed, a selection of viable alternatives is made leading to an engineering assessment of the selected alternatives to evaluate relative time, costs, and hazards associated with each alternative. An engineering assessment makes use of all pertinent data; however, much of the desired data are unavailable, particularly for abandoned or inactive sites. Therefore, many assessments are based on sketchy data *and direct site examination.* There is little question that a detailed understanding of radiological conditions, site characteristics, history, locale, and regulatory criteria must be blended appropriately with time and cost factors to adequately assess and minimize disposition hazards and costs. (CAJ)

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Dickson, H.W., Oak Ridge National Laboratory, Oak Ridge, TN

Monitoring for Compliance with Decommissioning Criteria

Research Project (1980)

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The purpose of this project is to define requisite radiological survey plans for decommissioned facilities to verify compliance with decommissioning criteria and for final regulatory inspection. The program identifies media to be sampled, sampling and survey techniques to be used, and necessary records and documentation. In addition, the project task includes the development of a system of checks and audits which allows inspectors to certify the validity of the monitoring results. As an illustrative example, application of the monitoring program to a hypothetical reactor site is demonstrated as part of the overall effort. Analytical costs and survey costs will be estimated for this protion of a decommissioning effort. (SSIE)(PTO)

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DOE is Preparing to Decommission More than 400 Facilities

Nucleonics Week 20(43):11-12 (1979, October 25)

The U.S. Department of Energy is preparing to decommission more than 400 facilities, including the Shippingport reactor, although that still has another two or three years' operation expected from its light water breeder reactor core. The overall decommissioning program covers perhaps 40-50 "significant" projects, according to DOE's Richland Operations Office, which is managing the program. Included are such things as the Molten Salt Reactor Experiment at Oak Ridge, the Materials Testing Reactor at the Idaho National Engineering Laboratory, the Weldon Spring Plant that refined uranium concentrates into uranium metal, and four of the old plutonium production reactors that until the beginning of this month were on standby at the Hanford Reservation but now have been officially retired. There's no guarantee yet that all the facilities will stay on the Richland Operations Office list, or in the order of priority that the office tentatively has formulated. DOE soon will publish its decommissioning program plans for the short term, needed to obtain funding for fiscal 1981, while the long-term plans, with estimated schedules and costs, are being developed. DOE plans to follow closely decommissioning criteria that are being developd by NRC and the Environmental Protection Agency; DOE hopes these will have been put out in final form by the time the decommissioning begins. (Partial Text)(NPK)

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Ewing, R.A., and H.L. Toy, Battelle Columbus Laboratories, Columbus, OH

Canvass of Nuclear Industry for Salability of Weldon Spring Chemical Plant

AD-A062 288/65T; 47 pp. (1976, December 30)

This report documents efforts to determine the salability of the Weldon Spring Chemical Plant through a canvass of the nuclear industry and to identify candidate purchasers. (GRA)

27

Ferguson, J.S., Middle West Service Company, Dallas, TX

Economic Analysis Versus Capital-Recovery Requirements of Power Reactor Decommissioning

CONF-800424; Proceedings of the American Power Conference, Chicago, IL, April 21, 1980, (pp. 792-798); Proceedings of the American Power Conference 42:792-798 (1980)

Utility capital recovery is controlled by generally accepted depreciation accounting practices and by regulatory commission accounting rules and, as a result, can differ significantly from engineering economics. Those involved with decommissioning of power reacotrs should be aware of the depreciation accounting and regulatory framework that dictats capital recovery requirements, whether their involvement is related to engineering economics or capital recovery. This presentation defines that framework, points out several significant implications (particularly tax implications), describes several conforming capital-recovery methods, describes several techniques that have been used with the decommissioning component in economic analysis of alternative energy sources, and discusses why those involvod in economic

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analysis should be well acquainted with the accounting and regulatory framework for capital recovery. (EDB)(PTO)

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Gilbert, R.O., R.R. Kinnison, and M.G. Barnes, Pacific Northwest Laboratory, Richland, WA

On the Application of Acceptance Sampling to the Decommissioning of Nuclear Facilities

PNL-SA-8942; CONF-810436; Environmetrics '81, Proceedings of a Conference, Washington, DC, April 6, 1981, (2 pp.) (1981, April)

Many formerly used nuclear sites and facilities require remedial action (RA) before they can be released for public use. Where 100% inspection is not possible, acceptance sampling (AC) methods should be used. Both attribute and variables inspection AC plans can be used during decommissioning-decontamination/RA operations. Sometimes kriging can be used to estimate radionuclide average concentrations. Other uses of AC methods are mentioned. (DLC)

29

Giuffre, M.S., R.L. Plum, C.M. Koplick, and R. Talbot, Analytic Sciences Corporation, Reading, MA

Information Base for Waste Repository Design: Volume 5 - Decommissioning of Underground Facilities

NUREG/CR-0495 (Vol. 5); TR-1210-1 (Vol. 5); 90 pp. (1979)

This report discusses the requirements for decommissioning a deep underground facility for the disposal of radioactive waste. The techniques for sealing the mined excavations are presented and an information base on potential backfill materials is provided. Possible requirements for monitoring the site are discussed. The performance requirements for backfill materials are outlined. The advantages and disadvantages of each sealing method are discussed. (EDB)

30

Graves, A.W., Rockwell International Corporation, Pasadena, CA

Decontamination and Disposition of Facilities Program

DOE/SF/00701-T52; 85 pp. (1975, January)

The program plan represents the top level guidance document for stating and performing the objectives of the Decontamination and Disposition Program. The program objectives, historical data, and program description are presented, along with the top level planning. The planning includes a statement of the funding basis and the corresponding first and second level activity network schedules. (EDB)

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Graves, A.W., Rockwell Hanford Operations, Richland, WA

233-S Plutonium Facility Decommissioning

Research Project; Contract No. RHO/80010-U3 (1980)

The decommissioning of 233-S Plutonium Facility task, Surplus Facilities Management Program (SFMP) Work Breakdown Structure (WBS) 5.4.6.3, includes all 200

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area surplus facility decontamination and decommissioning operations up through FY 1981. Beginning in FY 1982, each 200 area structural facility project will be under a separate WBS. During FY 1981, this WBS will also contain the long-range Rockwell Hanford Operations Disposition Planning (WBS 5.3.6.2) and the Strontium Semiworks D and D (WBS 5.4.6.4) efforts of initial planning and facility characterization. Each facility decommissioning task is subdivided into three major activities: (1) engineering and planning; (2) tooling and equipment development; and (3) D and D operations. The detailed description of each activity is contained in the Rockwell D and D Program Plan, RHO-CD-241(Rev. 1). (SSIE)

32

Gutwein, E.E., Gilbert/Commonwealth, Reading, PA

Sample Radiation Data Collection Program for Decommissioning a PWR Nuclear Power Plant

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 32), 52 pp. (1981, June)

Decommissioning studies are performed on operating nuclear facilities to determine a method of decommissioning and estimate the associated costs and radiological conditions. Decommissioning studies are periodically updated, necessitating a reevaluation of the data used in the previous study to assure that these data represent the best estimate of conditions at the time of final shutdown of the plant. Many of the conditions are very difficult to predict and can be done so with some degree of certainty only as the time nears for final shutdown. Radiation survey data are routinely collected at operating nuclear power plants. By carefully selecting survey points with decommissioning in mind and comparing these data over a number of years of operation, some confidence can be realized that the levels being used in the study will approximate radiological conditions during the decommissioning phase. However, in order to obtain the required radiological data a program must be developed to ensure that the data are comparable year after year. Discussion is given to the types of data to be collected, frequency, components and systems important during decommissioning, conditions for measurements and relationship of operating philosophy to the radiological conditions at final plant shutdown. (Auth)

33

Harmon, K.M., B.W. Mercer, H.T. Fullam, J.C. King, J.W. Litchfield, C.L. McDonald, J.R. Carrell, C.A. Allen, D.E. Blahnik, P.L. Kowhmstedt, E.L. Klepper, and J.A. Partridge, Pacific Northwest Laboratory, Richland, WA

Disposition (D&D) of Retired Contaminated Facilities at Hanford

BNWL-1952; Nuclear Waste Management and Transportation Quarterly Progress Report, July Through September, 1975, (pp. 39-42), 51 pp. (1975, November)

Development of a long-range plan for the D&D of retired ERDA facilities at Hanford was continued with the identification of several alternative cases and commencement of work on evaluation of those cases. Activity specifications for D&D of the 233-S Building were completed and approved by PNL and ARHCO. Work has begun on installation of an experimental burial trench, for demonstration of stabilization techniques. Further studies were made of chemical and electrochemical decontamination of stainless steel. A computer-based information system for the contaminated facilities at Hanford is being prepared to simplify future prioritization studies. The ALADIN language of the INFONET System was selected. A plan was formed for estimating cost for the various options to be studied. (Auth)(CAJ)

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Hill, G.S., Oak Ridge National Laboratory, Oak Ridge, TN

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Doses for Various Pathways to Man Based on Unit Concentrations of Radionuclides Pertinent to Decontamination and Decommissioning of Properties

ORNL/OPEA-7; 47 pp. (1979, March)

This report gives dose tabulations for unit concentrations of radionuclides likely to be encountered in the decommissioning of real estate contaminated with uranium and thorium ores and residues. The reported doses may be ratioed to known air, soil, and water concentrations, exposure times, and intakes to estimate the total radiation dose for individual exposed to the facilities. These dose estimates may be used in developing criteria to determine appropriate remedial actions for returning the properties to useful purposes and for establishing restrictions for such use. (Auth)

35

Holter, G.M., Pacific Northwest Laboratory, Richland, WA

Is Entombment a Suitable Alternative for Decommissioning a Commercial LWR?

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 32), 52 pp. (1981, June)

Decommissioning is required after final shutdown of a nuclear power reactor to ensure that future risk from the facility to public safety is within acceptable limits. This paper examines the suitability of entombment as one of the possible alternatives for decommissioning commercial LWRs. A clear definition of entombment is presented to provide a basis for examining the technical and regulatory constraints and restrictions. Entombment is compared with the other two decommissioning alternatives (immediate dismantlement and safe storage with deferred dismantlement) in terms of radiation dose considerations, waste disposal requirements, costs, and other consequences. Under current conditions, entombment is found to be less suitable than the other decommissioning alternatives, with several definite disadvantages. Furthermore, the principal advantage of entombment over immediate dismantlement, reduced occupational radiation dose, can be achieved more reasonably by safe storage with deferred dismantlement. Changing conditions (e.g., new regulations or lack of off-site disposal capacity) could impact the suitability of entombment, but the presence of significant quantities of long-lived radionuclides makes entombment of commercial LWRs unlikely except in very rare circumstances. (CAJ)

36

Jacoby, W., Westinghouse Electric Corporation, Advanced Reactors Division, Madison, PA

Decontamination and Decommissioning of the Cheswick Plutonium Facilities

Research Project (1981)

The objective is the complete decontamination and decommissioning (D and D) of the Westinghouse Advanced Reactors Division Cheswick Fuel Facilities in the shortest possible time, estimated at two to three years. This will be accomplished in five phases as follows: (1) the preparation of all necessary documents for and collection/packaging of all special nuclear materials in acceptable form for shipment to a reprocessing agency; (2) the decontmination of all facilities and equipment and loading of waste disposal bins, barrels and boxes prior to shipment of the waste to the designated burial site for 20 years retrievable storage; (3) the removal of facility services and disposal of all contaminated glove boxes and equipment; (4) the final survey of remaining facilities and their certification for unretricted use and preparation of a final report; and (5) the completion of the D and D of the Analytical Laboratory from decontamination, packaging and disposal of all equipment to final cleaning, survey and release of the facility for unrestricted use. (SSIE)

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Jenkins, C.E., T.S. La Guardia, and J.W. Jones, Battelle Pacific Northwest Laboratories, Richland, WA; Nuclear Energy Services, Inc., Danbury, CT; Quadrex, Richland, WA

Proposed Draft Standard ANS 11.68: Recommendations to Facilitate Decontamination and Decommissioning

PNL-SA-9635; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981 (1981, June)

The purpose of ANS Standard 11.18 is to recommend design guides to facilitate decontamination and eventual decommissioning of remotely operated radioactive facilities. This design guide contains generic recommendations to assist in the planning, selection and arrangement of equipment and materials, and the protection of surfaces to enhance system decontamination and disassembly. (ERA)(PTO)

38

Jones, J.W., UNC Nuclear Industries, Inc., Richland, WA

100-F Production Reactor: Decommissioning

Research Project (1981)

The objectives of this project are to establish engineering, planning, tool/process development and field operation for decommissioning the contaminated portion of the retired plutonium production reactors at Hanford, and to decommission the 100-F reactor as a demonstration project. (SSIE)

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Kennedy, W.E., Jr., E.S. Murphy, and E.C. Watson, Pacific Northwest Laboratory, Richland, WA

Inhalation as an Occupational Exposure Pathway During Decommissioning

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 32), 52 pp. (1981, June)

Airborne radioactive material is routinely generated in the workplace during decommissioning tasks. This material can be in many forms including suspended dust or fine aerosols. The purpose of this paper is to investigate the importance of inhalation as an occupational exposure pathway during decommissioning. Example calculations are performed using equations and methods from both ICRP Publication 2 and Publication 30 for exposure of workers to an airborne concentration of 10 radionuclides present in air during low-level waste burial ground exhumation operations. The air concentration is estimated using a mechanical mixing resuspension factor of 10(E-4) per meter. Example results for the ICRP 2 method, using (MPC)sub a values, indicate that bone is the critical organ and that the calculated air concentration is about 20 times higher than the limit value. For the ICRP 30 method, using ALI values, the example results indicate that the calculated air concentration is about 30 times higher than the limit value. Both of these results indicate that inhalation can be a major contributor to the total occupational dose. Various methods of reducing the inhalation dose to workers, including the use of water sprays and respiratory protection equipment, are also discussed. (CAJ)

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King, R.R., Battelle Pacific Northwest Laboratories, Richland, WA

Decommissioning of Hanford Facilities - Technology

Research Project; EY-76-C-06-1830 (1980)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

Technology applicable to the Hanford decommissioning effort is being developed. Concrete surface removal techniques are being evaluated. Water cannon and rock splitter techniques are shown to be effective and potentially useful concrete decontamination methods. A program is underway to investigate the properties of concrete which are important to understanding contamination mechanisms and to design high integrity containment structures. A biobarrier (rock, gravel, sand, topsoil) technique is being evaluated as a potentially useful method of preventing plant and animal penetration of contaminated burial grounds. A prototype field instrument is being developed for measuring low levels of residual transuranic activity in structural materials and soils. (SSIF)

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Klein, J.J., Pacific Gas and Electric Company, San Francisco, CA

Funding Alternatives for Nuclear Decommissioning Cost Recovery

Transactions of the American Nuclear Society 38:136-137; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 136-137) (1981, June)

The purpose of this paper is to present a system for analyzing potential methods of cost recovery and for comparing internal and external use of collected funds. Insurance as a method for funding decommissioning is not considered in this paper because decommissioning is a certain event for which insurance coverage is highly unlikely. In the case of premature shutdown, however, insurance may be available to cover the difference between collected and necessary funds. Sureties and lines of credit of the size necessary for decommissioning are also questionable. Prepayment of decommissioning costs provides the greatest assurance of fund availablity but also poses the question of very high costs. Since decommissioning is viewed as a non-revenue-producing expense, this method may have a negative effect on a utility's ability to attract capital. Funding at decommissioning is a very low assurance alternative, since the utility's ability to sell securities at the time of decommissioning cannot be assumed so many years in advance. The cost recovery method with the most favorable cost-to-customer/assurance trade-off is a funded reserve over the operative life of the plant, with funds collected from the customers serviced. In comparing internal to external use of funds, the most favorable option is the one in which the utility is viewed as an on-going concern, and decommissioning funds along with accumulated interest are not separated from the company's main operation. (Auth)(PTO)

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Kraft, S.P.

Nuclear Power Plant Decommissioning Cost Recovery

Transactions of the American Nuclear Society 38:138-139; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 138-139) (1981, June)

This paper discusses the electric utility industry's position on the cost recovery method that will be used to obtain funds for the decommissioning of nuclear power plants. A comparison is made of the utility's position to the current opinion of the U.S. Nuclear Regulatory Commission (NRC), the Federal Energy Regulatory Commission (FERC), and the states, and suggests directions for further development. In the realm of financial considerations, the electric utilities have four concerns regarding nuclear power plant decommissioning: (1) an accurate estimate of decommissioning cost; (2) provisions for collection of the funds necessary to decommission, regardless of decommissioning mode selected; (3) selection of a cost recovery method satisfactory to the economic regulatory bodies; and (4) selection of a method satisfactory to the NRC. The electric utilities have concluded that the best mix of these concerns is the so-called "unfunded reserve," created on the books of an electric utility as a negative net salvage depreciation and available as cash or other assets of the utility. This method of funding provides the most equity for the rate payers over the life of the plant, and provides reasonable assurance that funds will be available when needed through the on-going economic regulatory control of electric utilities. The New England Conference of Public Utilities Commissions, the States, and the FERC agree with this position. The NRC, however, disagrees. During the current reevaluation of its decommissioning policy and regulations, the NRC staff has been studying cost recovery to provide for decommissioning funds when needed to protect the public health and safety. The debate is far from over and will continue into the NRC rulemaking now scheduled for 1981 and a possible FERC rulemaking on the same issue. (PTO)

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Kurtz, E.F., General Electric Corporation, Sunnyvale, CA

Decommissioning of the Advanced Fuel Laboratory

Research Project (1981)

The objective of this project is to completely decommission the Advanced Fuel Laboratory. All special nuclear material (SNM) will be removed. Gloveboxes, hoods, and other equipment will be decontaminated and removed. (SSIE)

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Litchfield, J.W., and J.C. King, Pacific Northwest Laboratory, Richland, WA

Interactive Planning System for Developing Decommissioning and Decontamination Plans at Hanford

BNWL-SA-6539; 35 pp. (1977, September)

The 570-square mile Hanford Project contains facilities with varying degrees of radioactive contamination as a result of plutonium production operations. With the evolution of production requirements and technology, many of these have been retired and will be decommissioned and decontaminated (D and D). Planning for D and D at Hanford requires identification and characterization of contaminated fcilities, prioritization of facilities for decommissioning, selection of D and D modes, estimating costs and other characteristics of D and D activities, definition of future scenarios at Hanford, and preparation and assessment of plans to achieve defined scenarios. A multiattributed decision model using four criteria was used to prioritize facilities for decommissioning. A computer-based interactive planning system was developed to facilitate preparation and assessment of D and D plans. (EDB)

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Litchfield, J.W., J.C. King, R.R. King, J.M. Halter, R.G. Sullivan, J.F. Cline, R.L. Brodzinski, and G.H. Beeman, Pacific Northwest Laboratory, Richland, WA

Decommissioning of Retired Facilities at Hanford

PNL-2500 (Part 5); Pacific Northwest Laboratory Annual Report for 1977 to the DOE Assistant Secretary for Environment, Part 5: Control Technology, Overview, Health and Safety Policy Analysis, (pp. 1.17-1.19), 92 pp. (1978, February)

The decommissioning effort consists of two tasks: planning and technology. Objectives of the planning program are establishing a long-range comprehensive plan for decommissioning surplus contaminated facilities at Hanford, and facility characterization and planning for demonstration decommissioning projects. Four plans for achieving three alternative future scenarios include unrestricted use, current trend, and minimum level of effort. Plans are based on previously developed estimates of time, costs, and priorities for decommissioning compiled using a computer-based interactive planning system. Other activities of FY 77 included completing core sampling for the 105-DR production reactor and working on a radiological design guide for D&D at Hanford. Concrete surface removal, water cannon and rock splitter techniques were evaluated. The properties of concrete important to understanding contamination mechanisms and designing high-integrity containment structures were investigated. A "biobarrier" (rock-gravel-sand-topsoil cover) technique is a potentially useful method of preventing plant and animal penetration of contaminated burial grounds. A prototype field instrument was developed for measuring low levels of residual transuranic activity in structural materials and soils. (CAJ)

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Madia, W.J., Battelle Columbus Laboratories, Columbus, OH

Battelle's Plutonium Laboratory Decontamination Program

Research Project; Contract No. G-5010-5700; Contract No. AT-06-77RL99057

This program includes actions to be taken jointly by the Department of Energy (DOE) and Battelle's Columbus Division (BCD) to fully decontaminate Battelle's Plutonium Laboratory. This involves: (1) the program planning and preliminary laboratory cleanup; (2) the removal of bulk special nuclear material (SNM) from the laboratory; (3) the decontamination and removal of all gloveboxes; (4) the decontamination and removal of the auxiliary systems; (5) the decontamination and removal of the contaminated drain and holding tank system; (6) the decontamination of the interior wells, floors, and ceilings to the level required for uncontrolled use; (7) the packaging, transportation, and burial storage of wastes; (8) the restoration of the building's lighting and ventilation systems; and (9) the certification of compliance with ANSI N13.12 and Attachment A, to NUREG-0436, dated March 1978. These actions will be in accordance with all applicable regulations regarding the decontamination of research facilities and the packaging, transportation, and burial of radioactive materials. This is the first progress report written for this program. The major milestones accomplished to date include removal of all bulk SNM and a general laboratory cleanup, preparation of a detailed program plan, preparation and acceptance of the Environmental Impact Assessment, decontamination, removal, and packaging of all plutonium glove boxes, removal of the contaminated floor drain system from two rooms, and decontamination and final ANSI survey of the interior surfaces of these rooms. (SSIE)

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Marmer, G.J., Argonne National Laboratory, Argonne, IL

Study of Decommissioning Accelerators and Fusion Devices

Research Project

The objective of this study is to determine the cost, amount of waste produced and sensibility of components when an accelerator is permanently decommissioned. A thorough list of existing accelerators is being developed. Comments on guidelines for low level waste disposal as they pertain to accelerator comments are discussed. (SSIE)

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Melvin, J.P., R.A. Sexton, M.L. Frot, and S.E. Nunn, Rockwell Hanford Operations, Richland, WA

Cost/Risk/Benefit Analysis Report on the Decontamination and Decommissioning of Z-Plant

RHO-CD-761; 104 pp. (1979, September 28)

This study was performed to estimate the cost of decontaminating and decommissioning the Z-Plant. All of the buildings in the Z-Plant exclusion area except Building

2736-Z, the plutonium storage vault, are included in the study. The study also excludes all underground facilities within the exclusion area which are not contained within a building and all Z-Plant related facilities outside the perimeter fence. The contamination in Z-Plant is primarily plutonium-239 which has a half-life of 24,360 years. Because of the long half-life of plutonium-239, it is not practical to consider the isolation of the facility to await reduction of the contamination level by natural decay. Therefore, this study analyzes the costs, risk and benefit of decontaminating Z-Plant to four different levels of residual contamination. The three principle criteria used in the analysis are cost, the risk of offsite dose to the public, and the occupational exposure to onsite personnel. (EDB)

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Miller, R.L., UNC Nuclear Industries, Inc., Richland, WA

Decommissioning Engineering - Shippingport Atomic Power Station

Research Project (1980, April)

Following shutdown and defueling, the Shippingport Atomic Power Station is to be decontaminated and decommissioned consistent with contractor obligations. The engineering for the Shippingport Station Decommissioning Project (SSDP) includes preparing a decommissioning assessment, an environmental assessment, and environmental impact statement, and a detailed engineering report. The detailed engineering will provide work packages to be used by the decommissioning contractor to perform the actual decommissioning. All government-owned components and structures from the site are to be removed. (SSIE)(CAJ)

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Miller, R.L., and R.A. Paasch, UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects - Program Plan

NUREG/CR-2522; 20 pp. (1982, April)

This program plan describes a multi-year program initiated by the Nuclear Regulatory Commission (NRC) to assess and evaluate the methods, radiation exposure and costs associated with decommissioning of retired nuclear facilities. The objective of this program is to provide the NRC licensing staff with comparative data that will allow assessment of decommissioning alternatives for regulatory and ALARA (as low as reasonably achievable) implementation of future decommissioning proposals. The program is currently limited to nuclear reactors. The program is under the supervision of the Office of Nuclear Regulatory Research through its Chemical Engineering Branch. UNC Nuclear Industries (UNC) is responsible for the technical direction of the program and for preparation of documentation and summary comparisons of evaluated projects. The Department of Energy - Richland Operations Office, serves as an interfacing agency between NRC and UNC to provide administration of NRC funding to UNC to perform the work. Licensees currently decommissioning a facility or licensees who are planning decommissioning projects will be solicited for inclusion in the program. An analysis will be performed for each project and will include a comparison of the methods, costs and exposure usage with data contained in generic decommissioning studies. (Auth)(RHB)

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Nelson, I.C., Battelle Pacific Northwest Laboratories, Richland, WA

Criteria Development for DOE Decontamination and Decommissioning Operations

Research Project

The primary objective of this project is to prepare a guide for use by DOE and its contractors in conducting decommissioning operations. This guide will provide a uniform basis for assessing hazard inventories, developing cost/benefit ratios and risk analyses, decision making, monitoring for compliance, and certification of decommissioning activities. While initially addressed to radioactive contaminants, this work will, in all likelihood, be expanded to address other contaminants. The initial version of the guide will be in the form of a handbook containing the following: (1) basic standards and criteria for both protective storage and unconditional release conditions, as agreed upon with the sponsor; (2) recommendations for establishing or confirming radioactivity levels, including statistical design, sampling techniques, and instrumentation performance criteria and samples; (3) methodology for estimating occupational radiation exposures during decommissioning opertions; (4) methodology for estimating environmental exposures prior to, during, and subsequent to decommissioning operations, including unplanned releases; (5) simplified methods for determining specific numerical guidance for decontamination and/or release, for both exterior and interior surfaces and for bulk materials; and (6) recommendations for appropriate records generation and maintenance. (SSIE)

52

Nemec, J.F., E.A. Wegener, and E.W. Powers, UNC Nuclear Industries, Inc., Richland, WA

Production Reactor Decommissioning - The Planning Phase

Transactions of the American Nuclear Society 30:551; CONF-7811109; American Nuclear Society 1978 Winter Meeting, Proceedings of a Conference, Washington, DC, November 12-16, 1978, (p. 551) (1978)

The Hanford Atomic Products Operations was commissioned in 1942 by the Manhattan District of the United States Army Corps of Engineers as a site for the production of weapons-grade plutonium. Located in south-central Washington State, the original installation included construction of three nuclear reactors spaced several miles apart along the south shore of the Columbia River. Two of the three initial reactors, 100-D and 100-F, have been retired. The other reactor, 100-B, is in standby status. As part of a continuing effort to eliminate obsolete facilities on the Hanford Reservation, the U.S. Department of Energy (DOE) authorized United Nuclear Industries, Inc. (UNI) to conduct the Production Reactor Decommissioning Study in fiscal year 1978. The results of this study will be used to implement a demonstration project at the 100-F site which will verify proposed techniques and provide cost data to be used in the development of the disposition program for the remaining retired production reactor facilities. Today, only the reactor building itself, a number of reactor-related facilities, and two buildings used as biological laboratories remain on the 100-F site. Several underground solid and liquid waste disposal facilities are also included within the area. The decommissioning program involves removal of all radioactive and contaminated equipment and materials, decontamination of the buildings, subsequent demolition of these buildings, and stabilization of the ground disposal facilities. In short, all 100-F structures will be removed, and the site will be returned to its natural contour. The planning undertaken to implement the project and the results of the planning will be discussed. (JMF)

53

Oak, H.D., and G.M. Holter, Pacific Northwest Laboratory, Richland, WA

Decommissioning a Boiling Water Reactor Nuclear Power Plant

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (pp. 741-742); Transactions of the American Nuclear Society 34:741-742 (1980)

The results of a study to develop plans for and evaluate the costs and safety of conceptually decommissioning a reference boiling water reactor (BWR) are summarized. The modes considered were immediate dismantlement, passive safe storage, and entombment. The following are cost and time estimates for each mode: 1) immediate dismantlement- 24 months of planning and preparation and 42 months of active decommissioning; $44 million

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and 2100 occupational man-rem are estimated. 2) Passive safe storage- 18 months planning and preparation, and 30 months active decommissioning, with a period of continuing care followed by deferred dismantlement to terminate the license. Costs are $21 million and 390 occupational man-rem for preparations, plus continuing care costs of $75,000 annually. In addition, costs for deferred dismantlement are $35 million for 10-30 years after shutdown and a minimum of $26 million after 50 years. 3) Entombment- 24 months planning and preparation and 47 months active decommissioning with continuing care and possible deferred dismantlement. The cost and occupational dose for entombment preparations are $35 million and 1770 man-rem, respectively. Continuing care costs are $40,000/yr, plus deferred dismantlement-costs similar to passive size storage. Dose estimates to the public and the worker are discussed. Alternatives such as spent fuel shipment, facility demolition and site restoration, geologic disposal, and special train shipments could increase costs by $8 million to $29 million. (CAJ)

54

Pierce, E.E., and A.A. Walls, Oak Ridge National Laboratory, Oak Ridge, TN

Metal Recovery Building Decommissioning

Research Project; Contract No. ONL-WD12(27)

A number of ORNL facilities which were used to process or store radioactive materials for defense-oriented applications have been declared surplus to programmatic needs. Because the potential for release of radioactivity to the environment exists, these facilities will be decontaminated and decommissioned. The Metal Recovery Building consists of six hot cells, a dissolver, a canal used for the storage of irradiated slugs, and two underground waste storage tanks. The metal recovery cells will be removed one at a time under controlled conditions. The canal will be entombed and the contaminated portions of the building structure will be removed for burial. The uncontaminated areas will be restructured to furnish building space for future projects. The decommissioning of the Metal Recovery Building has been rescheduled to start in FY 1981, as presently scheduled in the Program Plan (RLO/SFM-79-2). A survey and inspection in 1979 revealed that the building and facility had undergone physical deterioration to such an extent that containment was no longer highly assured. This observation plus the general lack of detailed knowledge of the radionuclide inventory in the facility prompted a decision to reschedule the decommissioning activities and complete the radiological characterization and a conceptual design report in FY 1981. This decision requires deferral of the start of decommissioning activities by one or two years on the Old Hydrofracture Facility, Gunite Tanks, Waste Holding Basin, and the MSRE. The Gunite Tanks will not be emptied of sludge until late 1983 and the fuel charge in the MSRE drain tanks is well contained and monitored. Therefore, this schedule change will have little effect on these facilities. Decommissioning of the Waste Holding Basin and the Old Hydrofracture Facility will be rescheduled to begin as soon as resources permit. (SSIE)

55

Ruff, W.G., UNC Nuclear Industries, Inc., Richland, WA

100-F Production Reactor - Planning for Decommissioning

Research Project (1980)

The objectives of this project are to establish engineering, planning, tool/process development and field operation for decommissioning the contaminated portion of the retired plutonium production reactors at Hanford. (SSIE)

56

Schaich, R.W., Oak Ridge National Laboratory, Oak Ridge, TN

Curium Facility Decommissioning

Research Project; Contract No. ONL-WD11(27)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

Several ORNL facilities which were used to process or store radioactive materials for defense-oriented applications have been declared surplus to programmatic needs. The Curium Facility consists of a permanent concrete-shielded manipulator cell, four manipulator cells with shielding provided by stacked water tanks, a cell containing off-gas control and filtration equipment, and an underground storage tank. The manipulator cells are highly contaminated with curium-244 oxide (Cm2O3) and contain quantities of curium-244 oxide (Cm2O3) powder which must be encapsulated for storage in a water-cooled storage shield to be provided. After the cells are decontaminated to acceptable levels, the water tank shielding will be removed, and the area will be restored to a useful condition. The planning activity will involve acquisition of drawings, determination of contamination levels and equipment condition, development of the decommissioning methods for each facility, scheduling of operations and personnel, and coordination of operations. Decommissioning will involve decontamination of equipment and facility components to acceptable levels of radioactivity to leave in place, entombment, or complete or partial removal of the facility as appropriate. (SSIE)(PTO)

57

Schneider, K.J., and C.E. Jenkins, Pacific Northwest Laboratory, Richland, WA

Analysis of the Decommissioning of a Nuclear Fuel Reprocessing Plant

CONF-780622; American Nuclear Society 1978 Annual Meeting, Proceedings of a Conference, San Diego, CA, June 18-22, 1978, (pp. 366-367); Transactions of the American Nuclear Society 28:366-367 (1978)

This paper summarizes the results of a study performed for the U.S. Nuclear Regulatory Commission (NRC) to investigate the conceptual decommissioning of a fuel reprocessing plant. The primary purpose of the study was to develop conceptual decommissioning plans and to evaluate the safety, costs, and other related aspects of decommissioning a contemporary fuel reprocessing plant. The study is intended to provide background information for future regulations, designs, and operational characteristics of fuel reprocessing plants with regard to their decommissioning. The cost of management of the wastes from dismantlement amounts to about one-half of the total cost. Of the waste management costs, transportation accounts for about 25% and disposal accounts for about 60%. Safety impacts from decommissioning activities were estimated to be small. The 50-yr radiation dose commitment to members of the public from airborne releases from normal decommissioning activities was estimated to be less than 11 man-rem. Radiation doses to the public from accidents were also found to be low for all phases of decommissioning. Occupational radiation doses from normal initial decommissioning operations were estimated to be 69, 81, and 510 man-rem for layaway, protective storage, and immediate dismantlement, respectively. Deferred dismantlement was found to reduce the public and occupational radiation doses. (Auth)(JMF)

58

Science Applications, Inc., Oak Ridge, TN

Draft Preliminary Risk Assessment of the Weldon Spring Rock Quarry

SAI-OR-79-135-01; 92 pp. (1979, September)

The Weldon Spring quarry is an abandoned rock quarry located between Missouri State Route 94 and Femme Osage Creek, about 25 miles west of St. Louis, Missouri. For over twenty years the quarry has been utilized as a dump site, first for TNT contaminated rubble and later for low level radioactive material. The first usage for disposal of radioactive waste occurred in 1959 under the auspices of the U.S. Atomic Energy Commission. The site and the characterization of the drummed and uncontained waste are discussed in detail in Chapter 2 of this report. The ultimate objective of risk assessment activities for the Weldon Spring quarry is to develop an estimate of the public risk and the attendant uncertainties in that estimate. These parameters then provide one of the major inputs to decision making. The study reported in this document supports this objective but it is not intended to meet this total objective. Rather the present effort provides a preliminary and scoping evaluation of this risk. This allows a preliminary "ball-park" estimation of risk and establishes the basis for a definitive risk assessment of the Weldon Spring quarry. The specific results of the project necessary to support the objectives include the following items: (1) Risk Estimation - An estimate of the range of risk to the public of the Weldon Spring quarry in its current configuration results from this analysis. This estimate is only representative of the general range in which the hazard could be expected to occur, and is in no way a definitive risk assessment; (2) Methodology - A major result of the project is the development of the preliminary methodology for performance of a complete risk assessment; and (3) Identification of Areas for Further Work - The synthesis of the available data and the methodology identify the areas in which limiting ignorance exists. This includes identification of the areas in which more specific data are needed, and those areas in which methodology developments are necessary. (Auth)(PTO)

59

Toomey, J.E., Rockwell Hanford Operations, Richland, WA

Project Planning Approach

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 167-170), 256 pp. (1981, February)

The project planning approach utilized by Rockwell Hanford Operations in outdoor cleanup activities is briefly described. The rationale and requirements in addition to a description of the program planning documents (including control and project plans) are discussed. A recommended adaptation of this approach to a large-scale environmental cleanup process is presented. (CAJ)

60

Trapp, R.L., Florida Public Service Commission, Tallahassee, FL

Regulatory Treatment of Nuclear Decommissioning Cost

Transactions of the American Nuclear Society 38:137-138; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 137-138) (1981, June)

Currently, nuclear decommissioning costs are treated as a component of each company's depreciation design. Based on studies performed by Florida Power and Light Company (FPL) and Florida Power Commission (FPC), in which the entombment mode of decommissioning was assumed, a decommissioning cost of approximately $25 to $30 million for FPL's Turkey Point Units 4 and 5, FPL's St. Lucie Unit 1, and FPC's Crystal River Unit 3 has been included in the companies' depreciation rates for each of these units. It should be noted, however, that this treatment is currently under review by the Commision. FPC is before the Commission at this time seeking rate relief. At issue in Docket No. 800119-EU is whether the cost of decommissioning should be provided for through the use of funded reserve and whether the existing depreciation rates are adequate for this purpose. Public hearings for the consideration of the FPC rate request were scheduled for January 1981. A final commission order in Docket No. 800119-EU was expected in February. FPL has also recently filed for a test year with the commission. Since this is the first step toward initiating a formal rate case, it is anticipated that the method and adequacy of FPL's treatment of nuclear decommissioning costs will also be addressed during the year. As such, the Commission may decide to initiate a separate docket in which to consider the issue of decommissioning cost treatment for both FPL and FPC at the same time. Should such be the case, a resolution of the issue should be forthcoming by mid-1981. In any case, it would appear that 1981 will be a year for reflection by the Commission as well as the industry as to the proper treatment of nuclear decommissioning costs in Florida. (Auth)(PTO)

61

U.S. Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC

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Decommissioning of the Shippingport Atomic Power Station - Draft Environmental Impact Statement

DOE/EIS-0080D; 148 pp. (1981, October)

The U.S. Department of Energy proposed to decommission the Shippingport Atomic Power Station. This environmental impact statement analyzes possible decommissioning alternatives, evaluates potential environmental impacts associated with each alternative, and presents cost estimates for each alternative. The department's preferred decommissioning alternative is immediate dismantlement. Other alternatives include no action, safe storage followed by deferred dismantlement, and entombment. The environmental impacts that are evaluated include those associated with occupational radiation dose, public radiation dose, handling and transporting of radioactive wastes, resource commitments, and socio-economic effects. (EDB)(PTO)

62

U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Management of Surplus Radioactively Contaminated DOE Facilities

DOE/EV-0015; Division of Environmental Control Technology Program-1977, Decontamination and Decommissioning, (pp. 129-132), 138 pp. (1978, June)

There are currently more than 460 radioactively contaminated DOE facilities including cribs, ponds, trenches, buildings, and reactors, of which more than 80% are located at Hanford. Where practicable, the goal is to release property for alternative productive use without restrictions. Activities within the program include: providing surveillance and maintenance; developing improved techniques for safe and economic decontamination and disposition; developing plans, priorities, costs, and schedules for disposition projects; and implementing projects to improve safety, eliminate continued surveillance and maintenance, and restore facilities or land areas without radiological restriction. A decommissioning handbook will be published in FY 1979. Priorities are being established to provide a rational basis for future D&D planning and budgeting activities. This system will include an inventory and a data base for all designated surplus facilities. The effort will also identify the needs for developing supporting technology including dismantling and entombment techniques, soil cleanup and stabilization methods for burial grounds, and future R&D programs. (CAJ)

63

U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV

Project Gnome Decontamination and Decommissioning Plan

NVO-202 (Addendum B) (1979)

The purpose of Addendum B is to identify required changes from the Project Gnome Decontamination and Decommissioning Plan (NV-202). The changes are necessitated as a result of the near cavity fill-up by the contaminated salt and soil prior to the downhole disposition of the total volume of uncontaminated salt. An alternative disposition plan for salt burial, as noted in Addendum A, is therefore necessary. Additional long term monitoring objectives are also addressed. (TFD)(PTO)

64

U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV

Project Gnome Decontamination and Decommissioning Plan

NVO-202; 34 pp. (1979, April)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

The document presents the operational plan for conducting the final decontamination and decommissioning work at the site of the first U.S. nuclear detonation designed specifically for peaceful purposes and the first underground event on the Plowshare Program to take place outside the Nevada Test Site. The plan includes decontamination and decommissioning procedures, radiological guidelines, and the NV concept of operations. (EDB)

65
U.S. Department of Energy, Office of Nuclear Waste Management, Washington, DC

Nonradiological Effects of Operations and of Decontamination and Decommissioning

DOE/ET-0081 (Rev.); Environmental and Other Evaluations of Alternatives for Long-Term Management of Stored INEL Transuranic Waste, Ch. 12.3, (pp. 12-26.-12-39) (1979, December)

The nonradiological environmental impacts expected from operation and from decontamination and decommissioning (D&D) of the waste management facilities are described in this subsection. Each potential nonradiological environmental impact is considered, first in general terms, and then specifically, by waste management alternative. Impacts considered are: air quality, noise, terrestrial environment, water resources, solid waste disposal, land use, socioeconomic impacts, resource commitments, archaeological and historical sites, aesthetics, and sensitive areas. Monitoring requirements and mitigation of impacts are mentioned. (CAJ)

66
U.S. Department of Energy, Office of Nuclear Waste Management, Washington, DC

Radiological Effects of Facility Operations and of Decontamination and Decommissioning

DOE/ET-0081 (Rev.); Environmental and Other Evaluations of Alternatives for Long-Term Management of Stored INEL Transuranic Waste, Ch. 12.4, (pp. 12.39 - 12.67) (1979, December)

Radiological effects from normal operations of alternatives for long-term management of stored transuranic waste is discussed in this subsection. Topics are: human exposure pathways and calculational models, releases from facilities associated with each alternative, impact on land and water, impact on biota, radiological doses to individuals, radiological doses to populations, long-term environmental dose commitment, radiation dose from rail shipment of the processed TRU waste, projected health effects from radiation doses, and mitigation of radioactive release impacts and long-term monitoring requirements. (CAJ)

67
U.S. Department of Energy, Office of Nuclear Waste Management, Washington, DC

Surplus Facilities Management Program Decommissioning Technology Transfer Action Plan

Draft Report; 9 pp. (1981, April)

A preliminary outline is presented for the U.S. plan to establish a decommissioning technology transfer system and a proposal for NEA sponsorship of an international planning organization for technology exchange. The program will be specifically involved with information relating to the decommissioning of nuclear facilities and will include preparation and execution of decontamination for the purpose of dismantlement, ultimate disposal, and rehabilitation of contaminated sites and facilities. Goals include identifying and cataloging technology needs for decommissioning, implementing the development of identified decommissioning technology needs, disseminating decommissioning technology information, and promoting understanding and cooperation between the U.S. and other nations. Major tasks include the following: issue a questionnaire designed to identify decommissioning technology needs; develop potential projects; develop a mechanism for soliciting participation; develop and distribute proposals for domestic or international cooperative projects; develop administrative guidelines; and obtain responses and establish organizations responsible for implementation of the projects. (CAJ)

68

U.S. Department of Energy, Remedial Action Program Office, Washington, DC

Decommissioning of the Shippingport Atomic Power Station - Final Environmental Impact Statement

DOE/EIS-0080F; 125 pp. (1982, May)

The U.S. Department of Energy (DOE) proposes to decommission the Shippingport Atomic Power Station located at Shippingport, Pennsylvania. This environmental impact statement analyzes possible decommissioning alternatives, evaluates potential environmental impacts associated with each alternative, and presents cost estimates for each alternative. The Department's preferred decommissioning alternative is immediate dismantlement. Other alternatives include no action, safe storage followed by deferred dismantlement, and entombment. The environmental impacts that are evaluated include those associated with occupational radiation dose, public radiation dose, handling and transporting of radioactive wastes, resource commitments, and socioeconomic effects. Potential radiation doses from the preferred alternative decommissioning operations are as follows: (1) Total occupational exposure, based on conservative worst-case analyses, is estimated to be 1275 man-rem, with no worker being exposed in excess of the DOE occupational exposure standard of 5 rem per year (DOE Order 5480.1A); and (2) Total collective radiation dose to the general public is estimated to be 28 man-rem. Natural background in the Shippingport area is about 100 mrem per year to each person, or about 100,000 man-rem to the population of approximately 1 million residing within a 50-mile radius of the Shippingport Station. The highest potential radiation dose (50-year accumulated) to a member of the general public from abnormal operational events (potential credible accidents) during immediate dismantlement could be 2.9 mrem. This person would receive about 5000 mrem from natural background during the same period. Based on generic transportation studies of all radioactive waste shipments, the most severe credible offsite transportation accident could result in a 50-year accumulated radiation dose to the maximum-exposed individual of 25 rem to the lungs. However, the risk of such an accident is extremely small. (Auth)(PTO)

69

U.S. Department of Energy, Washington, DC

Finding of No Significant Impact, 100-F Area Decommissioning Program, Hanford Site

Federal Register 47(165):56125 (1980, August 22)

Based on an environmental assessment on the proposed 100-F area decommissioning program at the Hanford site, the Department of Energy (DOE) has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act of 1969. Therefore, no environmental impact statement is required. The proposed program would be a full scale decontamination and decommissioning demonstration project directed toward the removal or stabilization of all radioactive materials in the 100-F Area, including buildings and trenches. In addition, six radioactive solid waste burial grounds and seven contaminated liquid waste disposal facilities (cribs and trenches) would be isolated in place or, in a few cases, exhumed for removal to more suitable burial grounds. (CAJ)

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U.S. Nuclear Regulatory Commission, Advisory Committee on Reactor Safeguards, Washington, DC

Decommissioning

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

NUREG-0795; Comments on the NRC Safety Research Program Budget for Fiscal Year 1983, Ch. 5.7, (pp. 30-31, 38), 53 pp. (1981, July)

A report is presented which includes previous recommendations for steps to be taken by the Nuclear Regulatory Commission (NRC) in safety research, and some comments given on their present status. Specifically, on the subject of decommissioning, it is suggested that the current program does not reflect the emphasis on design features which would facilitate later decommissioning of nuclear facilities and which had been recommended in NUREC-0657. It is also suggested that the licensing staff incorporate the benefits of research into their regulations to a greater degree. On uranium recovery, the report states that the development of criteria for dealing with the large number of existing uranium mill tailings and for providing early guidance for the licensing and regulation of new mills, warrants the amount of funding requested. However, in reviewing specific research projects in this subject area, it was felt that there was a lack of studies directed toward solving the basic problems as contrasted to those designed merely to ameliorate releases from existing tailing piles. (CAJ)

71
U.S. Nuclear Regulatory Commission, Office of Standards Development, Washington, DC

Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities

NUREG-0436 (Rev. 1); 138 pp. (1978, December)

The present decommissioning regulations contained in Sections 50.33(f) and 50.82 of 10 CFR Part 50 require applicants for power reactor operating licenses to demonstrate that they can obtain the funds needed to meet both operating costs and estimated costs of shutdown and decommissioning. The development of detailed, specific decommissioning plans for nuclear power plants is not currently required until the licensee seeks to terminate his operating license. Recognizing that the current generation of large commercial reactors and supporting nuclear facilities would substantially increase the need for future decommissionings, the NRC staff began an in-depth review and reevaluation of NRC's regulatory approach to decommissioning in 1975. The Nuclear Regulatory Commission is now considering development of a more explicit overall policy for nuclear facility decommissioning and amending its regulations in 10 CFR Parts 30, 40, 50, and 70 to include more specific guidance on decommissioning criteria for production and utilization facility licensees and byproduct, source, and special nuclear material licensees. In response to comments from the public and states, and to information gained during the initial stage of execution of the plan, several modifications of the plan are now required. The revised overall report sets forth in detail the current NRC staff plan for the development of an overall NRC policy on decommissioning of nuclear facilities. (EDB)

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U.S. Nuclear Regulatory Commission, Office of Standards Development, Washington, DC

Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities

NUREG-0436; 65 pp. (1978, March)

Recognizing that the current generation of large commercial reactors and supporting nuclear facilities would substantially increase future decommissioning needs, the NRC staff began an in-depth review and re-evaluation of NRC's regulatory approach to decommissioning in 1975. Major technical studies on decommissioning have been initiated at Battelle Pacific Northwest Laboratory in order to provide a firm information base on the engineering methodology, radiation risks, and estimated costs of decommissioning light water reactors and associated fuel cycle facilities. The Nuclear Regulatory Commission is now considering development of a more explicit overall policy for nuclear facility decommissioning and amending its regulations in 10 CFR Parts 30, 40, 50, and 70 to include more specific guidance on decommissioning criteria for production and utilization facility licensees and byproduct, source, and special nuclear material licensees. The report sets forth in detail the NRC staff plan for the development of an overall NRC policy on decommissioning of nuclear facilities. (EDB)

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UNC Nuclear Industries, Inc., Richland, WA

Environmental Assessment of the F Area Decommissioning Program

DOE/EA-0120; 30 pp. (1980, October)

Plans to decommission the 100-F Reactor Area at the Hanford Reservation are discussed. The program will be a full scale decontamination and decommissioning (D&D) demonstration project directed towards the removal or stabilization of all radioactive materials in the 100-F Area consistent with a recommended disposition strategy. The end product of the decommissioning program will permit near term controlled use with eventual release of the site for unrestricted use. The program will provide detailed cost and engineering information which can be used to determine the final disposition of the remaining retired production reactors at Hanford and other DOE-owned facilities. Inventories of radioactivity remaining in the 100-F Area, D&D alternatives and potential impacts are discussed. (CAJ)

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Ureda, B.F., and W.F. Heine, Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Hallam

Nuclear News 13(6):40-48 (1970, June)

The basic requirements to decommission the Hallam Nuclear Power Facility were as follows: remove all fuel from site; remove all bulk sodium that could be drained from the systems; electrically react all remaining sodium; dispose of radioactive residues by burial or removal from site; decontaminate all components above operating floor of reactor building; and prevent release of contamination from subsurface areas and isolate the reactor vessel. (INSPEC)(PTO)

75

Wood, R.S.

Funding for Reactor Decommissioning: The NRC Perspective

Nuclear News 24(15):85-88 (1981, December)

The cost of decommissioning a nuclear power plant is discussed. Four funding approaches that have received the most attention from the NRC are: prepayment into a trust fund of estimated decommissioning funds at the start of facility operation; annual contributions into a trust fund outside the control of the utility over the estimated life of a facility; internal reserve or sinking fund amortizations over the estimated life of a facility; and insurance or other surety mechanisms used separately or in conjunction with any of the first three mechanisms. (EDB)

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Wood, R.S., U.S. Nuclear Regulatory Commission, Washington, DC

Funding for Reactor Decommissioning - The NRC Perspective

Transactions of the American Nuclear Society 38:135; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (p. 135) (1981, June)

Several alternative funding mechanisms have been identified to assure that adequate funds will be available to decommission a nuclear facility after its operating life is ended. These funding mechanisms are as follows: (1) prepayment of estimated decommissioning funds at the start of facility operation into a trust fund; (2) annual contribution over the estimated life of a facility into a trust fund; (3) negative salvage depreciation deductions accumulated over the estimated life of a facility in an

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internal reserve; and (4) insurance or other surety mechanisms used separately or in conjunction with the first three options. The five criteria by which NRC evaluates funding options are as follows: (1) the degree of assurance that the mechanism provides; (2) cost; (3) equity; (4) responsiveness to change; and (5) adaptability to multiple jurisdiction. (PTO)

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Berry, H.A., Reynolds Electrical and Engineering Company, Inc., Las Vegas, NV; EG&G, Inc., Las Vegas, NV

Gnome Site Decontamination and Decommissioning Project: Radiation Contamination Clearance Report March 28, 1979 - September 23, 1979

DOE/NV/00410-59; 80 pp. (1981, August)

The Gnome site, located approximately 48 kilometers (30 miles) southeast of Carlsbad, New Mexico, was selected for the first scientific experiment in the newly formed Plowshare Program in 1960. Project Gnome was the first attempt to develop nuclear devices exclusively for peaceful uses. Project Gnome was detonated December 10, 1961 in bedded rock salt, 361 meters (1,184 feet) below the surface, with a nuclear yield of 3.1 kilotons. Preparations for a second plowshare event, Project Coach, were begun at the Carlsbad site, but the event was never executed. This report describes the operations and radiological activities conducted during Phase II and Phase III of the Gnome site decontamination and decommissioning (D/D) project. The onsite raidological monitoring and documentation activities were performed for the Department of Energy, Nevada Operations (DOE/NV) by Reynolds Electrical and Engineering Co., Inc. (REECo) and EG&G, Inc., from March 28, 1979 to September 23, 1979. The monitoring program included soil sampling and analyses, portable instrument area surveys, thermoluminescent dosimeter (TLD) measurements and a post-operational aerial survey to document the final site status and to insure public and occupational health and safety. Although the analysis of data gathered during the final stages of the D/D project will provide the information necessary for DOE to return the Gnome site to the Department of the Interior, Bureau of Land Management (BLM) for unrestricted use of the land surface, there are permanent restrictions on excavation and/or drilling on the site at any depth between the surface and 1,500 feet. (Auth)(PTO)

78
Chapin, J.A., EG&G Idaho, Inc., Idaho Falls, ID

Characterization of the ARA-3 Area, Final Report

PR-W-79-030; 18 pp. (1979, September)

ARA-III was originally built to house the Army Gas Cooled Reactor Experiment (GCRE); it was complete in 1959, test work continued until 1961, and deactivated in 1961. The facility now consists of a control and reactor building, water well system demineralizer, waste nitrogen tank and stack, and liquid waste storage tanks. Two new buildings were built in 1969 to provide laboratory and office space. Radiation surveys, contamination surveys, and soil samples were taken at ARA-III to analyze the prospects of decontaminating and decommissioning this facility. No exposure fields were found exceeding 0.2 mR/hr, and a standard smear survey counted less than 20 cpm beta-gamma and 1 cpm alpha. Soil samples indicated natural background (Cs-137 and Co-60); however, a low level of silver (Ag-108M) was discovered in a ditch, indicating a spill had occurred in the past. Contaminated waste remaining at ARA-III consists of 3 underground tanks, 520 m of underground stainless steel piping, 70 m of underground vitrified clay drain line, two stacks, and a nitrogen fired heater tank and associated piping. Waste materials are listed in tables by volume, size and location. Cost estimates for the D&D of the area are tabulated. An additional $32,285 is required for project management costs, bringing the total cost to $280,000. (CAJ)

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Chapin, J.A., EG&G Idaho, Inc., Idaho Falls, ID

Characterization of the TAN-TSF Outside Areas, Final Report

PR-W-79-031; 12 pp. (1979, September)

Ten areas of the Test Area North-Test Support Facility (TAN-TSF) are addressed in this report. They include contaminated soil in two areas, a concrete slab, a sludge bed-sewage disposal plant, a liquid waste disposal pond, an initial engine test (TET) facility valve pit, three liquid waste tanks, a parts storage building, and an initial engine test facility. Tables show radiological surveys performed, wastes estimates, and cost estimates for labor and material. (CAJ)

80
Chapin, J.A., EG&G Idaho, Inc., Idaho Falls, ID

OMRE Leach Pond Characterization, Final Report

PR-W-79-029; 58 pp. (1979, September)

The Organic Moderated Reactor Experiment (OMRE) facility was decommissioned during FY 1978-79. Because information on the migration of the radioisotopes in a number of similar inactive leach ponds is nonexistant, it was decided to investigate various methods of sampling these areas, using the OMRE pond as a basis. The verticle augering technique is the recommended approach for further characterization of shallow soil areas on the Idaho National Engineering Laboratory (INEL), although the cost is higher with this method. Although the vertical coring device yields better analytical results, it is too complicated because the assembly, probe retraction, and reassembly between samples requires too many operations. The vertical punch is also not recommended, because of problems arising from having to use a large size punch. The results of the characterization analysis show the presence of cobalt-60, strontium-90, cesium-137, and europium-152 in the OMRE pond soil. Two options for the disposition of the pond are open: (a) leave it in place under protective storage (approximately 77 years for some locations to be reduced in activity), and (b) remove the areas of highest contamination in the pond base (cost of $10,000 and 40 cu m RWMC storage space). Option (b) is recommended by EG&G. (CAJ)

81
Chapin, J.A., EG&G Idaho, Inc., Idaho Falls, ID

Characterization and Decommissioning Plan for the Organic Moderated Reactor Experiment Leaching Pond

PR-W-79-003; 24 pp. (1979, January)

The Organic Moderated Reactor Experiment (OMRE) Facility decommissioning activity began in FY 1979. The EG&G D&D program has elected to delay the removal of the OMRE leaching pond in order to develop techniques for soil characterization using this pond as a test plot. The OMRE leaching pond has been divided into three general areas: the fenced area around the pond, the berm, and the pond base itself. The purpose of this series of tests is to: characterize the pond radionuclide inventory as to type and concentration of isotopes present in the 3 areas, develop a technique which is most suitable for characterization of other soil areas on the Idaho National Engineering Laboratory (INEL), and remove all contaminated soil and return the area to unrestricted use. Alternatives to the project would be to: 1) decontaminate the pond soil; 2) cover the area with a soil berm; or 3) no-action. The proposed project appears to be the most practical and feasible choice. (CAJ)

82
Ficker, C.F., National Lead Company of Ohio, Cincinnati, OH

Environmental Monitoring Program for DOE, Weldon Spring, Missouri Site

NLCO-009EV-SP; 39 pp. (1981, August)

The Department of Energy's Weldon Spring Site (DOE-WSS) is located in St. Charles Co., Missouri, and is comprised of two properties. One property is a part of the former Feed Materials Center operated by Mallinckrodt Chemical Works from 1956 to 1966. There are four raffinite pits on the property which contain radioactive residues from the processing of uranium ore concentrates, thorium compounds, and recycled scrap. The second property is an abandoned quarry approximately four miles southwest of the raffinite pit area, and is some eight acres in size. The quarry is contaminated as the result of its use as a disposal site first by the Atomic Energy Commission (AEC), and later by the Army during some decontamination work at the Weldon Spring Plant. It is the purpose of this report to present a program for monitoring at the DOE-WSS. Monitoring of the sites is necessary to maintain adequate environmental and health physics surveillance programs to assure the safety of the general public. This program (a) shows currently employed systems of monitoring along with recommendations to bring those systems in line with an overall plan, and (b) discusses programs for future environmental and health physics monitoring at WSS. (ERA)

83

Goldsmith, W.A., R.W. Leggett, F.F. Haywood, W.D. Cottrell, and D.J. Crawford, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Survey of the Mallinckrodt Chemical Works, St. Louis, Missouri

DOE/EV-0005/27; ORNL-5715; 191 pp. (1981, December)

From 1942-1957 the Mallinckrodt Chemical Works was used for various projects involving the production of purified uranium from pitchblende concentrates. Measurements were made of the following: residual alpha and beta-gamma contamination levels in the existing buildings that were used in the uranium projects; external gamma radiation levels at 1 m above the surface in these buildings and outdoors around these buildings; radon and radon daughter concentrations inthe air in these buildings; uranium, radium, actinium, and thorium concentrations in surface and subsurface soil on the site; concentrations of radionuclides in water and sediment found in drains both inside and outside the buildings; and concentrations of radionuclides in ground an dsurface water on the site and in rive water taken near the site. Alpha and beta-gamma contamination levels inside and outside some of the buildings were above limits set by current federal guidelines concerning the release of property for unrestricted use. Elevated external gamma radiation levels were measured at some outdoor locations and in some of the buildings. Licensable concentrations of uranium were found in soil at some places, and the concentration of uranium in a water sample taken from a core hole between buildings 100 and 101 was in excess of current federal standards. Radon and radon daughter concentrations in three buildings were in excess of standards for nonoccupational radiation exposure. (Auth)(CAJ)

84

Harper, J.R., and R. Garde, Los Alamos National Laboratory, Los Alamos, NM

The Decommissioning of TA-21-153, An Actinium-227 Contaminated Old Filter Building

LA-9047-MS; 17 pp. (1981, November)

An exhaust air filter building contaminated with Ac-227 was decommissioned at the Los Alamos National Laboratory, Los Alamos, New Mexico, in 1978. The building was constructed in the late 1940s to clean exhaust air from several buildings at TA-21, DP Site. It was in service until March 1970. The project involved preliminary decontamination, dismantling the building, and burying the debris at an on-site waste disposal/storage area. This report presents the details on the decommissioning procedures, the health physics, the waste management, the environmental surveillance, and cost for the operation. (Auth)(PTO)

85

Holoway, C.F., J.P. Witherspoon, H.W. Dickson, P.M. Lantz, and T. Wright, Oak Ridge National Laboratory, Oak Ridge, TN

Monitoring for Compliance with Decommissioning Termination Survey Criteria

NUREG/CR-2082; ORNL/HASRD-95; 271 pp. (1981, June)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM SITE SURVEYS

This document was prepared as part of the requirement for considering changes in regulations on decommissioning of commercial nuclear facilities. (Auth) Specifically, it addresses the final steps needed to ensure that a site which has been decontaminated can be released for unrestricted use. Consideration is given to preliminary and termination (certification) survey designs and procedures which might be used for licensed nuclear fuel cycle and non-fuel cycle facilities. In addition, information on instrumentation, evaluation and interpretation of monitoring data, and cost-effectiveness of monitoring is given. This guide was designed to be a general purpose document both for licensees and regulatory agency inspectors who are concerned with specifications of a monitoring program, complete with checks and audits, which can be used to verify compliance with decommissioning criteria. Moreover, much of the information and methodology presented here furnishes part of the data base being established by the U.S. Nuclear Regulatory Commission in its reappraisal of regulations of decommissioning of licensed facilities.

86
Jobst, J.E., EG&G, Inc., Las Vegas, NV

Aerial Radiological Survey of the Weldon Spring Chemical Plant (St. Charles, Missouri)

EGG-1183-1688; 46 pp. (1975, November)

Of the 27 lines flown over the Weldon Spring Chemical Plant drainage basins, five lines directory over the Plant site show uranium and thorium contamination probably due to Plant operations. Because the survey was done at an altitude of 152m, with a 300-meter line spacing, identification of individual radiation sources on the site is not possible from present data. One additional survey line over a quarry south of the Plant shows uranium contamination due to Plant wastes deposited there. (GRA)

87
Jobst, J.E., EG&G, Inc., Las Vegas, NV

Aerial Radiological Survey of the Weldon Spring Chemical Plant (St. Charles, Missouri) Date of Survey: May 11-14, 1976

EGG-1183-1700; 39 pp. (1977, January)

An aerial radiological survey was conducted over the Weldon Spring Chemical Plant, which is in St. Charles County, thirty miles from St. Louis, Missouri. The survey was performed in May 1976 using sodium iodide detectors mounted in a helicopter. Gamma gross count and thallium radiation isopleths were superposed on an aerial photograph of the Site. Several concentrations of uranium and thorium waste were located. All contaminants were on the Site or within 200 m of the fence line. The survey was sonsored by the U.S. Department of the Army, authorized by the U.S. Energy Research and Development Administration, and conducted by EG and G, Incorporated of Las Vegas, Nevada. (GRA)

88
Lawrence Berkeley Laboratory, Earth Sciences Division, Berkeley, CA

Preliminary Draft: Radiological, Hydrogeological, Geochemical and Geophysical Assessment of the Weldon Spring Quarry, Missouri Disposal Site

LBID-152; 144 pp. (1980, January)

The Weldon Spring Quarry was a U.S. AEC disposal site for low-level radioactive wastes between 1960 and 1969. The quarry is located in limestone bedrock, and only 200 feet of rock separate the wastes from the Missouri River alluvial deposits in which are located wells that supply municipal water systems. This report contains results of the first phase of a program to assess the extent of contaminant migration via surface and ground water, to inventory the wastes present at the site, and to predict the impact of remedial action options. The most immediate radiation hazard found was a group of processed uranium waste piles at the east end of the quarry. Except for the waste piles, surface radiation in the quarry is low (less than 0.5 mrem/hr beta and gamma). Split spoon samples from auger holes and gamma-spectrometric measurements in these holes, showed the wastes on the main floor of the quarry to be dominated by Ra-226 and daughters, and chemically separated uranium. It was estimated that the main floor deposits contain 10-20 curies of Ra-226, accompanied by a larger quantity of uranium. Geochemical samples of surface waters showed elevated uranium contents in the quarry sump in the Femme Osage Slough system, but not in Little Femme Osage Creek, Femme Osage Crek, or the Missouri River. Major recommendations for work to complete the study are given. (JMT)

89

Neidbrmeyer, G.J., Aberdeen Proving Ground, Chemical Demilitarization Installation Restoration, Aberdeen, MD

Assessment of Weldon Spring Chemical Plant in St. Charles County, Missouri

AD-A062 588; DRCPM-DRR-TR-76029; 180 pp. (1976, March 1)

Portions of a former explosives production facility in St. Charles County, Missouri, were transferred from the U.S. Army to the former US Atomic Energy Commission (AEC) for construction and operation of a feed materials plant in support of the Atomic Energy Program. The uranium and thorium processing subsequently conducted between 1957 and 1966 resulted in the radiological contamination of the facility and the immediate terrain. Four process waste basins (raffinate pits) were constructed onsite during AEC occupancy to receive processing wastes which contained radiological contaminants. The AEC operation was closed out and the facility returned to the Department of the Army for conversion to a herbicide production facility in support of immediate requirements in Southeast Asia. The property received from the AEC excluded the waste materials contained in four raffinate pits which have an estimated 150 tons of uranium content and 75 tons of thorium content. The US Army attempted decontamination of three former AEC process buildings, but was unsuccessful in achieving applicable guidelines for release to the general public. The herbicide project was cancelled prior to reaching operational status and the US Army retained the property along with a license for possession and storage of the source materials in the form of contamination. The raffinate pits were transferred to the AEC, and with no DOD or DA mobilization requirements, the plant entered a care and custody status pending further disposition. A preliminary contamination assessment of plant has been prepared. The assessment evaluated the radioactive and explosive contamination, and the geologic potential for contaminant migration. (GRA)

90

Ohnesorge, W.F., T.W. Oakes, D.W. Parsons, and J.L. Malone, Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN

An Environmental Radiological Survey of the Intermediate-Level Waste System Pipeline

ORNL/TM-7858; 41 pp. (1981, September)

The intermediate-level waste (ILW) pipeline was used to transfer liquid radioactive waste from the Oak Ridge National Laboratory (ORNL) area to the original hydrofracture facility and to the seepage pits and trenches. A history of the pits and trenches gives some insight to the amount of materials handled by these lines. These pits and trenches were in use from 1951 to 1966. Between February 7 and February 9, 1979, members of the Department of Environmental Mangement conducted radiation surveys of the ILW system pipeline between the original hydrofracture site and ORNL. The pipe system surveyed included branches to waste pits 2 and 3 and waste trenches 5 and 7. The measured gamma rates at the leak sites would indicate a contamination level on the order of 37 to 190 kBq/sq cm (1- to 5-uCi/sq cm) gamma activity if the contamination were all on the surface. Because the activity is mixed in the soil and would vary greatly with location, giving an accurate estimate of specific activity in microcuries per cubic centimeter would be difficult. However, it would be sufficient for planning purposes to say that on the order of 37 to 370

kBq/cu cm (1 to 10 uCi/cu cm) of beta-gamma activity might be expected in the top layers of soil and that greater amounts could be expected at greater depths (near the pipe) in some locations. These levels of activity would require the services of personnel from the Department of Health Physics of the Industrial Safety and Applied Health Physics Division for planning and executing a cleanup operation. (Auth)(PTO)

91

Simpson, D.R., and J.F. Emergy, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Assessment of the Decontamination and Decommissioning of a Small-Scale Fuel-Reprocessing Plant

CONF-811025; Proceedings of the 25th Conference on Analytical Chemistry and Nuclear Technology, Gatlinburg, TN, October 6, 1981, (6 pp.) (1981)

Decontamination and decommissioning (D and D) of surplus radiological facilities is becoming a major concern as buildings built during the 1940's and 1950's reach the end of their useful lives. Prior to the start of a D and D project, a detailed radiological characterization of the facility is required to determine the nature and extent of residual contamination. The Oak Ridge National Laboratory (ORNL) has recently begun such a characterization of Building 3505, originally called the Metal Recovery Facility, which served as a small-scale fuel reprocessing plant during the 1950's. Extensive contamination remains within areas of the facility, including transuranic (TRU) materials. Laboratory analyses were used in conjunction with in situ measurements of dose rate and contamination levels to determine the current status of the building and surrounding area. This information will be used to estimate the amount of decontamination required and the quantity of radioactive waste. (EDB)

92

Taylor, P.A., Y-12 Plant, Oak Ridge, TN

Radiochemical Analysis and Experimental Results of Solution from Weldon Spring, Missouri Ponds - Draft Report - Addendum to Y/DU-36

Y/DU-36-Addendum; 5 pp.

The water from Ponds 3 and 4 at Weldon Spring, Missouri, have been analyzed for alpha and beta activity. Calculations were made to compare the measured activities with the expected activity based on uranium, thorium, and radium concentrations. One beaker-scale experiment was performed which showed that denitrification bacteria will remove 95% of the radium-226 in solution, leaving less than 0.003 pCi radium-226/ml in the filtrate. (Auth)(PTO)

93

Taylor, P.A., Y-12 Plant, Oak Ridge, TN

Results of Weldon Spring Technical Support for FY-1980

Y/DU-113; 10 pp. (1980, November 21)

A new sample of solution was collected from pond 3 at the Weldon Spring site on July 10, 1980. This sample contained 2.15% NO3 which was substantially higher than the previously measured values of 1.1% - 1.4% NO3. The radium concentration of this sample was 200 pCi radium-226/l which compares well with the previously measured value of 195 pCi radium-226/l. A beaker-scale experiment has shown radium adsorption by bacteria naturally present in pond 3. It took eight months for the bacteria to reduce the nitrate concentration to below 50 mg/l. By this time the bacteria had adsorbed 98.6% of the radium originally present in the solution. (Auth)(PTO)

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Taylor, P.A., J.M. Napier, F.M. Schietlin, and G.W. Strandberg, Y-12 Plant, Development Division, Oak Ridge, TN; Oak Ridge National Laboratory, Oak Ridge, TN

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM SITE SURVEYS

Chemical Analysis of Ponds 3 and 4 at Weldon Spring, Missouri

Y/DU-36; 10 pp. (1979, December 10)

The water contained in two ponds at the site of an old uranium processing plant at Weldon Spring, Missouri, was sampled and analyzed. The purpose of the analysis was to quantify the amount of impurities present in the water. The results showed that the fifteen-million gallons of water contained in pond 4 meets discharge standards published by the state of Missouri; but, an approved discharge permit from the state is required. The five-million gallons of water in pond 3 will require treatment for nitrate, nitrite, and radium ions before discarding to the environment. (Auth)(PTO)

95
Tuttle, R.J., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Development and Application of Sampling Inspection in a Decontamination Program

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 31), 52 pp. (1981, June)

In a large decontamination project, it is impractical to completely survey every potentially contaminated surface of region, and yet it is essential that compliance with acceptance criteria be demonstrated. This can be done by use of a suitable sampling inspection plan, in which only portions, or spots, of the area are thoroughly inspected. Such a plan was developed and used in a large decontamination program, for release of a facility for unrestricted use, subject to NRC approval. This plan, and the survey methods needed to support its implementation, was developed to demonstrate compliance with the NRC Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material (with requirements similar to ANSI N13.12), and resulted in successful application to NRC for release of the facility. Survey measurements were made for each criterion specified in the Guidelines (average and maximum total alpha and beta activity and surface dose rate, and average removeable alpha and beta activity) in a pre-established number of locations for each area. Selection of these locations were determined by the surveyor, with instructions to bias the selection towards areas likely to have higher-than-average residual contamination. This strategy was chosen to assure success during the NRC release survey, and differs from approaches suitable for determination of the average or total residual contamination. Measurements made in each category are numerically analyzed to predict the maximum value likely to exist in the area. In most cases, decontamination was so effective, as shown by the numerical analysis of the measurements, that further decontamination was not required, and this was borne out by the NRC release surveys. The details of this sampling plan and the survey methods will be presented, and its performance will be compared both with an alternative sampling plan and with the ANSI N13.12 standard, which assumes complete inspection. (Auth)(CAJ)

96
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Assessment of Environmental Radioactivity in the Vicinity of Shippingport Atomic Power Station

EPA-520/5-73-005; 33 pp. (1973, November)

A study was conducted by the Eastern Environmental Radiation Facility (EERF) to assess the environmental radioactivity levels in the vicinity of the Shippingport Atomic Power Station, Shippingport, PA. The results of this study were compared to an earlier study done by NUS Corp. of Rockville, MD. The major points which were addressed are: (1) strontium-90 and iodine-131 levels in milk; (2) strontium-90 levels in soil; and (3) ambient radiation levels as determined using thermoluminescent dosimeters (TLD). (Auth)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM SITE SURVEYS

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Weidner R.B., and M.W. Boback, National Lead Company of Ohio, Cincinnati, OH

Niagara Falls Storage Site, Environmental Monitoring Report for 1979 and 1980

NLCO-007EV(Rev.); 31 pp. (1981, October 5)

The Niagara Falls Storage Site is a 190-acre facility located in Niagara County, New York. It is owned by the US Department of Energy (DOE) and is used for the storage of radioactive residues. This site is managed by NLO, Inc., contract operator of the DOE Feed Materials Production Center near Cincinnati, Ohio. During 1979 and 1980, water and air samples were collected at and near the storage site to provide information about radionuclides in the offsite environment. Results show that uranium and radium concentrations in ground and surface water were within DOE Guide values for uncontrolled areas. Radon-222 in air at the site west boundary exceeded the DOE Guide but offsite monitoring in the general area showed radon-222 concentrations well within the Guide. (GRA)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

98

Allen, R.P., Pacific Northwest Laboratory, Richland, WA

TRU Waste Decontamination

PNL-3000-9; Nuclear Waste Management Quarterly Progress Report, January Through March 1981, T.D. Chikalla and J.A. Powell, Ch. 5, (pp. 5.1-5.5) (1981, June)

Three TRU-contaminated gloveboxes with 258 sq ft of contaminated surface area were decontaminated to non-TRU levels. Improved procedures were developed for the removal of HEPA filters and stored material from inside the glove boxes, and for high-pressure water cleaning of the interior surfaces prior to disassembly. A new transition piece was installed to connect the high-production vibratory finisher to the supporting glove box line. A multi-energy gamma assay system has been assembled under subcontract with the Los Alamos Scientific Laboratory (LASL). The data acquisition system for automated collection and monitoring of criticality safety data was installed. A He-3 neutron slab detector system was assembled for the manual acquisition of criticality safety data. (Auth)(CAJ)

99

Allen, R.P., Pacific Northwest Laboratory, Richland, WA

TRU Waste Decontamination

PNL-3000-5; Nuclear Waste Management Quarterly Progress Report, January Through March 1980, Ch. 5, (pp. 5.1-5.14) (1980, June)

The program of developing electropolishing and related metal cleaning and finishing techniques for large scale decontamination systems continued. Disassembly, sectioning, and decontamination systems operations are described. A plutonium-contaminated Plexiglas glove box was decontaminated to non-TRU levels using vibratory finishing. Contamination-fixing films were used extensively during the disassembly and sectioning to minimize the spread of contamination. A radiation measurement system has been designed using polyethylene-moderated helium-3 neutron detector banks. A HpGe detector system was installed for use in glove box counting studies. A criticality safety study of the annular vibratory finisher was completed and shows the annular vibratory finisher to be critically safe with up to 4.5 kg of plutonium present. Use of newly developed fixatives eliminated the need for conventional contaminment enclosures, substantially reduced removal time, and permitted completion of disassembly operations with no spread of contamination. A combination of vibratory finishing and chemical treatment was used to decontaminate uranium contaminated molybdenum, and electropolishing was used on stainless steel contaminated with lead-210. (CAJ)

100

Allen, R.P., Pacific Northwest Laboratory, Richland, WA

Electropolishing for Surface Decontamination of Metals

PNL-3000-3; Nuclear Waste Management Quarterly Progress Report, July Through September 1979, A.M. Platt and J.A. Powell (Eds.), (pp. 12.1-12.8) (1979, November)

A report on a program to develop electropolishing and related metal cleaning and finishing techniques into an integrated large-scale decontamination system for decontaminating large volumes of TRU and other surface-contaminated solid waste is presented. Initial tests indicate that a vibratory finisher system utilizing metal media and a NaOH flushing solution is capable of reducing plutonium-contaminated glove box material to non-TRU levels. A plutonium glove box with 46 sq ft of contaminated surface area was disassembled, sectioned, and converted into non-TRU waste using a combination of electropolishing and vibratory finishing. Use of an anti-splatter compound during sectioning minimized airborne and surface contamination of the sectioning facility. Purification to reasonable levels of 250 gal of water representing a variety of plutonium-contaminated vibratory finisher, rinse, and cleaning solutions was successfully tested. Progress also has been made in developing in situ decontamination methods. (CAJ)

101
Allen, R.P., Pacific Northwest Laboratory, Richland, WA

TRU Waste Decontamination

PNL-3000-4; Nuclear Waste Management Quarterly Progress Report, October Through December 1979, A.M. Platt and J.A. Powell (Eds.), (pp. 5.1-5.8) (1980, April)

Continuing progress on the integrated operation of the disassembly, sectioning and decontamination systems is reported. Progress in development of vibratory finishing techniques included decontamination of plutonium-contaminated glass and uranium-contaminated molybdenum using steel media and sodium hydroxide. Tests conducted to evaluate the decontamination capabilities of Freon 113 with additives showed effectiveness on grossly contaminated items. Sectioning studies included installation and hot testing of a shear/punch for sectioning TRU-contaminated metals and identification of a saw blade for sectioning of TRU-contaminated Plexiglas glove box panels. Other tasks reported are cold testing of a centrifuge for solution processing, testing of polyelectrolytes and anti-foam compounds, equipment improvements for solidifying phosphoric acid, and new techniques for handling vibratory finishing wastes. (CAJ)

102
Allen, R.P., Pacific Northwest Laboratory, Richland, WA

TRU Waste Decontamination

PNL-3000-6; Nuclear Waste Management Quarterly Progress Report, April Through June 1980, A.M. Platt and J.A. Powell, (pp. 5.1-5.5.9), 142 pp. (1980, September)

Progress is reported in the onsite modifications of the high-production vibratory finisher which included lowering the working height of the tub, repositioning the cylinder operating the unloading gate, and repositioning the compound tank inlets and pump intakes. Installation of the finisher was completed. A glove box to be used with the vibratory finishing decontamination system was partially installed. Installation was completed of an electrostatic air cleaner for the plasma arc torch sectioning studies, and a hydraulic lift table for manipulating glove boxes in the sectioning/pretreatment facility. The system to transfer contaminated electrolyte and aqueous waste to the solution processing system was completed, and hot testing of a novel in-drum solidification apparatus was begun. A public information meeting was planned to provide information on vibratory finishing and other significant advances in TRU waste decontamination technology. Routine decontamination of sample recovery devices was demonstrated. (CAJ)

103
Allen, R.P., and H.W. Arrowsmith, Pacific Northwest Laboratory, Richland, WA

Radioactive Decontamination of Metal Surfaces by Electropolishing

Material Performance 18(11):21-26 (1979, November)

A method is described which permits removal of radionuclides such as plutonium, uranium, radium, cobalt, strontium, cesium, and americium from metal surfaces. Details are given to immersion systems, especially those using phosphoric acid and of techniques which can be used in the field with pumped electrolytes. Examples are given of use such as the decontamination of a large water supply relief valve at the Hanford-N-reactor, stainless steel animal cages, manipulator tong assemblies, fission products storage capsules (removing strontium fluoride contamination from Hastelloy Alloy C-276); tools from a radiation-safe glove box, analytical instruments, and a traveling wire flux monitor. Prepolishing aids to increase efficiency of other cleaning methods are described. (PTO)(EIX)

104

Allen, R.P., and H.W. Arrowsmith, Pacific Northwest Laboratory, Richland, WA

Electropolishing for Surface Decontamination of Metals

PNL-3000-2; Nuclear Waste Management Quarterly Progress Report, April Through June 1979, A.M. Platt and J.A. Powell (Eds.), (pp. 12.1-12.6) (1979, June)

Progress is reported on an alternative alkaline electrolyte which has the advantage of forming a filterable precipitate that contains essentially all the plutonium or beta/gamma contamination. Disadvantages include poor throwing power and the need for substantially higher current densities and operating temperatures. An effective anti-splatter compound that should facilitate the sectioning of contaminated components using plasma arc torch cutting techniques was identified. This spray-on film prevents adherence of dross at cutting distances as close as 6 inches. Fixatives for containing the contamination on glove boxes and other components during disassembly and sectioning operations were tested and are readily removed in the vibratory finisher. Modifications to the vibratory finishing system include a tub that doubles the drain capacity, a containment lid to reduce splashing, a new sludge tank design, and installation of a spray washer system. Using a barrel electropolishing system to remove uranium contamination from molybdenum permits decontamination of small items without racking. (CAJ)

105

Allen, R.P., and H.W. Arrowsmith, Pacific Northwest Laboratory, Richland, WA

Prepolishing of Surfaces for Exposure Control and Increased Plant Availability

Transactions of the American Nuclear Society 38:621-622; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 621-622) (1981)

Studies conducted at Pacific Northwest Laboratory (PNL) under US Department of Energy sponsorship have demonstrated the effectiveness of electropolishing as a decontamination technique for the removal of a variety of radionuclides from metal surfaces. For items that were re-used after decontamination by electropolishing, it was noted that the smooth, highly polished surface produced by the electropolishing process substantially reduced the time and radiation exposure required for subsequent decontamination operations using conventional cleaning techniques. Subsequent studies using samples prepared at PNL have shown that electropolished surfaces also become less contaminated than other common surface finishes under equivalent service or exposure conditions. The purpose of this paper is to review these findings in the context of the unique surface finish produced by electropolishing and to illustrate the substantial reduction in cost and exposure that could be achieved through the use of electropolishing for surfaces requiring critical path decontamination operations. (INSPEC)(PTO)

106

Allen, R.P., H.W. Arrowsmith, and W.C. Budke, Pacific Northwest Laboratory, Richland, WA

Electropolishing as a Large-Scale Decontamination Technique

BNWL-SA-6368; 33 pp. (1977, November)

Laboratory-scale studies have shown electropolishing to be a rapid and effective technique for removing plutonium and other radionuclide contamination from a variety of metal surfaces. This paper summarizes work in

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

progress at Pacific Northwest Laboratory, to develop electropolishing into a large-scale decontamination technique that can be used to minimize the amount of surface-contaminated metallic waste requiring geologic disposal. A 400-gallon electropolishing facility has been established to develop and demonstrate decontamination techniques for representative plutonium- and beta/gamma-contaminated nuclear industry materials and components. Initial tests using this facility have demonstrated the ability to decontaminate more than 15 sq ft of plutonium-contaminated stainless steel in less than 30 minutes. Supporting studies also are in progress to develop in situ electropolishing techniques for the decontamination of surfaces that cannot be transported to or immersed in an electropolishing cell and to develop solution treatment procedures to extend electrolyte life and minimize the amount of secondary waste generated by the decontamination process. (EDB)(NPK)

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Allen, R.P., H.W. Arrowsmith, and M.W. McCoy, Pacific Northwest Laboratory, Richland, WA

New Decontamination Technologies for Environmental Applications

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 110-122), 256 pp. (1981, February)

New decontamination techniques and associated contamination stabilization technologies under development at Pacific Northwest Laboratory (PNL) are presented and discussed. Topics include: vibratory finishing techniques, fixatives, electropolishing techniques, and freon technology. These technologies represent a versatile collection of tools and approaches for environmental decontamination applications. The fixatives provide a means for gaining and maintaining control of large contaminated areas, decontaminating large surface areas, and protecting equipment and supplies used in decontamination operations. Other decontamination techniques provide a method for removing loose surface contamination from almost all classes of materials and surfaces. These techniques could be used both as direct decontamination processes and for the cleaning of tools and equipment used in the decontamination operations. (CAJ)

108

Battist, L., U.S. Nuclear Regulatory Commission, Washington, DC

Residual Radioactivity

NUREG/CP-0008; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25, 1979, (pp. 268-306) (1979, December)

The establishment of a standard concerning the acceptable residual radioactivity for a decommissioned nuclear facility is described. The nuclear facilities discussed include nuclear power plants, fuel fabrication plants, fuel reprocessing plants, and radioactive waste burial grounds. (EDB)

109

Cavendish, J.H., National Lead Industries, Inc., Cincinnati, OH

Recycle of Contaminated Scrap Metal

Research Project; Contract No. AC-05-76OROLL56 (1980)

The objectives are to obtain amendments to the present Code of Federal Regulations, providing for the recycle of and unlicensed use of contaminated metals below specified de minimis levels, and to provide the technology and facilities for decontaminating DOE inventories of scrap metals meeting the amended criteria. The Cascade Improvement Program/Cascade Uprating Program (CIP/CUP) presently underway will generate large quantities of metallic scrap with a total value, at current market prices, in excess of $50 million. First, a large portion of the scrap was classified and, second, most of it was contaminated with slightly enriched uranium. Enriched uranium, being a special nuclear material, is covered by 10 CFR70 of the Code of Federal Regulations which prohibits the possession of any quantity by anyone not holding a specific license for its possession. This regulation effectively barred the commercial use of CIP/CUP scrap since issuance of a specific license to all potential users of the scrap and consumer products made from it would not be possible. Therefore, it was decided by OR to propose the amendment of 10 CFR70 to establish a de minimis limit below which metal would be exempted from the licensing requirements. In addition, a program to develop processing for decontamination of CIP/CUP scrap to meet the proposed de minimis limits was initiated. It was found that smelting eliminated the need for security classification and also decontaminated most metals. (SSIE)(PTO)

110

Chapin, J.A., EG&G Idaho, Inc., Idaho Falls, ID

Characterization of MTR-605 Process Water Building

PR-W-79-015; 27 pp. (1979, June)

The Process Water Building (MTR-605) was constructed to accomodate equipment that provided cooling water to the MTR reactor. The MTR reactor and the MTR-605 support equipment have been out of service for approximately 10 years. Data obtained from the characterization of the MTR-605 will be used to develop the rational for D&D of the process water facility. Radiological characterization data may be used in conjunction with codes under *Radiation Exposure Analysis* to determine the optimum approach for dismantlement of the process water system while minimizing exposure to workers during the actual D&D operation. When radiation and contamination measurements were taken, radiation readings up to 30 R/hr beta-gamma were obtained and contamination levels up to 20,000 dpm beta-gamma and 320 dpm alpha were found. The beta-gamma emitters were determined to be cesium-137, cobalt-60, and strontium-90. The only alpha emitting isotope identified was polonium-210. Portions of the MTR process water facility are being upgraded as part of the Test Reactor Area (TRA) liquid radioactive waste cleanup system. Decommissioning of the facility will provide the Idaho National Engineering Laboratory D&D program with valuable experience in decommissioning hardware with high radiation fields. The configuration of the system also provides unique access and handling problems that must be resolved and would have direct application in the D&D of a full scale power reactor system. The building will also be available for other programmatic needs at greatly reduced radiological exposure levels. In addition, volumes of equipment have been identified and categorized based on final disposition. (CAJ)

111

Childs, E.L., and J.L. Long, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Electrolytic Decontamination of Stainless Steel Using a Basic Electrolyte

Nuclear Technology 54:208-214 (1981, August)

An electrolytic plutonium decontamination process for stainless steel was developed for use as the final step in a proposed radioactive waste handling and decontamination facility to be constructed at the Rockwell International Rocky Flats plutonium handling facility. The process utilizes a basic (pH greater than 7) electrolyte which has been patented (U.S. Patent 4 193 853). Filtration can be used to separate most radioactive contaminants and dissolved metal from the electrolyte. A test plan was executed comparing the basic electrolyte with phosphoric acid and nitric acid electrolytes. Laboratory scale testing was done with stainless steel exposed to plutonium and americium. The alpha activity was reduced to less than 0.14 dpm/sq cm. The amount of wet sludge generated with the basic electrolyte was approximately 170 mg/sq cm of surface decontaminated. The electrolytic decontamination of Type 304L stainless steel from plutonium contaminated glove boxes using a basic electrolyte has been demonstrated. This process has the following advantages: (1) the waste generated can be separated from the solution through the use of a drum filter; (2) the waste generated is compatible with the existing nitrate-based Rocky Flats waste processing stream; (3) the process can achieve background levels of contamination; (4) the chemicals used in the process are readily available and inexpensive; and (5) the process has received approval from Nuclear Safety. (Auth)(PTO)

112

Crawford, J.H., Savannah River Laboratory, Aiken, SC

Decontamination of TRU Glove Boxes

DP-1473; 20 pp. (1978, March)

Two glove boxes that had been used for work with transuranic nuclides (TRU) for about 12 years were decontaminated in a test program to collect data for developing a decontamination facility for large equipment highly contaminated with alpha emitters. A simple chemical technique consisting of a cycle of water flushes and alkaline permanganate and oxalic acid washes was used for both boxes. The test showed that glove boxes and similar equipment that are grossly contaminated with transuranic nuclides can be decontaminated to the current DOE nonretrievable disposal guide of less than 10 nCi TRU/g with a moderate amount of decontamination solution and manpower. Decontamination of the first box from an estimated 1.3 Ci to about 5 mCi (6 nCi/g) required 1.3 gallons of decontamination solution and 0.03 man-hour of work for each square foot of surface area. The second box was decontaminated from an estimated 3.4 Ci to about 2.8 mCi (4.2 nCi/g) using 0.9 gallon of decontamination solution and 0.02 man-hour for each square foot of surface area. Further reductions in contamination were achieved by repetitive decontamination cycles, but the effectiveness of the technique decreased sharply after the initial cycle. (ERA)(PTO)

113

Fitz-Patrick, V.F., and R.P. Allen, Pacific Northwest Laboratory, Richland, WA

Component Decontamination

Transactions of the American Nuclear Society 38:626-627; CONF-810606; American Nuclear Society 1981 Annual Meeting, Proceedings of a Conference, Miami Beach, FL, June 7-11, 1981, (pp. 626-627) (1981)

Advanced decontamination techniques capable of rapidly and effectively removing radioactive contamination from metallic and selected nonmetallic surfaces have been developed at Pacific Northwest Laboratory (PNL) under U.S. Department of Energy (DOE) sponsorship. Although these new decontamination methods were developed for the processing of transuranic waste, they should be equally effective for reactor component decontamination applications ranging from the in situ decontamination of pipes and tanks for exposure reduction purposes to the complete decontamination of failed equipment. (INSPEC)

114

General Public Utilities Service Corporation, Parsippany, NJ; Electric Power Research Institute, Palo Alto, CA

Facility Decontamination Technology Workshop

GEND-002; CONF-791104; Proceedings of a Workshop, Hershey, PA, November 27, 1979; 518 pp. (1979, November 27)

Purpose of the meeting was to provide a record of experience at nuclear facilities, other than TMI-2, of events and incidents which have required decontamination and dose reduction activities, and to furnish GPU and others involved in the TMI-2 cleanup with the results of that decontamination and dose reduction technology. Separate abstracts were prepared for 24 of the 25 papers; the remaining paper had been previously abstracted. (GRA)

115

Halter, J.M., and R.G. Sullivan, Pacific Northwest Laboratory, Richland, WA

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

Techniques for Removing Contaminated Concrete Surfaces

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 185-194), 256 pp. (1981, February)

Various techniques used to clean concrete surfaces by removing the surface are compared. Three techniques investigated by the Pacific Northwest Laboratory (PNL) for removing surfaces are also descibred: the water cannon, the concrete spaller, and the high-pressure water jet. The equipment was developed with the assumption that removal of the top quarter inch of the surface would remove most of the contamination. If the contamination has gone deeper, the removal processes can be repeated until the surface is acceptable. Photographs show the equipment used and results of each method. (CAJ)

116
Hermetz, R.E., Mound Facility, Miamisburg, OH

Use of Urethane Foam in the Decontamination and Decommissioning of Nuclear Facilities

MLM-2853; CONF-811111; Proceedings of the Society of the Plastics Industry's Annual Technical Conference, San Francisco, CA, November 1, 1981 (1981, November)

Portable equipment for generating urethane foam was used in the decontamination and decommissioning (D and D) of the Plutonium Processing Building at the Mound Facility. The plans and estimates for the D and D were based on the procedures outlined below: (1) clean and remove the interior services, equipment, and any noncritical interior structural members, then prepare and package; (2) clean all interior surfaces within the enclosure (glovebox) of gross quantities by sweeping and scrubbing; (3) fix residual quantities of plutonium on interior surfaces with the application of sprayed urethane foam; (4)clean and remove exterior piping, valves, conduit, and support equipment, then prepare and package; (5) loosen gloveboxes from their positions, and either cut in two, if too long, or prepare for loading; (6) load gloveboxes into transuranic (TRU) type shipping containers; and (7) package and stabilize loads within shipping containers by the use of sprayed urethane foam. Procedures 3 and 7 outlined above call for the use of sprayed urethane foam in two different applications: one on the interior surface (Procedure 3) and the other for packaging (procedure 7). The results obtained from the application of the sprayed urethane foams have been very favorable. The savings in time and labor will help cut costs and schedule times by 10%. (EDB)(PTO)

117
Heshmatpour, B., G.L. Copeland, and R.L. Heestand, Thermo Electron Corporation, Wilmington, MA; Oak Ridge National Laboratory, Oak Ridge, TN

Decontamination of Transuranic Waste Metal by Melt Refining

ORNL/TM-7951; 22 pp. (1981, December)

Melt refining of transuranic (TRU) contaminated metals has been proposed as a decontamination process with the potential advantages of reclaiming metal and simplifying analytical problems. The feasibility of routinely achieving the 10 nCi/g (approximately 0.1 ppm) decontamination level by melt refining will demonstrate the removing of scrap metal from the TRU waste classification. To demonstrate this feasibility, mild steel, stainless steel, nickel, and copper were contaminated with 500 ppm PuO2 and melted with various fluxes. Four different fluxes, borosilicate glass, blast furnace slag, high silica slag, and artificial basalt, were used in these studies. The solidified slags and metals were analyzed for their plutonium contents by the use of a combination of wet chemical and alpha-activity counting technique. Partition ratios were calculated for plutonium using the analytical results of each experiment. Some metals were double refined to study the effect of secondary slag treatment. The initial weight of the slags was also varied to investigate its effect on plutonium removal. The results indicated that the use of proper slags is necessary for effective removal of plutonium. All four slags were effective in removing plutonium from the metals. Values of less than 1 ppm Pu (100 nCi/g) could be obtained in all cases. The double-refined samples were cleaned to less than 0.1 ppm Pu (10 nCi/g), which is the goal. Variation in the slag weight did not change the results significantly. Double refining of the metal with small primary and secondary slag volume can be an effective process for removal of TRU contaminants from metals. Further work is needed to improve metal-slag separation to routinely achieve the 10 nCi/g level so that the scrap can be reclassified out of the TRU waste category. (Auth)(CAJ)

118

Hill, E.F., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Decontamination of LMFBR Components: Report of FY 1979 Results

DOE/SF/76026-T7 (1979, September 25)

The results presented in this report show that the GCA (Glycolic-Citric Acids) process is as suitable or better for use in decontaminating wrought 316 stainless steel and CFBM castings as for decontaminating 304 stainless steel components. The report includes an evaluation of a number of parameters which must be controlled and understood to achieve satisfactory decontamination of LMFBR components: Mn-54 deposition and diffusion, sensitization, metal working, and oxygen control. It was found that castings retain about three times as much Mn-54 as wrought specimens and that this isotope does not diffuse into 316 stainless steel as rapidly as into 304 stainless steel. (ERA)(PTO)

119

Holladay, D.W., Oak Ridge National Laboratory, Oak Ridge, TN

Decontamination of Material Research and Development

Research Project: Contract No. ONL-WDX2(03) (1980)

Needed R and D will be carried out to provide a data base for selecting methods of treating various residues and solutions left from previous uranium ore sampling stations or processing plants. Methods for removal of Ra-226 and Th-230 in addition to uranium would be investigated. This involves testing of various leaching agents to dissolve the radionuclides followed by tests of methods for isolation and recovery of them from the leach solutions. Compatibility of the leached residues with the environment with respect to leachability of hazardous materials in groundwater and any airborne activity would be evaluated. Methods developed for removing radium and thorium from leach solutions can be readily adapted for treatment of pond water, etc. Plans are to keep the program flexible so that it can be rapidly focused on new and significant problems as they arise. (SSIE)(PTO)

120

Kazanjian, A.R., and M.E. Killion, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Plutonium Recovery in Advanced Size Reduction Facility

RFP-2952; Chemistry Research and Development Progress Report, November 1978 through April 1979, F.J. Miner (Ed.), (pp. 16-17), 34 pp. (1979, October 5)

The purpose of this investigation was to evaluate plutonium recovery and solution recycle for the various decontamination solutions being investigated for use at the Advanced Size Reduction Facility at Rocky Flats. A sodium nitrate-borax solution was shown to be the best medium for electro-decontamination at Rocky Flats. Plutonium recovery is easier and less waste is generated.

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

The only disadvantage is that chromium doesn't precipitate in this solution and must be periodically removed to maintain electrolytic efficiency. Phosphoric acid is no longer being used because the acid cannot be recycled. A nitric acid-borax solution was tested but resulted in the generation of large volumes of liquid waste. Separation of the plutonium from the impurities using Dowex 11 anion exchange resin gave a plutonium with less than 0.01 g/l impurities. (PTO)

121

Kennedy, W.E., Jr., E.C. Watson, D.W. Murphy, B.J. Harrer, R. Harty, and J.M. Aldrich, Pacific Northwest Laboratory, Richland, WA

A Review of Removable Surface Contamination on Radioactive Materials Transportation Containers

NUREG/CR-1858; PNL-3666 (1981, May)

This report contains the results of a study sponsored by the U.S. Nuclear Regulatory Commission (NRC) of removable surface contamination on radioactive materials transportation containers. The purpose of the study is to provide information to the NRC during their review of existing regulations. Data was obtained from both industry and literature on three major topics: 1) radiation doses, 2) economic costs, and 3) contamination frequencies. Containers for four categories of radioactive materials are considered including radiopharmaceuticals, industrial source material, nuclear fuel cycle materials, and low-level radioactive waste. Assumptions made in this study use current information to obtain realistic yet conservative estimates of radiation dose and economic costs. Collective and individual radiation doses are presented for each container category on a per container basis. Total doses, to workers and the public, are also presented for spent fuel cask and low-level waste drum decontamination. Estimates of the additional economic costs incurred by lowering current limits by factors of 10 and 100 are presented. Current contamination levels for each category of container are estimated from the data collected. (Auth)(CAJ)

122

King, R.R., J.M. Halter, R.G. Sullivan, J.F. Cline, R.L. Brodzinski, and G.H. Beeman, Pacific Northwest Laboratory, Richland, WA

Decommissioning Technology

PNL-2500 (Part 5); Pacific Northwest Laboratory Annual Report for 1977 to the DOE Assistant Secretary for Environment, Part 5: Control Technology, Overview, Health and Safety Policy Analysis, (pp. 1.19-1.21), 92 pp. (1978, February)

The purpose of this program is to conceive, develop, and test advanced decommissioning and decontamination technology that will be applicable to the Hanford decommissioning effort. The four tasks associated with this program are as follows: (1) concrete decontamination; (2) concrete properties/structures; (3) burial ground stabilization; and (4) D&D survey instrumentaion. Two novel techniques for concrete decontamination are being investigated. A water cannon was found to consistently spall craters 4 to 5 inches in diameter in concrete. A rock splitter bit has performed very well on concrete foundations. A program has been initiated to investigate the effects of the following parameters on concretes: freeze/thaw cycling; chemical degradation; permeability with respect to time; stress; thermal cycling; and radiation effects. The burial ground stabilization task is designed to test the ability of a "biobarrier" to prevent plant and animal penetration into buried wastes. The D&D survey instrumentation task has developed a prototype field unit to measure very low levels of residual transuranic activity in structural materials and soils following decontamination. (PTO)

123

Lackey, W.J., L.C. Williams, S.M. Tiegs, and G.L. Copeland, Oak Ridge National Laboratory, Oak Ridge, TN

Low Level Waste Smelting Studies

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

Research Project; Contract No. ONL-WL06(11) (1980)

The objective of the Low Level Waste Smelting Studies is to demonstrate decontamination and volume reduction of low-level beta-gamma contaminated metals by smelting. This task will: (1) determine the feasibility for decontaminating beta-gamma contaminated scrap metals by melting under an oxidizing slag with the contaminants being concentrated within the slag, this work will include both ferrous and nonferrous metals containing a wide variety of radioisotopic contaminants; (2) determine the feasibility for decontaminating metals such as aluminum (which may not be decontaminated sufficiently by slagging) by drip melting with the surface contaminants being concentrated within the dross; (3) devise assaying techniques to accurately determine the levels of contaminants remaining in the metals following smelting; (4) determine processes for ultimate disposal of the contaminated slag and dross and determine the degree of radionuclide containment (leach resistance) of the final waste form; (5) determine the smelting equipment required to reliably and economically accomplish decontamination of low-level scrap metals; and (6) demonstrate decontamination and volume reduction of low level beta-gamma contaminated metals in engineering scale smelting equipment. (SSIE)

124
Long, J.L., Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Decontamination of Glovebox Surfaces with a Basic Electrolyte

RFP-3089; Quality Engineering and Control Annual Progress Report - January Through December 1980, R.L. Carpenter, (Ed.), (pp. 2-3), 27 pp. (1982, February 1)

Experiments were performed on highly contaminated, stainless steel glovebox samples, and the decontamination of such samples to background levels was demonstrated. Comparison of the anodic dissolution results of the basic electrolyte with those of phosphoric acid on stainless steel surfaces at 90 deg C indicate similar decontaminating characteristics. The effect of temperature on decontamination efficiency in a basic electrolyte will be investigated in detail later. Up to a 20 percent decrease in metal removed for a given level of decontamination can be achieved by operating at 90 deg C rather than at room temperature. This decrease in waste generated is desirable but the magnitude is such that it would be feasible to operate at lower temperatures to avoid operational problems, such as high vaporization rate of the electrolysis solution. (Auth)(PTO)

125
Mound Facility, Miamisburg, OH

Use of Urethane Foam in Preparing for Decontamination and Decommissioning of Radioactive Facilities

MLM-2797 (OP); CONF-810112; Urethane Foam Expo-6, Proceedings of a Conference, Orlando, FL, January, 1981, (5 pp.) (1981, January)

Portable urethane foam generating equipment has been in use for 15 to 20 years for a large number of applications, such as roof systems, tank insulation, and building insulation. Still another industrial application is its use in the decontamination and decommissioning of radioactive facilities at Mound Facility. The major problems encountered with urethane foams were with the packaging and stabilization procedures. The operation for spraying the foam on interior surfaces and equipment involved getting the gun inside without opening up the interior to the outside environment. A Gusmer FF proportioner and Model D spray gun was used for this operation. The gun was modified so that the trigger could be remotely located to facilitate its entry through a glovebox gloveport opening. The Model D gun has an air cap to blow foam off the tip of the gun. The plastic bag is then put on a glove port and fastened securely. Urethane spray is applied on all exposed surfaces. This assures that all residual material is fixed for shipment. This simplifies cleaning operations as there is no need to remove the last trace of plutonium and results in a considerable shortening of the time required to prepare the gloveboxes. With the interior foamed, the gloveboxes are moved to the loading and packaging areas. Urethane foams are used to fill in the voids in the final shipping container. Radioactive waste materials are segregated according to the level of radioactive material present: (1) low-level, or low specific activity (LSA); high-level; and transuranic (TRU). Foam is used in TRU packages as packaging material to stabilize the loads and to help cushion against shock in transit. (Auth)(PTO)

126

Parrott, J.R., Oak Ridge National Laboratory, Oak Ridge, TN

Cleanup of Building 3019 and Surroundings at ORNL Following Plutonium Release of November 20, 1959

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 135-143), 256 pp. (1981, February)

In November 1959 a non-nuclear explosion involving an evaporator occurred in a shielded cell in the Radiochemical Processing Pilot Plant at Oak Ridge National Laboratory. Plutonium was released, probably as an aerosol of fine particles of plutonium oxide, through the cell ventilation system, the cell door (which had blown open), and pipe passages and service openings that pass through the cell wall. This paper describes the extent of contamination and the decontamination effort, through several phases, required for resumption of operations. The levels of contamination resulting from the explosion are indicated. The highest concentration was inside the cell; the next highest was in the area directly above the cell, diminishing toward the office area. By November 23, 1959 all buildings were open for occupancy except Building 3019, which was reinhabited in six weeks. Complete decontamination was accomplished in nine months at a cost of approximately $500,000. (CAJ)

127

Stelle, A.M., Rockwell International Corporation, Pasadena, CA

Post-Retirement Plan for Radiological Decontamination of the SRE Site

DOE/SF/00701-T57; TI-599-19-103; 56 pp. (1970, July 30)

The Sodium Reactor Experiment (SRE) post-retirement condition is described in the context of a plan to remove all sources of radiation and to remove hazardous or dangerous materials and equipment from the SRE site. Restraints imposed by contractual provisions between the AEC and North American Rockwell Corporation and by the State of California, Bureau of Radiological Health are discussed. The manpower and the material requirements are estimated for the plan. (EDB)(PTO)

128

Ureda, B.F., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Building 003 Decontamination and Disposition - Final Report

AI-ERDA-13158; 40 pp. (1976, February 25)

The decontamination and disposition of the contaminated facilities in building 003 are complete. The hot cave, the building radioactive exhaust system, the radioactive liquid waste system, and the fume hoods were removed. The more significant D and D activities are summarized, special techniques are noted, and problems and their resolution are discussed. Results of the radiological monitoring are presented. (EDB)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

129

Allison, G.S., Pacific Northwest Laboratory, Richland, WA

Prototype Arc Saw Design and Cutting Trials

PNL-3446; 34 pp. (1980, September)

A program was initiated to develop the arc saw as a tool capable of removing the end fittings from spent nuclear fuel bundles. A special arc saw for this purpose was designed, installed at the Pacific Northwest Laboratory and satisfactorily operated to remove end fittings from simulated, nonradioactive fuel bundles. The design of the arc saw included consideration of the cutting environment, power supply size, control equipment, and work piece size. Several simualted fuel bundles were cut to demonstrate that the arc saw met design specifications. Although the arc saw development program was curtailed before significant performance data could be collected, tests indicate that the arc saw is a good means of cropping spent fuel bundles and is well suited to remote operation and maintenance. (GRA)

130

Basham, S.J., Jr., and K.D. Kok, Battelle Columbus Laboratories, Columbus, OH

Research Reactor Dismantling: A Case History

Transactions of the American Nuclear Society 22:636-637 (1975)

The Battelle research reactor began operation on October 29, 1956, at power levels up to 1 MW, was raised to 2 MW in 1959, and terminated operation on December 31, 1974. A request for possession-only license was made on September 13, 1974; the request comprised (a) dismantling plan, (b) revised technical specifications, and (c) revised safety analysis report. The possession-only license and technical specifications were approved on March 10, 1975. The dismantling plan was approved on March 19, 1975. Certain preliminary steps were taken toward retirement during the intervening period between final operation and receipt of approvals by the Nuclear Regulatory Commission (NRC). These steps were activities that had been previously conducted under the provisions of the operating license for the facility. Dismantling operations continued through mid-year 1957. All fuel was shipped for reprocessing. The activated components and contaminated materials were shipped to a burial site. Cost estimates for the task proved to be conservative. Cost of dismantling was about $220,000. (JMF)

131

Carroll, J.W., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Decommissioning of Sodium Reactor Experiment Facilities

Research Project (1981)

The objectives of the task are to dismantle the Sodium Reactor Experiment (SRE) facility and to remove all significant reactor originated radioactivity from the site, thus releasing the facility from all requirements for radiological control, licensing, or monitoring and make the site available for other uses. (SSIE)

132

Coobs, J.H., Oak Ridge National Laboratory, Oak Ridge, TN

Curium Facility Decommissioning

Research Project (1981)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

The objective of this project is to remove and encapsulate residual curium-244 oxide powder and to decontaminate and/or remove facility components to allow the facility to be utilized for other use. (SSIE)(PTO)

133
Elswick, T.C., Mound Facility, Miamisburg, OH

Decommissioning of DASMP Areas (Mound Facility)

Research Project (1981)

The D and D of inactive DASMP areas (Mound Facility) was initiated, wherein surplus plutonium-238 contaminated gloveboxes and other equipment were removed from the inactive DASMP areas. These areas are being restored to a reusable condition for further program utilization. The areas to be decommissioned and decontaminated are portions of the PP Building, portions of the R Building, and the Waste Transfer System. The project consists of removing contaminated gloveboxes and decontaminating areas to specified levels. (SSIE)(JMF)

134
Gieseler, W., U.S. Department of Defense, Army Electronics Research and Development Command, Harry Diamond Laboratory, Adelphi, MD

Diamond Ordnance Radiation Facility Decommissioning

Research Project; Contract No. DA0G5646 (1980)

The objectives of this project at the Diamond Ordnance Radiation Facility are: (1) to remove the special nuclear material (SNM), (i.e. reactor fuel elements) and return it to Department of Energy (DOE) for disposal; (2) to remove all radioactive and activated material from the facility and ship to a Nuclear Regulatory Commission (NRC) licensed burial site; and (3) to decontaminate the facility building and restore for alternate use. Other objectives includes: (1) to enter into an interagency agreement with DOE to arrange, or have arranged, the rental of shipping casks for the SNM and their transportation to other reactor facilities or to DOE Idaho for storage; and (2) negotiate a contract for the dismantlement and decontamination of the facility and building restoration for alternate use. (PTO)(SSIE)

135
Harper, J.R., and R. Garde, Los Alamos National Laboratory, Los Alamos, NM

The Decommissioning of a Tritium Contaminated Laboratory

LA-9056-MS; 14 pp. (1981, November)

A tritium laboratory facility at the Los Alamos National Laboratory, Los Alamos, New Mexico, was decommissioned in 1979. The project involved dismantling the laboratory equipment and disposing of the equipment and debris at an on-site waste disposal/storage area. The laboratory was constructed in 1953 and was in service for tritium research and fabrication of lithium tritide components until 1974. The major features of the laboratory included 25 meters of gloveboxes and hoods, associated vacuum lines, utility lines, exhaust ducts, electrodryers, blowers, and laboratory benches. This report presents details on the decommissioning, health physics, waste management, environmental surveillance, and costs of the operation. (Auth)(PTO)

136
Harper, J.R., and R. Garde, Los Alamos National Laboratory, Los Alamos, NM

Removal of Contaminated Air Scrubbers at TA-35-7, Los Alamos National Laboratory

LA-9058-MS; 12 pp. (1981, November)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

Five large excess contaminated air scrubbers located in Building 7 at TA-35 were removed and disposed of in 1979-1980. The scrubbers were contaminated with strontium-yttrium and cesium. This report details the removal procedures, the health physics program, the waste management program, and the costs of the operation. (Auth)

137

Harper, J.R., and R. Garde, Los Alamos National Laboratory, Los Alamos, NM

Decommissioning the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE 1)

LA-9052-MS; 13 pp. (1981, November)

The Los Alamos Molten Plutonium Reactor Experiment (LAMPRE I) was decommissioned at the Los Alamos National Laboratory, Los Alamos, New Mexico, in 1980. The LAMPRE I was a sodium-cooled reactor built to develop plutonium fuels for fast breeder applications. It was retired in the mid-1960s. This report describes the decommissioning procedures, the health physics programs, the waste management, and the costs for the operation. (Auth)

138

Lundgren, R.A., Pacific Northwest Laboratory, Richland, WA

Reactor Vessel Sectioning Demonstration

PNL-3687; 19 pp. (1981, July)

Pacific Northwest Laboratory (PNL) has completed a successful technical demonstration of simulated reactor vessel sectioning using the combined techniques of air arc gouging and flame cutting. A 4-ft x 3-ft x 9-in. thick sample was fabricated of A36 carbon steel to simulate a reactor vessel wall. A 0.25-in. layer of stainless steel (SS) was tungsten inert gas (TIG)-welded to the carbon steel. Several techniques were considered to section the simulated reactor vessel. An air arc gouger was chosen to penetrate the stainless steel, and flame cutting was selected to sever the carbon steel. After the simulated vessel was successfully cut from the SS side, another cut was made, starting from the carbon steel side. Cutting from the carbon steel side has the advantages of cost reduction since the air arc gouging step is eliminated, and contamination control because the molten metal is blown inward. The following recommendations are offered: 1) develop remote manipulation for the air arc gouger/flame cutter that can be used interchangeably; 2) develop a remote air gouger for underwater operations as a method for containing particulates and combustion products; 3) investigate other techniques such as burning bars, conical-shaped explosive charges, or arc lances; 4) obtain real-time cost estimates to establish a data base for sectioning operations; and 5) consider cutting the vessel wall from the carbon steel side. (Auth)(CAJ)

139

Lundgren, R.A., Pacific Northwest Laboratory, Richland, WA

Reactor-Vessel Sectioning Demonstration

PNL-3687 (Rev. 1); 27 pp. (1981, September)

A technical demonstration was successfully completed of simulated reactor vessel sectioning using the combined techniques of air arc gouging and flame cutting. A 4-ft X 3-ft X 9-in. thick sample was fabricated of A36 carbon steel to simulate a reactor vessel wall. A 1/4-in. layer of stainless steel (SS) was tungsten inert gas (TIG)-welded to the carbon steel. Several techniques were considered to section the simulated reactor vessel; air gouging was selected to penetrate the stainless steel, and flame cutting was selected to sever the carbon steel. Three sectioning operations were demonstrated. For all three, the operating parameters were the same, but the position of the sample was varied. For the first cut, the sample was placed in a horizontal position and was suc-

cessfully severed from the SS side. For the second cut, the sample was turned over and cut from the carbon steel side. Cutting from the carbon steel side has the advantage of cost reduction. (EDB)(RHB)

140
Meservey, R., Idaho National Engineering Laboratory, Idaho Falls, ID

Decommissioning Liquid Waste Evaporator System (PM-2A)

Research Project (1981)

The Liquid Waste Evaporator System PM-2A is to be completely dismantled. All contaminated systems will be decontaminated, disassembled, removed, and transported to the Radioactive Waste Management Complex. The project involves decommissioning two 189,270 liter underground carbon steel storage tanks, a condenser building with a 567.8 liter holding tank, the PM-2A evaporator tank with heater, and a stainless steel waste water line 339.8 m long. The waste water line runs between the inoperative liquid waste evaporator (located in Building TAN-616) and PM-2A Tanks 709 and 710. Three uncontaminated tanks are also located in the PM-2A area. Approximately 5400 cu m of contaminated soil exists in this area. (SSIE)(CAJ)(JMF)

141
Meyers, G.W., and W.D. Kittinger

Dismantling the Sodium Reactor Experiment

Nuclear Engineering International 24(208):24-25 (1979, January)

The decommissioning of the Sodium Reactor Experiment near Los Angeles, California, is nearing completion. The reactor vessel and all contaminated support systems are being removed in order to return the building and the site to unrestricted use. The work is briefly described. (EDB)

142
Phillips, D.A., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

SRE Underwater Plasma Arc Cutting Development Test Report

DOE/SF/75006-T6; 69 pp. (1976)

Methods and equipment for cutting holes in stainless steels and carbon steels in air and under water using plasma arc torches are discussed. (LCL)

143
Pierce, E.E., and A.A. Walls, Oak Ridge National Laboratory, Oak Ridge, TN

Radiochemical Waste Decommissioning (3026-C)

Research Project; Contract No. ONL-WD10(27)

Several ORNL facilities which were used to process or store radioactive materials for defense-oriented applications have been declared surplus to programmatic needs. The Radiochemical Waste Facility (3026-C) consisted of twelve storage tanks ranging in size from 25 to 100 gallons arranged on two levels within a combination stacked-concrete block and poured-concrete shield with internal dimensions 7 x 6 x 15 ft high. The facility is located north of building 3026-C. Visual examination of the tanks in FY 1979 resulted in a decision to begin immediately with an effort to empty the tanks into the ILW system, remove and package the tanks, and transport them to the SWSA. This effort was started in FY 1979 and was completed in FY 1980. The remaining pit, piping, and residue in the bottom of the pit are highly radioactive with readings greater than 20 R/hr at contact. (SSIE)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

144

Raile, M.N., Atlantic Richfield Hanford Company, Richland, WA

Demolition and Removal of Plutonium-Contaminated Facilities at Hanford

Conference on Remote Systems Technology, Proceedings of the 23rd American Society Winter Meeting, San Francisco, CA, November 1975, (pp. 252-262) (1975, November)

The successful demolition and cleanup of a plutonium-contaminated facility at the U.S. Energy Research and Development Administration Hanford Plant in Washington state is described. Several new materials, along with special techniques and equipment, were utilized for the containment and control of plutonium contamination during the course of the demolition work. The use of light-capacity fiber-glassed plywood boxes for long-term (20 year minimum) storage of the contaminated materials in underground transuranic waste trenches has led to the development, design, and use of larger capacity, modular, fiber-glassed plywood boxes that are replacing standard carbon steel boxes at less than one-third the cost, and without the potential for early failure from normal soil or atmospheric corrosion. (EDB)(PTO)

145

Rinehart, R.E.

Sheet-Metal 'Fabricating Center' and the Use of Plasma-Arc Cutting

Sheet Metal Industries 58(6):466-468 (1981, June)

An outline is given of some of the many technological improvements that have been made to plasma-arc cutting systems since the world's first numerically controlled Fabricating Center was developed by W.A. Whitney Corporation (USA) in 1974. Special reference is made to the principle of plasma-arc cutting, the two types commonly used (dual-gas and air-plasma), some common terms (e.g. kerf, dross, level, drag), torch positioning, cutting tolerances and speeds, and the advantages of plasma-arc cutting over nibble punching. (MS)(JMF)

146

Smith, D.L., D.L. Davenport, and A.M. Snyder, EG&G Idaho, Inc., Idaho Falls, ID

Borax-V Decontamination and Decommissioning Plan

PR-W-79-017; 187 pp. (1979, September)

A program to dismantle and decontaminate the Boiling Reactor Experiment (BORAX) facility is described, which will provide for the dismantling, necessary decontamination and removal of this system, and for restoration of the area after FY-1980. Cost and schedule analyses are provided and shown in diagrams. The calculated weights and volumes of materials expected to be removed from the BORAX facility are tabulated for each building. The materials are separated into radioactively contaminated and noncontaminated categories, and estimates are based on facility Architectural and Engineering (A&E) drawings, system piping and instrumentation diagrams, and a facility radiological characterization. A post-D&D report will be generated by the project manager. This report will contain documentation of the original condition of the site (photographs, written description, prints, etc.), final condition, and description of major work changes required to complete the project. Original cost and schedule estimates will be compared with actual budget and schedule required to complete the project. Personnel radiation exposure resulting from BORAX-V D&D will be documented and compared to the predicted values. Significant problems encountered and any special tooling, procedures and methods, or other technology developed will also be documented. (CAJ)

147

Stouky, R.J., NUS Corporation, Rockville, MD

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

Factors Affecting Power Reactors Decommissioning Costs for Complete Removal

CONF-780622; American Nuclear Society 1978 Annual Meeting, Proceedings of a Conference, San Diego, CA, June 18-22, 1978, (pp. 668-669); Transactions of the American Nuclear Society 28:668-669 (1978)

Decommissioning costs for power reactors to the point of complete removal are affected by many variables. At the forefront are labor costs with differentials at one location ranging from around $11.00 per hour (utility employees) to $25.00 per hour (building tradesmen where much intermediate contract work is used). Rising labor costs always make estimates difficult, and intermingled with them are such variables as project duration, project extent and complexity, relative contamination levels, and the existence of adjacent manned facilities owned by the utility which affects decommissioning costs due to the sharing of support services. (JMF)

148
Szulinski, M.J., Atlantic Richfield Hanford Company, Richland, WA

The Hanford Decontamination Facility

ARH-SA-181; 25 pp. (1974, June)

This paper discusses the operation of a decontamination center at Hanford and a recent Hanford development program for decontamination of equipment. Before 1957, almost no failed contaminated equipment was reclaimed and restored to service at Hanford. Since that time, however, skills, equipment, and facilities have been developed to reclaim and reuse millions of dollars worth of process equipment which would have been retired from use under former conditions. The structural and confinement features of an obsolete separations plant made it readily adaptable for a decontamination center. Conclusions drawn from the decontaminaiton development program include: (1) highly-contaminated equipment can be decontaminated for inspection and repair or modification; (2) in a fuels reprocessing plant, the economics are favorable; (3) considering disposal of equipment and eventual decommissioning, decontamination may be a necessity; (4) further research and development on contamination/decontamination needs to be done, and new tools are available; (5) decontamination procedures need to consider the objective of the operation and the disposition of the transferred radioactivity (i.e., waste management); and (6) whenever possible, equipment and facilities should be designed with consideration for contamination/decontamination. (Auth)(PTO)

149
Ureda, B.F., Rockwell International Corporation, Pasadena, CA

SRE Activity Requirement Number: 18 and 19 Decontamination and Dismantling of Mark I and Mark II Fuel Handling Machines

DOE/SF/00701-T60; 6 pp. (1976, November)

The SRE Mark I and Mark II Fuel Handling Machines will be decontaminated and dismantled. Disassembled components will be further decontaminated as necessary to permit disposal of the components as salvage. Components that cannot be decontaminated economically will be packaged and shipped to burial. The dismantling will be performed in the SRE High Bay using appropriate techniques for safety handling radioactivity and sodium containing components. (EDB)

150
Wodtke, C.H., Oak Ridge National Laboratory, Metallurgy Division, Oak Ridge, TN

Constricted-Arc Process Cuts Metals Under Water

Metal Progress 78(6):91-93 (1960, December)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

Constricted-arc cutting with torches of special design has been adapted at Oak Ridge National Laboratory for underwater operation and is being used successfully in the maintenance of nuclear reactors. Cutting is rapid and because the torch and work are completely submerged, spatter is confined and release of radioactivity to the air is reduced to a safe level. (Auth)

151

Wodtke, C.H., Oak Ridge National Laboratory, Metals and Ceramics Division, Oak Ridge, TN

Underwater Plasma-Arc Cutting

Underwater Welding Cutting and Hand Tools, Proceedings of a Symposium, Columbus, OH, October 10-11, 1967, (pp. 160-181) (1967, October)

Underwater plasma-arc cutting was successfully applied in the laboratory and in remote maintenance on a nuclear reactor system. Reactor maintenance was greatly facilitated through use of the process because it was rapid, quite reliable, and adaptable to mechanized as well as remote operation. Process and equipment requirements for underwater operation were not complex. Torches were relatively simple to make in special shapes and sizes to suit job conditions. Cuts in various metals up to 1 inch thick were made at water depths to 11 feet. Additional development work should produce equipment capable of cutting thicker sections at greater depths. It is conceivable that the plasma-arc cutting process could be applied to advantage for underwater maintenance and salvage in other fields of activity. Our somewhat limited experience does not extend to anticipating all problems that might be encountered in other applications, possibly in salt water. In particular the electrical hazard to operators should be carefully evaluated where hand-held torches are to be used. (Auth)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM LAND DECONTAMINATION AND RECLAMATION

152

Ahlquist, A.J., Los Alamos Scientific Laboratory, Los Alamos, NM

LASL Experience in Decontamination of the Environment

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 46-60), 256 pp. (1981, February)

This paper descirbes a major environmental decontamination project conducted at the Los Alamos Scientific Laboratory (LASL) in 1975-76. Methods and recommendations based on experience gained are discussed. In determining ALARA the following factors were evaluated: the isotope of concern; the extent and magnitude of contamination; the dollar costs of removing additional soil; the hazards to personnel and equipment in trying to remove the additional soil; and future land use. Speed of sample analysis and distance to the disposal area are also cost factors to consider. Documentation of the as-left conditions should be very thorough and accurate, in case future decontamination is necessary. The use of photographs and notes and data summaries are important and should be kept up-to-date so that data do not get overlooked or confused because of a time lag between data collection and analysis. Once reasonable dose limits are met, factors for further consideration are: the containment involved; location of the contamination; future land use; ability to detect the different types of radioactivity in field situations; cost of further efforts to reduce contaminant concentrations; and the quantities of waste generated. (CAJ)(PTO)

153

Alford, C.E., J.A. Hayden, R.L. Kochen, R.L. Olsen, and J.R. Stevens, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Decontamination of Rocky Flats Soil

RFP-2952; Chemistry Research and Development Progress Report, November 1978 through April 1979, F.J. Miner (Ed.), (pp. 17-18), 34 pp. (1977, October 5)

The objective of this program is to further develop, improve, and scale-up the soil decontamination process for plutonium, americium, and uranium. The process will be used to decontaminate approximately three acres of Rocky Flats soil presently covered by an asphalt pad. A method consisting of attrition scurbbing and wet-screening was developed to reduce the volume of contaminated soil. This process reduced the volume by about 65%. Work to enhance the removal of plutonium from soil was primarily in four areas: (1) testing polar/non-polar separation media; (2) testing surfactants with acid scrubbing solutions; (3) testing surfactants with basic scrubbing solutions; and (4) use of a large magnet to remove ferromagnetic particles from soil. Approximately 40 reagents were tested as additives to the scrubbing solutions. The most effective decontamination solution was a solution of 2 vol % HNO3, 2 vol % pine oil, 0.2 vol % HF, and 5 wt % Calgon in water. This solution consistently decontaminated 80 to 85 percent of the soil to equal to or less than 30 dpm/g. (PTO)

154

Alford, C.E., J.A. Hayden, D.L. Mitchell, R.L. Kochen, R.L. Olsen, and J.R. Stevens, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Soil Decontamination at Other Sites

RFP-2952; Chemistry Research and Development Progress Report, November 1978 through April 1979, F.J. Miner (Ed.), (pp. 18-19), 34 pp. (1977, October 5)

The purpose of this program is to develop and demonstrate soil decontamination processes for the removal of plutonium and other actinides from contaminated soils from other DOE sites. The four major tasks are as follows: (1) preparation for soil characterization; (2) identification of sites and sample collection; (3) improvement of the primary soil decontamination process; and (4) identification of other physical decontamination methods. Five sites were selected for this study. Soil samples from Hanford, INEL, LASL, Mound, and Oak Ridge were collected, analyzed, and shipped to Rocky Flats for testing. Direct use of the Rocky Flats primary soil decontamination process is not expected to be applicable to soils from all five the sites sampled. A proposal has been submitted to the Transuranic Waste Systems Office for the development of a mobile soil decontamination laboratory. (PTO)

155

Barker, C.J., Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Removal of Plutonium-Contaminated Soil from the 903 Lip Area During 1976 and 1978

RFP-3226; 7 pp. (1982, January 25)

This report describes the removal of plutonium-contaminated soil from the 903 Lip Area at the Rocky Flats Plant, Golden, Colorado. The report includes the history of the contamination; development work associated with planning soil removal; descriptions of the work performed, using two different methods of soil removal; and data indicating that the soil removal was conducted with no adverse impact on the environment. (Auth)

156

Bicker, A.E., Reynolds Electrical and Engineering Company, Inc., Las Vegas, NV

Site Decontamination

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 91-99), 256 pp. (1981, February)

A brief description is given of the three DOE sites that have been radiologically decontaminated under the auspices of the Nevada Operations Office. The methods used to perform radiological surveys, the logistics required to support the decontamination (including health physics and sample analysis), and the specific techniques used to reduce or remove the contamination, are presented in detail. The sites include the Tatum Dome Test Site (TDTS) near Hattiesburg, Mississippi, Pahute Mesa on the Nevada Test Site; and the Gnome site near Carlsbad, New Mexico. The contamination, the terrain, and the climatic conditions were different in each case. (CAJ)

157

Boothe, G.F., Rockwell Hanford Operations, Richland, WA

Surface Soil Contamination Standards for Rockwell Hanford Operations

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 144-151), 256 pp. (1981, February)

The emphasis of cleaning up the site and decontaminating surface areas has increased in recent years. Standards are needed to determine if solid waste or other material is contaminated relative to disposal requirements and to establish contamination limits below which posting, restrictions, and environmental controls are not necessary. It was evident from a review of the literature that specific soil standards applicable to Rockwell Hanford Operations were not available. The Rockwell Environmental Protection (EP) Group developed standards which were approved by Rockwell in October 1979. These standards divided by a factor of 5-10 may be reasonable assurance that current radiation protection standards are not exceeded. Four basic criteria of radiation protection were considered: external radiation, ingestion, concentrations in air, and concentrations in water. Rockwell's contamination standards compared with limits that have been developed by other groups are shown in a table. (CAJ)

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Church, B.W., U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV

Nevada Operations Overview

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 61-70), 256 pp. (1981, February)

An overview of the Nevada Operations decontamination and decommissioning activities is presented. Essentially, all these sites are the results of weapons testing, with the exception of the Nuclear Rocket Development Station. A brief history is followed by a discussion of operational factors in the context of "lessons learned", special problems, and long-term considerations. Experience shows that: (1) presurvey is a must, in terms of estimating the size of the cleanup of a job-(Little or no presurvey can lead to a gross underestimate of time and cost); (2) cleanup criteria, which are some kind of acceptable criteria in terms of soil concentrations for various radionuclides, are necessary to indicate the magnitude of the job; (3) the examination of historical documents is extremely important, particularly from the safety sense; (4) sampling and analytical methods are important in that the kind of equipment taken to the field can dictate flexibility in terms of turnaround; (5) in project management, experienced people are extremely important-(If the project managers have no working knowledge of radioactivity, they should be put through an intensive training program first); and (6) planning cannot be overdone. Besides logistics, the special problems that need to be considered are: waste disposal, public relations, and other safety factors that may be unexpected or not accounted for. Long term considerations such as monitoring, land use, and political aspects are briefly discussed. (CAJ)

159

Giacomini, J.J., and F.L. Miller, Jr., University of Nevada, Desert Research Institute, Las Vegas, NV

Statistical Aspects of the Cleanup of Enewetak Atoll

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 100-103), 256 pp. (1981, February)

Data-base management and statistical analysis support for the Department of Energy team provided by the Desert Research Institute for the Enewetak Atoll Radiological Cleanup is described. A system for recording (in machine-retrievable form) all radiological measurements made during the cleanup, excluding personnel dosimetry, was designed and implemented. Statistical analyses were performed throughout the cleanup effort and were used to guide excavation activities. The islands of the atoll were classified as residential, agricultural or food-gathering, depending on their past or intended use, and cleanup criteria were developed for each class of island. The cleanup activities can be divided into four categories: preliminary work; characterization analysis; cleanup analysis; and final analysis. One of the main lessons learned on Enewetak was to document decisions, problems, etc. through daily logs, technical notes, standards operating procedures, memoranda, and official letters. (CAJ)

160

Graves, A.W., Rockwell Hanford Operations, Richland, WA

Soil Surface Decontamination and Revegetation Progress

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 152-166), 256 pp. (1981, February)

The type of work being done by the Program Office at Rockwell Hanford Operations (Rockwell) related to large-area decontamination efforts is briefly discussed.

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Part of the program is involved with large-surface area cleanup in conjunction with surveillance and maintenance of retired sites and facilities and the other part of the program is involved with the decontamination and decommissioning of structures. Large-surface area cleanup work is the subject of this paper. There are 322 surplus contaminated sites and facilities on the Hanford Site for which Rockwell has responsibility. Rockwell's Program Office applies a disciplined approach to the cleanup of these retired sites. The three major project tasks are: surveillance and maintenance of the sites prior to D&D; contaminated equipment volume reduction; and structural D&D. Before and after photos show some of the projects completed over the last 20 years, and the equipment used. (CAJ)

161

Hayden, J.A., P.M. Arnold, J.R. Stevens, R.L. Kochen, K.Y. Gallagher, D.W. Rutherford, and B.K. Damkroger, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Soil Decontamination Study, DOE Facilities

RFP-3118; CONF-800753; Proceedings of a DOE Information Dissemination Seminar, Richland, WA, July 29-30, 1980, (52 pp.) (1980)

This paper presents an overview of soil decontamination research that was conducted at Rocky Flats since the 1970's. A brief summarization is made on the outlook, the approach, and the similarities and differences observed for TRU contaminated soil at DOE sites. Also discussed are the TWSO task, the Rocky Flats site survey, the decontamination criteria, and the characterization and decontamination data. (PTO)

162

Healy, J.W., and W.J. Wenzel, Los Alamos Scientific Laboratory, Los Alamos, NM

Contamination Limits for Real and Personal Property: July-December 1975

LA-6337-PR; 6 pp. (1976, May)

Studies of surface contamination continued with an attempt to apply previous concepts. Revision of the proposed limit for plutonium in soils was started with major efforts on wind resuspension and the use of data on environmental lead to estimate intake by children. (Auth)

163

Healy, J.W., and W.J. Wenzel, Los Alamos Scientific Laboratory, Los Alamos, NM

Contamination Limits for Real and Personal Property: January - June 1976

LA-6484-PR; 6 pp. (1976, September)

Progress is reported on the plutonium in soils limit and on the surface contamination study. The report on the soils limit is being typed in draft form for review at other ERDA facilities. A model for surface contamination was derived and programmed but parametric studies have not yet been done. (Auth)

164

Kinnison, R.R., and R.O. Gilbert, Pacific Northwest Laboratory, Richland, WA

Estimates of Amounts of Soil Removal for Clean-Up of Transuranics at NAEG Off-site Safety-Shot Sites

PNL-SA-8267; 7 pp. (1980, March)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM LAND DECONTAMINATION AND RECLAMATION

Rough estimates are given for the amount of soil removal necessary to "decontaminate" five representative safety-shot areas. In order to decontaminate to levels of less than 160 pCi combined Pu-239/240 per gram surface soil, it is estimated that over one-half million tons of soil would have to be removed from the five area. This is a preliminary estimate based on summary data and concentration contour maps readily available in NAEG publications. More accurate estimates could be obtained by applying Kriging techniques to available soil data if the need arises. The inclusion of Am-241 and Pu-238 activities do not significantly increase the soil tonnage estimates obtained for combined Pu-239/240 because of their relatively small contributions to total transuranic activity. The magnitude of the errors inherent in the use of summary data to obtain "rough estimates" also suggests that a revision of the tonnage estimates for combined Pu-239/240 to include Am-241 and Pu-238 is not warranted. (Auth)(PTO)

165
Mitchell, D.L., P.T. Faccini, and J.E. Garnett, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Soil Decontamination

RFP-2982; Chemistry Research and Development Progress Report for December 1978 through May 1979, F.J. Miner (Ed.), (pp. 27-28), 48 pp. (1980, June 30)

The project objective is to develop a dustless process for decontaminating soil and will include preparation of design criteria and equipment specifications for a production-scale facility at Rocky Flats. Data for determining the most economical method for disposing of the soil will be generated. Pilot-scale equipment is being operated on noncontaminated soils. Water recycle experiments are in progress to flocculate and remove colloids formed in the basic wash solution. Chemical and physical makeup of the soil has been shown to have a dramatic effect on flocculation of the colloid in the wash solution. The Colorado School of Mines Research Institute has been contracted to provide process information generated using noncontaminated soils. Three tests were completed at the manufacturer's pilot plant: one manufacturer investigated scrubbing and obtained information as to retention time, scrubber size, and water usage; another looked at thickening, phase separation via filtration (unsuccessful), and centrifugation. A third manufacturer ran low-speed centrifugal dewatering tests, which looked promising. (CAJ)

166
Mitchell, D.L., L.Q. Fong, and L.F. Richmond, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Soil Decontamination

RFP-2877; Chemistry Research and Development Progress Report, June through November 1978, F.J. Miner (Ed.), (pp. 31-32), 50 pp. (1979, May)

Equipment specifications are being developed for use on the soils decontamination project at the Rocky Flats Plant. Data generated will help in the formulation of an economic evaluation of methods for disposing of the soil. Progress on a flotation-extraction process to concentrate the plutonium in less than 35wt% of the original soil is reported. A screw excavator has been selected to test for the removal of soil from the pad area. (CAJ)

167
Mueller, M.A., W.E. Kennedy, Jr., and J.K. Soldat, Pacific Northwest Laboratory, Richland, WA

Review of Soil Contamination Guidance

PNL-3866; 37 pp. (1981, August)

A review of existing and proposed radioactive soil contamination standards and guidance was conducted for United Nuclear Corporation (UNC), Office of Surplus

Facilities Management. Information was obtained from both government agencies and other sources during a literature survey. The more applicable standards were reviewed, evaluated and summarized. Information pertaining to soil contamination for both facility operation and facility decommissioning was obtained from a variety of sources. These sources included: the Code of Federal Regulations, regulatory guides, the Federal Register, topical reports written by various government agencies, topical reports written by national laboratories, and publications from the American National Standards Institute (ANSI). It was difficult to directly compare the standards and guidance obtained from these sources since each was intended for a specific situation and different units or bases were used. However, most of the information reviewed was consistent with the philosophy of maintaining exposures at ALARA levels ("as low as reasonably achievable"). (Auth)

168

Rutherford, D.W., and J.R. Stevens, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Sampling Design for Use by the Soil Decontamination Project

RFP-3163; 36 pp. (1981, May 18)

The Depa. tment of Energy (DOE) has established a goal of determining the location and extent of transuranic contamination in soil at DOE sites. The purpose of this effort is to provide a data base for decision making on corrective action such as stabilization (removal, packaging, and shipping to storage sites), or removal, decontamination, and return to the original site. This report proposes a general approach to the problem and discusses soil sampling to map the contaminated area and to provide samples for characterization of soil components and contamination. Basic concepts in sample design are reviewed with reference to environmental transuranic studies. Common designs are reviewed and evaluated for use with specific objectives that might be required by the soil decontamination project. Examples of a hierarchial design pilot study and a combined hierarchial and grid study are proposed for the Rocky Flats 903 pad area. (Auth)(CAJ)

169

Straume, T., C.R. Kellner, and K.M. Oswald, Lawrence Livermore Laboratory, Livermore, CA

Cleanup of Radioactive Mud Spill U2Oaa Postshot Drilling Site NTS

UCID-17423; 55 pp. (1977, March)

Radioactive decontamination of a large area of rugged terrain on the Nevada Test Site Area 20 was undertaken after a spill of radioactively contaminated mud occurred at the U2Oaa Postshot drilling site. This report describes methods used to cleanup the contaminated mud, the relative effectiveness of the methods utilized, and the radiation protection measures taken prior to and during the cleanup procedures. The effectiveness of the decontamination methods used, as measured by the percentage of radioactivity remaining (FR), ranged from 1% to 10%, depending upon the method used and type of terrain. Front end loading was most efficient in large relatively flat areas of fine-grain, compact soil, while vacuuming was very effective in flat areas with fine-grain compact soil, but was very slow compared to front end loading. Approximately 2584 cu yd of contaminated soil was removed, with a total residual radioactivity of 900 mCi of Ru-106/Rh-106 and 0.0[illegible] mCi Ru-103, present 6 months following the spill and after decontamination. No person was exposed to external or internal doses above the maximum allowable limits. (CAJ)

170

Straume, T., C.R. Kellner, and K.M. Oswald, Lawrence Livermore Laboratory, Mercury, NV

Radioactive Decontamination Methods and Their Effectiveness

Health Physics 35(2):309-314 (1978, September)

A large area of rugged terrain on the Nevada Test Site was contaminated following a spill of radioactively contaminated drilling mud. The contamination was shown to consist of Ru-103 and Ru-106/Rh-106, with total estimated activity at release time of 38 and 6 curies, respectively. Several decontamination methods were used and their effectiveness assessed by determining the fraction of radioactivity remaining (FR) following each decontamination procedure. In flat areas, the front end loader was by far the most efficient method. In canyon areas, flushing with water was most effective on rocky surfaces, while shoveling and bagging in evaporated mud collection ponds worked well. In locations where radioactive mud/water had not penetrated the ground surface to more than 1-2 in., vacuuming was very effective. However, unless the contaminated area was very small vacuuming was too slow to be of practical value. The radioactive mud spill area was safely cleaned up using standard earth moving equipment. (INSPEC)(PTO)

171

Sutter, S.L., Pacific Northwest Laboratory, Richland, WA

Potential Aerodynamic Entrainment of Soil from Excavation Operations in a Contaminated Area

Nuclear and Chemical Waste Management 2(1):39-42 (1981)

Experiments were performed to provide an indication of the amount of material that could be made airborne during soil-working operations in a contaminated area. Contaminated soil was collected, dried, and mixed, and particle size distribution and contamination levels characterized. In a 0.6 x 0.6 m wind tunnel, soil was pumped into an airstream moving at 1.4, 4.6, 6.8, and 8.9 m/s. Airborne mass and particle samples were collected. The fraction of source soil made airborne increased as a linear function of wind speed. Airborne contamination increased with wind speed at a rate about 4 times the soil mass. Source terms (i.e., fraction of material initially made airborne) can be estimated using the information developed. These can, in turn, be used in diffusion models to estimate downwind contamination levels as required for safety assessments of radioactive or chemical waste sites. (Auth)

172

Thompson, G.H., Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Soil Decontamination at Rocky Flats Plant

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 104-109), 256 pp. (1981, February)

Work being done at Rocky Flats Plant (RFP) to decontaminate soil contaminated with plutonium-239 is described. A discussion is included on the source of the contamination and what has been done to contain it while decontamination methods are being developed. The purpose of the work was to decontaminate the soil so that it could be returned to the site instead of requiring packaging, shipment, and storage. The results of studies that were made to characterize the soil are described. Preliminary results show wet screening and attrition scrubbing together can give 70-80 wt% reduction in the amount of soil that has to be packaged and shipped to a repository. Modifications may be possible that will increase this percentage to a our design basis of 90 wt%. The total concept of contamination soil processing with lab and pilot plant work, as well as preliminary design of full-scale processing facilities and excavating equipment is being studied. (CAJ)(PTO)

173

Toomey, J.E., Rockwell Hanford Operations, Richland, WA

Methods and Costs for Soil Removal

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 171-175), 256 pp. (1981, February)

Methods used in the surface stabilization of radioactively contaminated areas by the engineering organization at

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Rockwell are discussed. The work has been divided into three major tasks: soil transport, surface preparation, and surface stabilization. Methods and equipment for each task are described and limitations of the eqiupment are mentioned. (CAJ)

174

U.S. Atomic Energy Commission, Nevada Operations Office, Las Vegas, NV

Cleanup Summary Report, Tatum Dome Test Site, Mississippi

NVO-129; 16 pp. (1972, June)

All Tatum Dome Test Site radiation dose levels which might be potentially hazardous to present and future human surface use have been reduced to the lowest practicable levels, consistent with the applicable guides. The cleanup was accomplished by (1) sampling and analyzing of soil, water, vegetation, and indigenous animal life from on-site work areas and contiguous off-site areas, (2) excavating and placing all contaminated soil and pumping all contaminated water and other accumulated contaminated fluids into the Tatum Salt Dome nuclear cavity, (3) sealing the cavity by plugging all drilled entry holes with cement, and (4) transporting for disposal at NTS all remaining solids (including several types of material), equipment, debris, and other personal property either contaminated or suspected of being contaminated. The post clean-up radiological status of the site was determined by analyses of samples of water, soils, garden produce and environmental samples from man's food web including rabbit, squirrel, quail, chicken, eggs, pecans and white-tailed deer. Migration of radionuclides to man through resuspension in air and water was determined to be negligible. Twenty-four hour air samples collected after decontamination at several locations indicated no significant activity above background levels i.e. 10(E-15) to 10(E-14) uCi/cc gamma, 10(E-15) to 10(E-14) uCi/cc beta, 10(E-17) to 10(E-15) uCi/cc Sr-90, and 10(E-18) to 10(E-17) uCi/cc Pu-139. (FMM)

175

Wenzel, W.J., and J.W. Healy, Los Alamos Scientific Laboratory, Los Alamos, NM

Contamination Limits for Real and Personal Property. Progress Report, January-June 1975

LA-6125-PR; 4 pp. (1975, October)

Data for the movement of various contaminants (Sr-89, I-131, and P-32) from several different laboratory surface materials and textiles were determined and the fractional amount removed per unit time was fitted to an artibrary scale of level of action. Both the nature of the contaminant and the nature of the surface appear to affect the fractional removal although data are not available to define the dependence in any detail. (GRA)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

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Fox, W.E., J.D. Allen, A.C. Breismeister, and R.L. Ricketts, Los Alamos Scientific Laboratory, Los Alamos, NM

Size Reduction and Waste Packaging of Plutonium-Contaminated Glove Boxes

Transactions of the American Nuclear Society 30:772-774 (1978, November)

A size reduction and packaging facility is being built to initially process waste resulting from the decommissioning and decontamination of the old plutonium facility at Los Alamos, New Mexico. The various configurations considered and the engineering development of the facility are summarized. (Auth)

177

Gallagher, K.Y., and A.L. Johnston, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Lead-Loaded Glove Incineration

RFP-3043; Chemical Systems Engineering Progress Report June through December 1979, R.J. Erfurdt (Ed.), (pp. 5-7), 40 pp. (1980, October 25)

The objective of this project is the development and implementation of an experimental program to generate basic process information for the decontamination and combustion of used lead-loaded rubber gloves. The successful method should incorporate recovery of transuranic elements from the waste gloves with production of a product suitable for terminal repository disposal. Problems encountered in separating the metallic lead from the char were responsible, in part, for abandoning the lead oxide reduction concept. Two factors which pose problems for this task are: (1) filler materials present in the gloves inhibited coalescence of the metal; and (2) substantial elutriation of lead occurred when the gloves were combusted in a fluidized bed. In summation, the selected concept will require the contaminated gloves to be washed, pyrolyzed (preferably in a fluidized bed of carbonate media), and immobilized. (Auth)(PTO)

178

Grella, A.W., U.S. Department of Transportation, Materials Transportation Bureau, Office of Hazardous Materials Operations, Washington, DC

A Review of the Department of Transportation (DOT) Regulations for Transportation of Radioactive Materials

Report; 41 pp. (1976, August)

Under the Department of Transportation Act of 1966, the U.S. Department of Transportation (DOT) has regulatory responsibility for safety in the transportation of radioactive materials by all modes of transport in interstate or foreign commerce, and by all means, except postal shipments. This review is a reference and guidance type document for training purposes, and is not intended to serve as an interpretation or restatement of the regulations. The major sections comprising this document are: (1) background discussion; (2) summary of radioactive materials transportation; (3) summary of principal shippers' requirements in preparation and offering of radioactive material packages for shipment; (4) carrier requirements in handling of radioactive materials packages; (5) discussion of more frequently noted discrepancies on radioactive material shipments; (6) IAEA regulations, and (7) radioactive materials definitions. (PTO)

179

Harper, J.R., and R. Garde, Los Alamos National Laboratory, Los Alamos, NM

The Decommissioning of the TA-42 Plutonium Contaminated Incinerator Facility

LA-9077-MS; 16 pp. (1981, November)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

During 1978, a plutonium-239 contaminated incinerator facility at the Los Alamos National Laboratory, Los Alamos, New Mexico, was decommissioned. The project involved dismantling the facility and burying the debris at an on-site radioactive solid waste disposal/storage area. Contaminated soil from the 5000 sq m area was also buried. The facility was constructed in 1951 to incinerate plutonium-239 contaminated wastes. It was later used as a decontamination facility. The major features included: a control building with a 185-sq m floor area; an incinerator; a cyclone dust collector; a spray cooler; a venturi scrubber; an air filter bank; an ash separator; and two 140,000-liter ash storage tanks. Approximately 600 cu m of debris and 1200 cu m of soil contaminated with less than 10 nCi plutonium-239 per gram of soil were buried at the laboratory disposal area. Five cubic meters of plutonium-239 contaminated ash residues containing more than 10 nCi plutonium-239 per gram of waste were packaged and stored to meet the U.S. Department of Energy's 20-year retrievable storage criteria. The operation required 80 work days and 5800 manhours at a cost of $150,000. This report presents the details concerning decommissioning procedures, the health physics, the waste management, the environmental surveillance results, and a cost breakdown for the operation. (Auth)(PTO)

180

Huntsman, L.K., EG&G Idaho, Inc., Idaho Falls, ID

Hallam Project Processing Operations

PR-W-78-018; 57 pp. (1978, September)

The Hallam Nuclear Power Facility (HNPF) was dismantled between 1964 and 1968. The IHXs, evaporators, superheaters, eliminators, sodium pump casings, and various other components from the HNPF have been in storage at the Idaho National Engineering Laboratory (INEL) in the Test Area North (TAN) hangar since the plant was dismantled. A program was proposed to provide for the sodium removal and necessary decontamination of the Hallam components. The purpose of this project was to prepare the excessed Hallam reactor components for disposal at the Radioactive Waste Management Complex (RWMC), perform destructive research and development on various components, or if possible, return the components to the commercial market through surplus property sale. In order to accomplish this, a system was designed and fabricated to react the sodium in the components by carefully introducing small quantities of steam into an inert nitrogen atmosphere and then passing this aqueous nitrogen through the components. Recommendations for future work of this type include: safety; operational procedures and materials; and design and purchasing suggestions. Main conclusions were that: 1) a detailed management plan must be written and implemented; 2) although the wetted gaseous nitrogen process is controllable and safe, Na is unpredictable, and care must be taken when operating the system; and 3) handling and neutralizing large quantities of strong caustic is safe as long as the procedures are adhered to, and the proper equipment is used. (CAJ)

181

Kratzer, W.K., UNC Nuclear Industries, Inc., Richland, WA

Decontamination and Decontaminant Waste Disposal

UNI-SA-18; 20 pp. (1975, October 9)

Typical decontaminations expected at nuclear power reactors and the problems associated with the processing of decontamination wastes are described. (GRA)

182

Mack, J.E., Oak Ridge National Laboratory, Oak Ridge, TN

Contaminated Scrap Metal Inventories at ORO-Managed Sites

ORNL/TM-8077; 28 pp. (1982, February)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

Radioactively contaminated scrap metal inventories were surveyed at facilities operating under contract with the U.S. Department of Energy and managed through the Oak Ridge Operations Office. Nearly 90,000 tons of nickel, aluminum, copper, and ferrous metals (steels) contaminated with low-enriched uranium have accumulated, primarily at the uranium enrichment facilities. The potential value of this metal on the scrap market is over $100 million. However, existing regulations do not permit sale for unlicensed use of materials contaminated with low-enriched uranium. therefore, current handling practices include burial and above-ground storage. Smelting is also used for shape declassification, with subsequent storage of ingots. This survey of existing inventories, generation rates, and handling capabilities is part of an overall metal waste management program to coordinate related activities among the ORO-managed sites. (Auth)

183
Majors, W.K., and V.A. Swanson, Rockwell International Corporation, Pasadena, CA

Procedure for Decontamination and Disposal of the Kinetics Experiment Water Boiler Facility, Building 073

DOE/SF/00701-T53; 24 pp. (1974, September 18)

This detailed working procedure describes the step-by-step requirements for the dismantling, decontaminating, packaging, and shipping for disposal of all radioactively contaminated items from the Kinetics Experiment Water Boiler Facility at Santa Susana. (EDB)(PTO)

184
McCormack, M.D., EG&G Idaho, Inc., Idaho Falls, ID

Waste Incineration

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 123-134), 256 pp. (1981, February)

The problem of decommissioning a burial ground at the Idaho National Engineering Laboratory (INEL) is discussed. About 3 million cubic feet of waste has been buried at the INEL, most of it from the Rocky Flats Defense Operation, containing plutonium and other transuranic elements. Drums retrieved in 1974 that were buried in the mid-1950's were not in very good shape. An analysis of all the available incinerators was performed to determine which was best suited for processing the INEL waste. A number of processes were evaluated for DOE-funded incinerators currently and for municipal incinerators. Constraints were set up that each process should meet. The only processes that could meet the repository criteria assumed for the study were the three slagging pyrolysis units. The others could meet the criteria only if the added step of vitrification or immobilization in concrete or asphalt was added. A recommendation was made to DOE that R&D be done on the use of the slagging pyrolysis process for the INEL wastes. The results of the evaluation showed this process to be the most promising. The major difference between the slagging pyrolysis incinerator and the other processes evaluated was the operating temperature. At higher temperatures such inerts as dirt, metals, and sludges would be fused into a basalt-like slag. Artists' concepts of a proposed slagging pyrolysis facility are shown. The current cost estimate is $500 million, based on a 1978 start date. (CAJ)

185
Powers, E.W., UNC Nuclear Industries, Inc., Richland, WA

Radioactive Material Shipping Container DOT 7A Test Report (UNI-4400)

UNI-1009; 17 pp. (1981, April)

Testing of the UNI-440 shipping container, its design and construction material, is described. In order to pass the test there must be no penetration of the container and no loss of contents or evidence of breach. This test qualifies the container design and assures that containers fabricated in accordance with UNC Drawing No. H-3-31667 meet Specification 7A requirements. The compression and penetration tests were both successful. The container failed the initial drop test, but passed the second test after the lid attaching bolt pattern was changed to include more bolts. A summary of the test compliance and results are tabulated. Illustrations are provided. (CAJ)

186

Taylor, R.A., and J.J. Thompson, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM

Disposal of a Radioactive Contaminated Pathological Waste Incinerator

Health Physics 40(6):902-904 (1981, June)

This note describes the decommissioning and disposal of an incinerator used for biological wastes from animal studies involving inhaled radionuclides. Since the incinerator was contaminated with radioactivity, it was essential to decommission and dispose of it in a safe but economical manner. The dismantling work was done by a health physics technician (qualified in welding) who would fully understand the required safety precautions. Monitoring was carried out on a part-time basis by the Institute's health physicist. Although no unforeseen problems were encountered during the dismantling procedure, the additional expense incurred by using health physics personnel, instead of unqualified workmen, was felt to be justified by the satisfactory completion of all procedures. (EDB)

187

Turner, R.D., EG&G Idaho, Inc., Idaho Falls, ID

Preconceptual Studies for Processing of the EBR-1 Mark 2 Contaminated NaK

RE-D-79-221; 60 pp. (1979, September)

The EBR-I Complex consists of the Experimental Breeder Reactor Building (EBR-601), the Zero Power Reactor Building (RTF-601), the Argonne Fast Source Reactor (AFSR) Shielding, and the contaminated NaK (eutectic solution of sodium and potassium) Storage Pit. The purpose of the D&D Program was to make the EBR-I Complex safe for public use and enjoyment as a National Historic Monument. Four containers of NaK, assumed to hold 10.5 grams of plutonium which was not recovered during disassembly of the Mark II Core, were not processed during the EBR-I D&D work. This document reports current progress toward a system which will dispose of the four containers of EBR-I NaK, and is a general description of work completed in FY-79, including the literature search for the NaK disposal conceptual design, the procedures for the ARVFS bunker inspection and requirements for the disposal facility, recommendations of several disposal facility concepts and designs, potential hazards in the disposal of the EBR-I NaK, and costs and schedules of various design and work stages. Conclusions and recommendations of the best and most economical disposal options are discussed. The appendix provides the design requirements document for the disposal facility, which is intended to separate the non-radioactive NaK and other materials from the radioactive materials, safely dispose of the non-radioactive materials, prepare and submit the radioactive materials for long term storage, and provide design and operation data for a similar disposal system for subsequent process evaluation. (CAJ)

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188
Bechtel National, Inc., San Francisco, CA

Review of Nuclear Power Reactor Decommissioning Alternatives

SAN-2055-T1; 67 pp. (1978, October)

The aim of this study was to assess the validity of the AIF/NESP decommissioning study without introducing a new estimate with a new set of assumptions and bases. The approach taken in this assessment was to review the assumptions regarding the regulations applicable to the decommissioning effort and then to evaluate the alternatives proposed. The methodology and procedures employed were evaluated to assess their feasibility based on experience in the design and construction of nuclear power plants. Finally the cost estimates were analyzed without preparing new detailed figures. These reviews were then used to evaluate the overall acceptability of the AIR/NESP report as a basis for individual plant estimates and to identify those areas that appear to require additional support to further investigation. (EDB)(JMF)

189
Chapin, J.A., Idaho National Engineering Laboratory, Idaho Falls, ID

Idaho National Engineering Laboratory Decontamination and Decommissioning Summary

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 215-228), 256 pp. (1981, February)

Decontamination and decommissioning (D&D) work performed at the Idaho National Engineering Laboratory (INEL) during FY 1979, including both operations and development projects, are described. The different types of D&D projects planned or completed are first presented, followed by a discussion of problems encountered and recommendations based on the lessons learned. Contaminated areas at the INEL consist of test reactors, reactor support facilities, a fuel reprocessing facility, and various soil areas. The author points out that when D&D activities today are compared with those during SL-1 19 years ago, there appears to have been very little technology development in the field of D&D. A diagram of a contaminated area due to an accident, and before-and-after views of two D&D projects are shown. (CAJ)

190
Denham, D.H., Battelle Pacific Northwest Laboratories, Richland, WA

A Radiological Guide for DOE Decommissioning Operations

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 23), 52 pp. (1981, June)

The Pacific Northwest Laboratory (PNL), under contract to the Division of Operational and Environmental Safety, U.S. Department of Energy, has prepared a draft "Radiological Guide for DOE Decommissioning Operations" currently being peer reviewed by Doe Field Office and contractor staffs. Since this Guide is intended to promote the efficient and uniform decommissioning of the many DOE nuclear facilities and sites whose missions are complete, it is imperative that a consistent set of criteria and methodologies be applied to all DOE decommissioning operations. This Guide attempts to provide that framework through an integrated systems approach in which all factors interact. For this Guide, focused on the evaluation of the radiological status of a site/facility, decommissioning is assumed to include three major phases: site characterization, remedial action, and certification. This paper will focus on the draft Guide emphasizing the need for (1) an overall management team with expertise in health physics, statistics, instrumentation and quality assurance; (2) design objectives based on ALARA; (3) selection of de minimis criteria;

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and (4) a methodical records search and statistically based surveys to estimate residual radionuclide inventories, and to provide a basis for additional surveys, survey instrument requirements, dose estimates, and appropriate protective measures.

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Denham, D.H., P.A. Eddy, K.A. Hawley, R.E. Jaquish, and J.P. Corley, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Low-Level Waste Burial Ground - Environmental Surveillance Programs

NUREG/CR-0570 (Addendum); 109 pp. (1981, July)

This addendum supplements, and to some extent replaces, the preliminary description of environmental radiological surveillance programs for low-level waste burial grounds (LLWBG) used in the parent document, "Technology, Safety and Costs of Decommissioning a Reference Low-Level Waste Burial Ground," NUREG/CR-0570. The addendum provides additional detail and rationale for the environmental radiological surveillance programs for the two referenced sites and inventories described in NUREG/CR-0570. The rationale and performance criteria shall be useful in providing guidance for determining the acceptability of environmental surveillance programs for other inventories and other LLWBG sites. Two generic burial grounds, one locatod on an arid western site and the other located on a humid eastern site, are reference facilities considered. The two sites are assumed to have the same capacity for waste, the same radioactive waste inventory, and similar trench characteristics and operating procedures. The climate, geology, and hydrology of the two reference sites are typical of existing western and eastern sites, although a single population distribution was chosen for both. Each reference burial ground occupies about 70 hectares and includes 180 trenches filled with a total of 1.5 million cu m of radioactive waste. In addition, there are 10 slit trenches containing about 1.5 million cu m of high beta-gamma activity waste. Environmental surveillance programs are described for the several periods in the life of a LLWBG: preoperational (prior to nuclear waste receipt); operational (including interim trench closures); post-operational (after all nuclear waste is received), for both short-term (up to three years) and long-term (up to 100 years) storage and custodial care; and decommissioning (only for the special case of waste removal). (PTO)(CAJ)

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Elder, H.K., Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Uranium Hexafluoride Conversion Plant

NUREG/CR-1757 (1981, October)

Two basic decommissioning alternatives are studied to obtain comparisons between cost and safety impacts: DECON, and passive SAFSTOR; a third alternative, DECON of plant and equipment with stabilization and long-term care of lagoon wastes, is also considered. DECON includes the immediate removal of all radioactivity in excess of unrestricted release levels, with subsequent release of the site for public use. Passive SAFSTOR requires decontamination, preparation, maintenance, and surveillance for a period of time after shutdown, followed by deferred decontamination and unrestricted release. The decommissioning methods assumed for use in each decommissioning alternative are based on state-of-the-art technology. The elapsed time following plant shutdown required to perform decommissioning work in each alternative is estimated to be from 8 months for DECON, to 11 months for SAFSTOR. Planning and preparation for decommissioning prior to plant shutdown will require about 6 months for either DECON or SAFSTOR, with an additional 6 months for planning and preparation prior to starting deferred decontamination. DECON with lagoon waste stabilization is estimated to take 6 mo for planning and about 8 mo to perform the work. Cost estimates, including a 25% contingency, are over $5 million for DECON, and over $8 million for passive SAFSTOR for 10 years. DECON with lagoon waste stabilization will cost over $4 million, with an annual cost of $11,000 for long-term

care. Waste management costs for DECON comprise about 38% of the total decommissioning cost. Disposal of lagoon waste at a commercial low-level waste burial ground is estimated to add $10 million to costs. Safety analyses indicate that impacts from decommissioning activities should be small and radiation doses to the public from accidents would be very low for all phases. Comparison of the cost estimates shows that DECON with lagoon waste stabilization is the least expensive method, but does not allow unrestricted release of the site. The cumulative cost of maintenance and surveillance and the higher cost of deferred decontamination makes passive SAFSTOR more expensive than DECON. Several methods to assure that the licensee has adequate funds for decommissioning are considered, ranging from a single payment when plant operations begin, to payments into a sinking fund during the normal plant operating period, to a single payment when normal plant operations cease and decommissioning begins. (CAJ)(JMF)

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Elder, H.K., and D.E. Blahnik, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Uranium Fuel Fabrication Plant: Appendices

NUREG/CR-1266 (Vol. 2); 214 pp. (1980, October)

This report is a compilation of nine appendicies to the main report. The appendicies are as follows: (A) Reference Site Details; (B) Waste Inventory Details; (C) Radiation Dose Methodology; (D) Environmental Surveillance and Records Maintenance Details; (E) Payments Needed to Finance Decommissioning; (F) Site/Waste Stabilization Decommissioning Activity Details; (G) Waste Relocation Decommissioning Activity Details; (H) Cost Assessment Details; and (I) Radiological Safety Details. (PTO)

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Elder, H.K., and D.E. Blahnik, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Uranium Fuel Fabrication Plant: Main Report

NUREG/CR-1266 (Vol. 1); PNL-3354; 237 pp. (1980, October)

Information on the technology, safety and cost for the conceptual decommissioning of a reference uranium fuel fabrication plant is presented. Comprehensive engineering information on potential decommissioning methods and costs and on the impacts on public and occupational safety of decommissioning are developed. Two decommissioning alternatives (DECON and passive SAFSTOR) are studied to obtain comparisons between costs and safety impacts. Decommissioning cost is estimated to be $3.54 million for DECON, with occupational radiation doses from normal decommissioning operations of 16 man-rem. For passive SAFSTOR for 10 years, an estimated cost of $7.52 million and about 22 man-rem with 10 years of safe storage is estimated. The annual cost of maintenance and surveillance and the higher cost of deferred decontamination makes passive SAFSTOR more expensive. Methods to assure that the licensee has adequate funds for decommissioning are considered. (CAJ)

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Kittinger, W.D., Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Atomics International's Recent Decommissioning Experience

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 176-184), 256 pp. (1981, February)

A description of the decommissioning activites performed in a program for the decommissioning of eight nuclear facilities is presented The facilitics, located at

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the Rockwell Santa Susana Field Laboratory, served experimental and developmental programs for space nuclear power, liquid metal technology, and commercial power generation. One of the eight facilities in the decommissioning program was the Sodium Reactor Experiment (SRE). Accomplishments in the SRE dismantling project are listed; the most important being the demonstration that there are no insurmountable technical problems to decommissioning. (CAJ)

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Konzek, G.J., J.D. Ludwick, W.E. Kennedy, Jr., and R.I. Smith, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors: Main Report

NUREG/CR-1756 (Vol. 1) (1982, March)

Safety and cost information is developed for the conceptual decommissioning of two representative licensed nuclear research and test reactors. Three decommissioning alternatives are studied to obtain comparisons between costs (in 1981 dollars), occupational radiation doses, potential radiation dose to the public, and other safety impacts. The alternatives considered are: DECON (immediate decontamination), SAFSTOR (safe storage followed by deferred decontamination), and ENTOMB (emtombment). The study results are presented in two volumes. Volume 1 (Main Report) contains the results in summary form. The sections contained in volume 1 are as follows: (1) introduction; (2) summary; (3) study approach and bases; (4) decommissioning alternatives and selection considerations; (5) review of licensed research and test reactors decommissioning experience; (6) regulatory considerations for decommissioning; (7) financing of decommissioning; (8) characteristics of the reference research and test reactors; (9) suggested methodology for determining acceptable residual radioactive contamination levels for the decommissioning research and test reactors; (10) decommissioning safety; (13) comparisons with other studies; (14) facilitation of decommissioning; (15) impacts of alternate study bases; and (16) glossary. (Auth)(PTO)

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Konzek, G.J., J.D. Ludwick, W.E. Kennedy, Jr., and R.I. Smith, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors: Appendices

NUREG/CR-1756 (Vol. 2) (1982, March)

Safety and cost information is developed for the conceptual decommissioning of two representative licensed nuclear research and test reactors. Three decommissioning alternatives are studied to obtain comparisons between costs (in 1981 dollars), occupational radiation doses, potential radiation dose to the public, and other safety impacts. The alternatives considered are: DECON (immediate decontamination), SAFSTOR (safe storage followed by deferred decontamination), and ENTOMB (entombment). The study results are presented in two volumes. Volume 1 (Main Report) contains the results in summary form. Volume 2 (Appendices) contains the detailed data, including unit-component data, that support the results given in a Volume 1. The appendices included in volume 2 are as follows: (a) descriptions of the reference sites; (b) reference research reactor facility description; (c) reference test reactor facility description; (d) radiation dose rates and concrete surface contamination data; (e) radionuclide inventories; (f) public radiation dose models and calculated maximum annual doses; (g) decommissioning methods; (h) generic decommissioning information; (i) details of DECON; (j) details of SAFSTOR; (k) details of ENTOMB; (l) demolition and site restoration details; (m) cost estimating bases; and (n) public radiological safety assessment details. (Auth)(PTO)

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Moore, E.B., Jr., Pacific Northwest Laboratory, Richland, WA

Decommissioning of Nuclear Facilities

Nuclear Safety 21(3):364-366 (1980, May-June)

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Facilitation of the decommissioning of light-water reactors is discussed. Equipment modifications, construction techniques, or design changes which will improve safety or reduce costs are identified. Some of the facilitation methods mentioned are rather expensive per man-rem saved. Any method that reduces radiation dose during maintenance is likely to produce a larger total dose reduction during maintenance than during decommissioning since the opportunity for dose reduction in maintenance is much greater than in decommissioning. Similarly, any method that results in less outage time for maintenance also results in an overwhelming cost savings (approximately $400, 000/day) if replacement power must be purchased at wholesale rates. Facilitation alternatives and their associated costs and radiation dose reductions are summarized in a table. (CAJ)

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Murphy, E.S., and G.M. Holter, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Low-Level Waste Burial Ground: Appendices

NUREG/CR-0570 (Vol. 2); 246 pp. (1980, June)

To provide more detailed information and descriptions of the individual aspects of this study, nine appendices with accompanying figures, tables, and references are included in this volume. Supporting material necessary to evaluate the radiological safety impacts of decommissioning activities at the reference low-level waste (LLW) site such as the location or the maximum-exposed in individual relation to the reference site, parameters used for the calculation of radiation doses from the consumption of foods grown on a decommissioned site, and demographic characteristics of the site are presented in appendix A. In appendix B waste inventory data for existing commerical sites are summarized, the bases for the inventory are discussed, and the method used to calculate the inventory at burial ground closure is described. Assumptions, models, and parameter values used to support the dose calculations are detailed in appendix C; in turn these calculated doses are used in the analysis of release conditions for the LLW site and to estimate safety impacts. Appendix D provides the details of the environmental surveillance and records maintenance activities. Payment schedules for each of the three financing approaches required to pay for site stabilization and long-term care of the burial ground are illustrated in appendix E. Appendices F and G contain detailed descriptions of site/waste stabilization and relocation methods and procedures, respectively, while appendix H details cost estimates for these options. The final appendix I presents the information required to quantify the public and occupational safety impacts of decommissioning a LLW burial ground; public doses from airborne releases of radioactivity, occupational dose calculations, estimated radiation doses to the public and to transportation workers from relocation activities, and radioactive waste inventories on which calculations are based are all included in this appendix. (RHB)

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Murphy, E.S., and G.M. Holter, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Low-Level Waste Burial Ground: Main Report

NUREG/CR-0570 (Vol. 1); 413 pp. (1980, June)

Two generic burial grounds, one chosen to typify the climate, geology, and hydrology of an actual western burial site and the other to typify characteristics of an eastern site, are used as reference facilities for this study. Each reference burial ground occupies about 70 hectares and includes 180 trenches filled with a total of 1.5 million cu m of radioactive waste. The waste consists of 60% (by volume) nuclear fuel-cycle waste with an average of about 15 Ci/cu m and 40% non-fuel-cycle waste with an average activity of about 0.1 Ci/cu m. In addition, there are 10 slit trenches containing about 1,500 cu m of high beta-gamma activity waste. A methodology, based on the concept of an allowable annual dose to a maximum-exposed individual, is demonstrated for release conditions at a low-level waste (LLW) burial ground after operations cease. Release conditions for a LLW burial ground where a subsurface radioactive inventory

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remains may include the following: a combination of waste relocation requirements; site/waste stabilization procedures; institutional controls, and property-use restrictions for the general public. The basic decommissioning options considered in the study are site/waste stabilization followed by long-term care of the site, and waste relocation. Three stabilization plans, corresponding to varying levels of effort that may be required to properly stabilize a site, are evaluated for each reference site. Site stabilization is estimated to require from 10 to 36 wks to complete, with calculated expenditures of 7.7-39.8 man-yr of effort and total decommissioning costs of from $0.5 million to $7.7 million in 1978 dollars. The total accumulated occupational radiation dose for normal site stabilization activities is estimated to be between 0.1 and 2 man-rem. The three waste relocation options considered in this study ar relocation of the waste from a slit trench, relocation of transuranic-contaminated waste from a section of burial trench, and relocation of all the waste from a single burial trench. The respective corresponding time and costs for each relocation option are 19-56 wks at $1.4-$3.2 million, 13-22 wks at $440,000-$910,000, and 25-34 wks at $0.7 million. The estimated cost of relocating the waste from an entire burial ground is $1.4 billion and would require 21 yr at the western site and 25 yr at the eastern site. In addition to time and cost considerations an analysis is made of the radiological consequences of postulated decommissioning accidents during stabilization and waste relocation operations. A wide spectrum of accidents is considered, with appropriate assumptions leading to calculated airborne releases of radioactivity and resulting radiation doses to the maximum-exposed individual. Three options to provide funds for decommissioning and long-term care of LLW burial grounds are also identified and evaluated. They include: payment of costs before site operations begin; payment during the operating lifetime of the burial ground; and payment when decommissioning costs are incurred. (RHB)

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Nemec, J.F., UNC Nuclear Industries, Inc., Richland, WA

Decommissioning of Nuclear Power Plants

Nuclear Power Waste Technology, Moghissi, A.A., H.W. Godbee, M.S. Ozker, and M.W. Carter (Eds.). The American Society of Mechanical Engineers, Ch. 8, (pp. 303-319) (1978)

The management of nuclear wastes has concentrated on wastes generated as a by-product of fuel cycle operations. As the nuclear industry matures obsolete facilities are being retired at an expanding rate. These retired facilities represent a major waste form which could place a significant burden on waste storage and burial facilities. Historically, the decommissioning of obsolete radioactive facilities has been accomplished in a variety of ways: some have been partially decontaminated and placed in lay-away under strict access and continued surveillance; a few have been entombed; others have been decontaminated and converted to beneficial uses; and some have been completely dismantled and their sites released for unconditional uses. This chapter presents state of the art information concerning final disposition of nuclear power reactor facilities. It describes past decommissioning experiences, proposed steps to achieve final disposition of a nuclear facility and a brief discussion of federal regulations. (Auth)(PTO)

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Oak, H.D., G.M. Holter, W.E. Kennedy, Jr., and G.J. Konzek, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station, Main Report

NUREG/CR-0672 (Vol. 1) (1980, June)

Safety and cost information is developed for the conceptual decommissioning of a large 1155-MW(e) boiling water reactor (BWR) power station. Three approaches (immediate dismantlement, entombment, and passive safe storage with deferred dismantlement) are studied to obtain comparisons between costs (in 1978 dollars), occupational radiation doses, potential radiation dose to the public, and other safety impacts. Dismantling the reference BWR immediately following shutdown is estimated to cost $43.6 million, to require about 2 yr for planning and preparation prior to final reactor shutdown and about 3.5 yr for active decommissioning following final reactor shutdown, and to result in radiation doses to decommissioning workers of about 1845 man-rem. Preparations for passive safe storage, safe storage for 30 yr, and deferred dismantlement after 30 yr are estimated to cost $58.8 million. An estimated 1.5 yr will be required for planning and preparation prior to shutdown and about 3 yr to place the facility in passive safe storage, resulting in an estimated radiation dose to workers of about 418 man-rem. Cost estimates for entombment are $40.6 million, and will require about 2 yr for planning and preparation prior to final reactor shutdown, 4 yr for active decommissioning following final reactor shutdown, and will result in radiation doses to workers of about 1684 man-rem. Cost estimates of continuing care during passive safe storage and entombment are $75,000 and $40,000/yr, respectively. Dismantling estimates after periods of safe storage are between $36 and $20 million, depending on the storage mode employed and the duration of the storage period, requiring a time span equivalent to immediate dismantlement, and resulting in radiation doses to workers ranging from about 495 man-rem for dismantlement after 10 yr of storage to a few man-rem after 50 yr of storage. Dose impacts on the public would be small, with the principal impact resulting from the transport of radioactive materials to a disposal site. (Auth)(CAJ)

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Oak, H.D., G.M. Holter, W.E. Kennedy, Jr., and G.J. Konzek, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station, Appendices

NUREG/CR-0672 (Vol. 2) (1980, June)

The fifteen appendices in this volume are entitled: Evaluations of Decommissioning Financing Alternatives; Reference Site Description; Reference BWR Facility Description; Radiation Dose Rate and Concrete Surface Contamination Data; Radionuclide Inventories Public Radiation Dose Models and Calculated Maximum Annual Doses; Decommissioning Methods; Generic Decommissioning Information; Immediate Dismantlement Details; Passive Safe Storage; Continuing Care; and Deferred Dismantlement Details; Entombment Details; Demolition and Site Restoration Details; Cost Estimating Bases; Public Radiological Safety Assessment Details; and Details of Alternate Study Bases. References are given after most appendices, and numerous tables summarize the information. (CAJ)

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Opelka, J.H., R.L. Mundis, G.J. Marmer, and J.M. Peterson, Argonne National Laboratory, Argonne, IL

Particle-Accelerator Decommissioning

ANL/ES-82; 129 pp. (1979, December)

Generic considerations involved in decommissioning particle accelerators are examined. There are presently several hundred accelerators operating in the United States that can produce material containing nonnegligible residual radioactivity. Residual radioactivity after final shutdown is generally short-lived induced activity and is localized in hot spots around the beam line. The decommissioning options addressed are mothballing, entombment, dismantlement with interim storage, and dismantlement with disposal. The recycle of components or entire accelerators following dismantlement is a definite possibility and has occurred in the past. Accelerator components can be recycled either immediately at accelerator shutdown or following a period of storage, depending on the nature of induced activation. Considerations of cost, radioactive waste, and radiological health are presented for four prototypic accelerators. Prototypes considered range from small accelerators having minimal amounts of radioactive material to a very large accelerator having massive components containing nonnegligible amounts of induced activation. Archival information on past decommissionings is presented, and recommendations concerning regulations and accelerator design that will aid in the decommissioning of an accelerator are given. (EDB)

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Ramsey, R.W., Jr., U.S. Department of Energy, Washington, DC

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

Implementation of DOE Remedial Action Programs

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (pp. 30-31), 52 pp. (1981, June)

The Department of Energy is conducting three programs of remedial action to control exposure from natural radioactivity in mill tailings or uranium processing. The formulation of the program and the administrative and physical arrangements for implementing remedial actions are described. Recent experience shows the importance of accurate field survey techniques to allow legal certification that stringent decontamination criteria have been met. (CAJ)

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Smith, R.I., Battelle Pacific Northwest Laboratories, Richland, WA

Safety and Costs Related to Decommissioning Light Water Reactors

Research Project; Contract No. B-2117

The objective of the program is to develop the technology, safety, and costs of decommissioning light water reactors. The study of pressurized water reactors has been completed. The study of a boiling water reactor and of a multiple reactor power station are underway. Studies of reactors which have experienced an accident and floating reactors have yet to be initiated. (SSIE)

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Smith, R.I., Battelle Pacific Northwest Laboratories, Richland, WA

Safety and Costs for Decommissioning Nuclear Fuel Cycle

Research Project; Contract No. B-2036

The objective of the program is to develop the technology, safety, and costs of decommissioning various nuclear fuel cycle facilities for light water reactors (exclusive of the reactors themselves and uranium mills) and of non-fuel cycle nuclear facilities. Individual studies of fuel reprocessing plants, small mixed oxide fuel fabrication plants, and low-level waste burial grounds have been completed. Other studies of uranium fuel fabrication and of non-fuel cycle nuclear facilities are underway. Yet to be started is a study of a uranium fluoride conversion plant. (SSIE)

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Teknekron Research Inc., McLean, VA

Decontamination and Decommissioning

DOE/EP-0029; Environmental Readiness Document Advanced Isotope Separation Program, (pp. 24-25), 51 pp. (1981, August)

Recent conceptual studies reviewing the technology, safety, and costs of decommissioning various nuclear facilities have concluded that current technology is adequate for safely handling retired facilities. Further refinements will lower costs and reduce radiation exposures. No major environmental problems are expected as a result of D&D operations for facilities using UF6 or uranium metal. The routine release of radioactive material during D&D should be even less than routine releases during normal facility operations. By comparison, D&D Advanced Isotope Separation Program (AIS) facilities appear to have several advantages over gaseous diffusion and centrifuge enrichment. Less equipment will require decommissioning, and the contamination levels in an AIS facility at the time of decommissioning are expected to be lower than those in a diffusion plant. Candidate decontamination techniques are described and briefly discussed. (CAJ)

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U.S. Congress, House of Representatives, Washington, DC

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Decommissioning and Decontamination of Nuclear Facilities

Report Prepared for the Subcommittee on the Environment and the Atmosphere of the Committee on Science and Technology; 19 pp. (1978)

This Committee Print is based upon hearings held before the Subcommittee on the Environment and the Atmosphere on decommissioning, decontamination, and nuclear waste disposal problems associated specifically with a nuclear fuel reprocessing plant at West Valley, N.Y., and generically with all types of nuclear facilities. The report stresses the importance of further research into the following questions about decommissioning and decontamination: what technical options are available, who will pay the cost, how they will be financed, and who is institutionally responsible for seeing that the job is properly done. Thus, it serves to recapitulate the need for two studies, one on West Valley alternatives and the other on various aspects of decommissioning and decontaminating nuclear facilities, which are authorized by S. 1811, the fiscal year 1978 ERDA Authorization Act. The report is written in four chapters, with chapter I containing introductory information concerning the subject of decontamination and decommissioning of nuclear facilities, relevant legislation, and the structure and purpose of the hearings. What follows is a more detailed discussion of the waste disposal and related problems at West Valley, N.Y. (ch. II), and of the generic study of decommissioning and decontamination of nuclear fuel elements (ch. III). Included within these two chapters are brief summaries of the major concerns of the witnesses; the hearings are to be published in full elsewhere. Chapter IV contains the committee's findings and recommendations based on the hearings. (EDB)

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U.S. Congress, House of Representatives, Washington, DC

Decommissioning and Decontamination

Hearing Before the Subcommittee on the Environment and Atmosphere of the Committee on Science and Technology, 95th Congress, 1st Session, June 15-16, 1977, No. 20 (1977)

Hearings on the issues and problems associated with the decommissioning and decontamination of nuclear facilities and disposing of nuclear wastes are presented. The House approved the appropriation of an additional $2 million for ERDA's decommissioning and decontamination program, half of which is to be used for a general study of the consequences of decommissioning, disposal, and decontamination of elements in the nuclear fuel cycle. The remaining $1 million is to fund a study of the options for waste disposal at the Nuclear Fuel Services commercial reprocessing plant at West Valley, N.Y. The June 15th hearing focused on the West Valley plant, which operated from 1966 until 1972. The 600,000 gallons of liquid high-level radioactive waste, which will transfer to New York State, are stored in carbon steel tanks that will eventually corrode. The waste disposal problems at West Valley closely resemble those of the nuclear weapons program. In fact, 60 percent of the spent fuel originally came from military reactors because, at the time, the Atomic Energy Commission sought to encourage a commercial reprocessing industry by guaranteeing a market. The June 16th hearing concentrated on generic environmental, health, safety, and economic issues associated with decommissioning other nuclear facilities, such as reactors. The hearing will examine not only the various alternatives and costs, but also the institutional mechanisms for handling, regulating, and financing the operation. Congressman Lundine, who represents the district which includes West Valley, appeared on June 16th to relate the concerns of this constitutents on the future disposition of this facility. (EDB)

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U.S. Department of Energy, Office of Nuclear Waste Management, Washington, DC

The United States Department of Energy Remedial Action Programs

Booklet; 22 pp. (1980)

This is a colorful public information booklet describing the Remedial Action Program, its history, and its four subprograms (Grand Junction, Uranium Mill Tailings, Formerly Utilized MED/AEC Sites, and Surplus Facilities Management). Maps show locations of DOE disposal sites and contaminated surplus facilities. Pictures and reference are included. (CAJ)

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U.S. Department of Energy, Surplus Facilities Management Program Office, Richland, WA

Decommissioning - The Problem - The Solution

Brochure; 4 pp. (1981)

This pamphlet describes the Surplus Facilities Management Program and is a brief public information bulletin that answers some commonly asked questions pertaining to nuclear facility decommissioning. (CAJ)(PTO)

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U.S. Department of Energy, Washington, DC

Management of Surplus Radioactively Contaminated Department of Energy Facilities

DOE/EV-0128; Division of Environmental Control Technology Program - 1979, (pp. 139-170) (1980, June)

This section focuses on the safe management and disposition of the Department of Energy facilities that are radioactively contaminated. There are currently more than 460 of these facilities, including cribs, ponds, trenches, buildings, and reactors, more than 80 percent of which are located at Hanford, Washington. The overall plan for the management of surplus contaminated facilities owned by the department continues to be based on the long-term objective of eliminating potential hazards and reducing the need for perpetual surveillance and maintenance. Activities within the program include: (1) providing surveillance and maintenance to ensure that surplus facilities remain in an environmentally safe condition; (2) developing improved techniques for the safe and economic decontamination and disposition of radioactive facilities, equipment, materials, and land; (3) developing plans, priorities, costs, and schedules for disposition projects; and (4) implementing projects leading to improved safety, elimination of the expense of continuing surveillance and maintenance, and restoration of needed facilities or land areas without radiological restriction. (EDB)(PTO)

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U.S. Department of Energy, Washington, DC

Decontamination and Decommissioning

DOE/EV-0128; Division of Environmental Control Technology Program - 1979, (pp. 135-137) (1980, June)

Decontamination and decommissioning activities were organized into four major program areas: decontamination of surplus radioactively contaminated Department of Energy facilities; remedial action for inactive uranium mill tailings sites; Grand Junction offsite remedial action program; and remedial action at formerly utilized Manhattan Engineer District and Atomic Energy Commission contractor sites. (EDB)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - December 1981 - Commercial Program

UNC/OSFM-82-3a; 33 pp. (1981, December)

Highlights from the progress reported by the area offices for commercial program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - Installation of a sheet metal wall to enclose the area vacated by removal of the gloveboxes in the PP-C3 Laboratory has been completed. This completes the glovebox removal phase in PP-C3; (2) Idaho - Monticello Site Remedial Action - Alternate project scenarios reflecting the FY 1982 SFMP budget allocation have been prepared and submitted to SFMPO. One scenario, recently approved by Grand Junction Area Office (GJAO), was to acquire additional FY 1982 funding from the Uranium Resource Assessment Program (URAP) to proceed with site analysis activities; (3) Oak Ridge - ORNL Surplus Facilities Surveillance (Commercial) - The excavations that exposed the abandoned sections of the ILW Transfer Line were filled and the terrain returned to normal grade. The ILW Transfer Line will revert to a surveillance mode until further remedial action activities can be supported; (b) CEER Reactor Decommissioning - Lack of DOE-HQ decision regarding a waste disposal site for CEER wastes is delaying waste shipments; (c) Niagara Falls Storage Site (NFSS) Remedial Action - Funding uncertainties will delay some aspects of planning and execution of FY 1982 activities if not resolved in the near future; (4) Richland - (a) Shippingport Station Decommissioning Project (SSDP) - Planned shutdown of the Shippingport Atomic Power Station has been changed from January, 1985 to October 1, 1982. (b) Program Administration (Commercial) - Preparation of the FY 1982-86 Program Plan, originally scheduled for distribution by the end of December, 1981 still continues. Significant portions of the document cannot be finalized until the FY 1982-86 budget planning levels are established (i.e., Niagara Falls Storage Site and Weldon Spring Site status); and (5) San Francisco - Advanced Fuels Laboratory (AFL) Decommissioning - Fiberglass coating and lid sealing of shipping containers continues to be a major problem. To date only 28 of the 37 required shipping containers have been received from the vendor, and only six lid seals have been completed. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - December 1981 - Defense Program

UNC/OSFM-82-15a; 20 pp. (1981, December)

Highlights from the progress reported for the defense program reported by the area offices include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Construction of the roof duct size-reduction facility on the penthouse is approximately 50 percent complete: (2) Oak Ridge - Curium Facility Decommissioning - Progress continues to be made in reducing smearable contamination levels in the water shielded cells; and (3) Richland - Surveillance of Hanford 200 Areas - The main exhaust fan at the Strontium Semiworks Facility (201-C) was repaired. Planned work includes: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - The filtration system repair will be completed, weather permitting. Interior contamination control (caulking) will continue, weather permitting; (2) Idaho - INEL Surplus Defense Facilities - DOE-ID and EG&G are currently evaluating alternative remedial actions for the PM-2A facility. Resolution of this matter is expected during January 1982; and (3) Oak Ridge - ORNL Surplus Defense Facilities - Transfer of four ORNL facilities, currently in the SFMP Commercial Program, to the SFMP defense program is under consideration at DOE-HQ. These four facilities are: (a) Fission Products Development Laboratory (FPDL), (b) Old Hydrofracture Facility; (c) Waste Holding Basin, Site 3513; and (d) ILW Transfer Line. Official guidnce in this matter is expected during January 1982. (PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - January 1982 - Defense Program

UNC/OSFM-82-16a; 29 pp. (1982, January)

Highlights of the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Construction of the roof duct size-reduction facility on the penthouse is approximately 75 percent complete; (2) Idaho - INEL Defense Facilities - The final draft of the INEL Long Range Decommissioning Plan was published and transmitted to DOE-ID for their review and

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approval; (3) Oak Ridge - Curium Facility Decommissioning - Progress continues to be made in reducing smearable contamination levels in the water shielded cells. Work will continue at a reduced level of effort pending clarification of FY 1982 funding availability; (4) Richland - Program Administration (Defense) - A draft of the SFMP Cost Efficiency Study was completed and sent to DOE-RL for review and comment. Planned Work for defense programs include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - The filtration system repair will be completed, weather permitting; (2) Idaho - INEL Surplus Defense Facilities - DOE-ID and EG&G are currently evaluating alternative remedial actions for the PM-2A facility. Resolution of this matter is expected in the near future; and (3) Oak Ridge - ORNL Surplus Defense Facilities - Transfer of four ORNL facilities from the SFMP Commercial Program to the SFMP defense program is under consideration at DOE-HQ. These four facilities are: (1) Fission Products Development Laboratory (FPDL); (2) Old Hydrofracture Facility; (3) Waste Holding Basin, Site 3513; and (4) ILW Transfer Line. Official guidance in this matter is expected in the near future. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - February 1982 - Defense Program

UNC/OSFM-82-17a; 30 pp. (1982, February)

Highlights of the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - A contamination profile of the facility was completed. Construction of the roof duct size reduction facility on the SMA penthouse is approximately ninety percent complete; (2) Idaho - INEL Defense Facilities - The IET valve pit characterization report was completed and transmitted to DOE-ID for review and approval. The PM-2A decommissioning plan was revised to reflect the recommended cleanup and stabilization action for the facility. Planning and scheduling activities for this project were initiated; (3) Oak Ridge - Curium Facility Decommissioning - Decontamination of the water-shielded cells was completed to an acceptable level for cell modification work. Decontamination of the cell charging area continued with major portions of the area being decontaminated to smearable alpha levels of less than 5000 dpm. Alternate use of the Curium Facility is being investigated; and (4) Richland - Program Administration (Defense) - OSFM prepared field task/proposals for Hanford 100 Areas planning and surveillance tasks and OSFM administrative functions. Planned Work for the defense programs include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Roof duct removal and interior contamination control activities will continue at the SM Building, weather permitting; (2) Chicago - New Brunswick Laboratory - An inspection of the site and sampling of the wells is scheduled for March, 1982, weather permitting; (3) Oak Ridge - Metal Recovery Facility - Fabrication of new hatch covers for Cell "A" will be completed; and (4) Richland - Program Administration (Defense) - The FY 1984 Defense Budget Plan will be prepared and issued. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - October 1981 - Defense Program

UNC/OSFM-82-13a; 21 pp. (1981, October)

Highlights of the progress reported by the area offices for defense program work include: (1) Albuquerque - Mound Facility (SM Building) - Repairs to the SM Building filtration system were initiated and all filters in the filter bank were replaced; (2) Idaho National Engineering Laboratory (INEL) Surveillance - Routine surveillance was performed and plans were made to initiate required repairs to two INEL facilities; and (3) Oak Ridge - Curium Facility Decommissioning - Decontamination of the water shielded cells continued using high pressure spraying and remote wiping of floor plans and walls. ORNL Defense Facilities Surveillance - Plans were developed to repair the roof over A-Cell of the Metal Recovery Facility. Planned work for defense programs includes: (1) Albuquerque - Mound Facility (SM Building) - The filtration system repairs will be completed. Interior contamination control activities (painting, caulking) will continue; (2) Chicago - New Brunswick Laboratory (NBL) - The site will be visited in November 1981 to inspect the I Building slab stabilization and the perimeter fence; (3) Idaho - Idaho National Engineering Laboratory (INEL) Surveillance - INEL surveillance activities will continue; and (4) Oak Ridge - Curium Facility Decommissioning - Decontamination activities in the four water-shielded cells will continue. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - November 1981 - Defense Program

UNC/OSFM-82-14a; 21 pp. (1981, November)

Highlights of the progress reported by the area offices for defense program work include: (1) Albuquerque - Mound Facility Special Metallurgical (SM) Building Surveillance - Interior contamination control activities (caulking) are ninety percent complete. Construction of a temporary facility for roof duct size reduction was initiated and is approximately 10 percent complete; (2) Chicago - New Brunswick Laboratory (NBL) Surveillance - The NBL site was visited November 13-14, 1981, and samples were taken from the ten monitoring wells; (3) Oak Ridge - Curium Facility Decommissioning - Significant progress is being made in reducing smearable contamination levels in the water shielded cells; and (4) Richland - Surveillance of Hanford 200 Areas - The main exhaust fan at the Strontium Semiworks Facility (201-C) failed and was shut down. The backup steam turbine exhaust fan is being used to provide ventilation pending repair of the main exhaust fan. Major problems encountered in defense program work include: (1) Oak Ridge - Curium Facility Decommissioning - Decontamination efforts in the water shielded cells will be terminated if additional funds cannot be provided by January 1982 to support this activity; and (2) Richland - Surveillance of Hanford 200 Areas - Failure of the main exhaust fan at the Strontium Semiworks leaves the facility with no backup ventilation system until the main exhaust fan is repaired. Cost to repair the main exhaust fan may impact other surveillance and maintenance activities due to budget constraints. Planned work for the defense programs includes: (1) Albuquerque - Mound Facility Special Metallurgical (SM) building Surveillance - The filtration system repair will be completed. Interior contamination control will continue; and (2) Richland - Surveillance of Hanford 200 Areas - The main exhaust fan at the Strontium Semiworks facility will be repaired. General - Maintenance and surveillance activities will continue. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - October 1981 - Commercial Program

UNC/OSFM-82-Ia; 34 pp. (1981, October)

Highlights of the progress reported by the area offices for commercial program work include: (1) Albuquerque - Inactive ANSPD Areas Decommissioning - Six gloveboxes in the PP-C3 and PP-F3 laboratories have been removed and packaged and glovebox shielding in the PP-F2 laboratory was removed and size reduced. Structural decontamination was initiated in the R-127 laboratory; (2) Chicago - Building 350 (Pu Gloveboxes) Decommissioning - Removal of equipment from glovebox PF-10A continued. Approximately 200 cubic feet of waste was removed from the glovebox; (3) Nevada - Nuclear Rocket Development Station Decommissioning - A detailed survey of the R-MAD Radioactive Waste Site, the Radioactive Storage Yard, and adjacent areas of the perimeter was completed and all packageable radioactive debris in these areas was collected and packaged for disposal; (4) Oak Ridge - ILW Transfer Line Remedial Action - Residual liquid in the ILW Line was sampled and is being analyzed; (5) Richland - Office of Surplus Facilities Management - Budget options for the FY 1982 and FY 1983 Commercial Program were developed for the SFMP. Budget cases were developed to optimize available funding while responding to identified needs; and (6) San Francisco - Sodium Reactor Experiment Facility Decommissioning - Decontamination of the soil and bedrock was completed and backfilling the excavation was initiated. Advanced Fuels Laboratory Decommissioning - Required Model 9136 shipping containers were fabricated and delivered to the vendor for fiberglass coating. One loan of Low Specific Activity (LSA) waste was shipped to Hanford Site for disposal. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - November 1981 - Commercial Program

UNC/OSFM-82-2a; 34 pp. (1981, November)

Highlights of the progress reported by the area offices for commercial program work include: (a) Albuquerque - Inactive ANSPD Areas Decommissioning - The last glovebox in the PP-F3 laboratory has been removed and packaged, completing the glovebox removal phase in PP-F3. The two Waste Transfer System (WTS) pipelines over the creek have been removed and the area stabilized, completing the WTS stabilization phase; (2) Oak Ridge - ILW Transfer Line Remedial Action - The exposed ILW pipeline sections on either side of the White Oak Creek have been stabilized and the sampling excavations are being backfilled and returned to the original contour until remedial action activities can be supported. CEER Reactor Decommissioning - The CEER decommissioning project is being held in abeyance pending DOE-HQ authorization of a waste disposal site; (3) Richland - Shippingport Station Decommissioning Project (SSDP) - The Draft Environmental Impact Statement (EIS) for SSDP was printed. Copies have been recieved by DOE-RL for distribution. As a result of a Change Control Board Meeting held November 9, 1981, contingency funds were authorized for a revision to the SSDP Engineering Project Plan. The revision was to include a major change in the technical approach. Additionally, the revision will include a change in the Shippingport Station shutdown date from January, 1985 to October, 1982, which could change the starting date for decommissioning activities. Program Administration - OSFM prepared presentation materials and coordinated the overall arrangements for the FY 1982 SFMP Budget and Program Planning Conference held at the Aladdin Hotel in Las Vegas, Nevada, November 17-19, 1981; and (4) San Francisco - Sodium Reactor Experiment Facility Decommissioning - Backfilling of the SRE excavation has been completed. A $12,000 savings was realized on the backfill material by arranging for supply and delivery of about 3,000 cubic yards of material from a nearby construction site. Advanced Fuels Laboratory Decommissioning - To date, a total of five gloveboxes have been removed from the laboratory and packaged for shipment. Lack of adequate vendor quality control during the shipping container fiberglass coating process has necessitated excessive use of General Electric quality control personnel. Some weight problems have resulted from the extensive container repairs required to meet Rockwell Hanford burial requirements. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - January 1982 - Commercial Program

UNC/OSFM-82-4a; 48 pp. (1982, January)

Highlights of the progress reported by the area offices for commercial programs include: (1) Albuquerque - Inactive ANSPD Areas Decommissioning - As a result of the FY 1982 budget reduction from earlier planned levels for ABSPD Areas disposition, scheduled milestones for the R Building have been slipped by six months and for the Waste Transfer System by nine months; (2) Chicago - Building 350 (Plutonium Gloveboxes) Decommissioning - As a result of underestimating the dismantling effort required on the PR-10A and PF-12 gloveboxes, the project has slipped somewhat behind schedule. Impacts

of this slippage on the final project completion date have not yet been determined; (3) Nevada - Nuclear Rocket Development Station (NRDS) Decommissioning - Consolidation of the contaminated soil in the R-MAD Radioactive Waste Site has been completed. A significant reduction in the total amount of soil removed, compared with previous estimates, was realized as a result of detailed area surveying and spot cleanup efforts during the consolidation work; (4) Oak Ridge - CEER Reactor Decommissioning - DOE-HQ guidance regarding a waste disposal site for CEER wastes has not yet been received, and the Request for Proposals for a decommissionig contractor has not been transmitted yet to prospective bidders by DOE-Oak Ridge Operations Office. Niagara Falls Storage Site (NFSS) Remedial Action - Funding uncertainties continue to delay some aspects of planning and execution of scheduled NFSS FY 1982 activities; (5) Richland - Program Administration (Commercial) - The FY 1984 SFMP Budget Call Letter was completed and transmitted to the participating DOE Field Offices. An overview presentation of the Surplus Facilities Management Program was given to the Deputy Assistant Secretary for Nuclear Waste Management and Fuel Cycle Programs in Richland, Washington, on January 25, 1982. A draft of the SFMP Cost Efficiency Study was completed and sent to DOE-RL for review and comment; and (6) San Francisco - Sodium Reactor Experiment Facility Decommissioning - The decontamination of Building 163 is complete. A final survey of the building is currently being conducted. Advanced Fuels Laboratory Decommissioning - Only four of the required thirty-seven fiberglass coated shipping containers remain to be delivered by the vendor; however, fiberglass coating and lid sealing continue to be major problems. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - March 1982 - Defense Program

UNC/OSFM-82-18a; 30 pp. (1982, March)

Highlights from the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Interior contamination control (painting) was started; prime coat application is 75 percent complete; (2) Chicago - New Brunswick Laboratory (NBL) Surveillance - Inspection of the site and sampling of the monitoring wells were completed in March. There were no signs of forced entry to the site. Wind-blown trash has accumulated along the fence line. This will be removed during the scheduled May 1982 inspection; (3) Oak Ridge - (a) Metal Recovery Facility (MRF) - New hatch covers were installed on "A" Cell at the Metal Recovery Facility; (b) Curium Facility Decommissioning - The Curium Facility charging area has been decontaminated to less than 5,000 d/m alpha smearable levels; (c) ILW Transfer Line - Analysis of the ILW Transfer Line piping samples indicated that the carbon steel portion of the line to be removed will require handling as TRU waste. The stainless steel portion will be handled as low-level waste. It is not anticipated that the additional waste handling will impact the estimated cost of the project; and (d) ORNL Surplus Defense Facilities - Four ORNL Commercial facilities have been reclassified to Defense and are included in this report. These facilities are: Fission Products Development Laboratory, Old Hydrofracture Facility, Waste Holding Basin 3515 and the ILW Transfer Line; (4) Richland - (a) 100 Areas Surveillance - The Redox crane was inspected and repaired to aid in investigation of a leak in the Redox "D" Cell. Cable and hook inspection and operational procedure update is required before the crane is fully operational. (b) Program Administration - OSFM prepared the FY 1984 Defense SFMP Budget Plan for DOE-RL transmittal to DOE Headquarters. Planned Work for the defense program includes: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Planned upgrade of the building exhaust system will be completed; (2) Chicago - New Brunswick Laboratory - The next site inspection is scheduled for May 1982; and (3) Richland - 100 Areas Surveillance - Roof repairs at the 100 D/DR Reactor Buildings will be initiated. Program Administration - The OSFM Midyear Review will be completed. Entry of basic program information into the Data Base (OSFM computer system) will be completed. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

Office of Surplus Facilities Management Monthly Progress Report - March 1982 - Commercial Program

UNC/OSFM-82-6a; 49 pp. (1982, March)

Highlights from the progress reported by the area offices for commercial program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The glovebox removal phase was completed in the PP-F2 Laboratory with the packaging of glovebox 501. Ten gloveboxes were removed and packaged from various PP Building common suppor laboratories and service rooms; (2) Chicago - Building 350 (Plutonium Gloveboxes) Decommissioning - Due to the underestimation of dismantling efforts for the PF-10A and PF-12 gloveboxes, scheduled work will be delayed at least until the end of FY 1982, and perhaps into the first Quarter of FY 1983. Forecast of the new completion date will be made as soon as possible; (3) Oak Ridge - ORNL Surplus Facilities Surveillance (Commercial) - The transfer of four ORNL facilities (FPDL, Old Hydrofracture Facility, Waste Holding Basin, and ILW Transfer Line) from the SFMP Commercial Program to the SFMP Defense Program was approved by DOE-HQ on March 12, 1982. Weldon Spring Site Surveillance - The DOE Action Memorandum reassigning WSS from the Defense to the Commercial Program was approved by DOE-HQ on March 12, 1982. - Niagara Falls Storage Site (NFSS) Remedial Action - The engineering work for stabilization of Buildings 413/414, the site surveying specifications and drawings, and the material testing bid package were completed during this report period. This completes all scheduled FY 1982 engineering work at NFSS. The DOE Action Memorandum reassigning NFSS from the Defense to the Commercial Program was approved by DOE-HQ on March 12, 1982; (4) Richland - Shippingport Station Decommissioning Project (SSDP) - The final SSDP Environmental Impact Statement (EIS), including response to public and agency comments, was approved by DOE-RL and sent to DOE-HQ for approval. The Updated SSDP Project Plan, incorporation the October 1982 plant shutdown date and the one-piece reactor vessel removal was submitted to DOE-RL and DOE-HQ for approval. Program Administration (Commercial) - The SFMP FY 1984 Commercial Waste Management Budget Plant was completed and submitted to DOE-RL for review and approval. A draft summary report of the responses to the International Decommissioning Technology Exchange Questionnaire was prepared and submitted to DOE-RL and DOE-HQ for review; and (5) San Francisco - Advanced Fuels Laboratory Decommissioning - Shipment of all ceramic gloveboxes from the AFL to Hanford for burial was completed. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - April 1982 - Defense Program

UNC/OSFM-82-19a; 36 pp. (1982, April)

Highlights from the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Surveillance - Duct removal was initiated and is 10 percent complete. Painting (contamination control) in the SM-10 contaminated area is 75 percent complete. Construction of the roof duct size reduction facility in the SMA penthouse is 90 percent complete; (2) Chicago - New Brunswick Laboratory (NBL) - Analysis of monitoring well samples continued and some limited analytical work was performed on the core samples obtained during monitoring well drilling in September 1981; (3) Idaho - INEL Defense Facilities - Completion of the updated INEL Long Range Decommissioning Plan (Milestone 4) was not met during April as scheduled. The revised PM-2A Liquid Waste Evaporator facility decommissioning plan was transmitted to DOE-ID for review and approval. Work procedures for PM-2A decommissioning were prepared and supplies and materials have been obtained in preparation for starting work; (4) Oak Ridge - Surveillance and Maintenance - A comprehensive report covering all aspects of the Metal Recovery Facility (MRF) Radiological Characterization is in early draft stage. Curium Facility - Decontamination efforts were begun on Cell 5 area (concrete shielded cell) to remove gross contamination from cell walls and floors. All surface areas in Cell 5 have been reduced to less than 20,000 dpm

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

smearable alpha contamination. ILW Transfer Line - Work scheduled for the remainder of FY 1982 under current funding involves completion of engineering for planned FY 1983 activities (removal of ILW pipeline sections from the White Oak Creek floodplain, and stabilization of two remote leak sites); (5) Richland - Surveillance of Hanford 100 Areas - Repairs were made to deteriorated and wind damaged access doors at 100 D/DR, H and F area buildings. The original doors wre worn and have become safety hazards; and Program Administration - Draft responses to the SFMP-participant Field Offices addressing their FY 1984 budget requests and the SFMP-supported funding levels were prepared and submitted to SFMPO for review. Analysis of the FY 1982 Midywar Review inputs from SFMP Field Offices was completed and recommendations provided to SFMPO. The first draft of the "Decommissioning Waste Container Directory" has been completed and distributed to DOE-RL for review. The directory is intended to serve as a comprehensive reference document covering the many types of containers which are or may be applicable to the packaging and shipment of decommissioning wastes. Additional sources are being pursued for information on other waste container designs and specifications. Responses have been received from approximately 300 individuals in 19 countries who are planning to attend the 1982 International Decommissioning Symposium to be held in Seattle, Washington, on October 10-14, 1982. The Technical Program Committee for the Symposium also held a paper review meeting for approximately 50 paper summaries submitted for consideration. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - April 1982 - Commercial Program

UNC/OSFM-82-7a; 50 pp. (1982, April)

Highlights from the progress report by the area offices for commercial program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The "Coordinated ANSPD NEW/OMA Program Plan update", reflecting project status and schedule changes, was completed. The Mound ATMX 610 rail car damaged at INEL in February has been repaired and subsequently returned to service; (2) Chicago - Building 350 (Plutonium Gloveboxes) Decommissioning - Dismantling efforts required for PF-10A and PF-12 gloveboxes were underestimated. It now appears that glovebox removal will not be completed by the end of FY 1982 as scheduled. Options for completing the project within the FY 1982 timeframe are being investigated; (3) Idaho - INEL Surplus Facilities Surveillance (Commercial) - Completion of the Updated INEL Long Range Decommissioning Plan was not accomplished during April as scheduled. The plan is currently under review by DOE-ID. A new publication date will be established when DOE-ID comments are received; (4) Oak Ridge - Weldon Spring Site Surveillance - As an apparent result of the heavy rains this year in the St. Louis area, extensive sloughing has been experienced along the west side of the Raffinate Pit No. 4 berm. Although there appears to be no immediate threat of failure of the berm and subsequent spread of contamination from the pit, hydrological analyses are being conducted to define the extent of the problem: CEER Reactor Decommissioning - Criteria were established for the shipment of CEER wastes to Oak Ridge National Laboratory (ORNL) for disposal. Niagara Falls Storage Site (NFSS) Remedial Action - In support of the NFSS Phase 1 goal of gaining radiological control of the NFSS site, design work was initiated for the central ditch onsite (and west ditch offsite) cleanup effort; (5) Richland - Program Administration (Commercial) - Draft responses to SFMP Field Offices addressing the FY 1984 budget submittal to DOE-HQ were prepared and submitted to SFMPO for review. Analysis of the FY 1982 Midyear Review inputs from SFMP Field Offices was completed and recommendations provided to SFMPO. Responses have been received from approximately 300 individuals in 19 countries who are planning to attend the 1982 International Decommissioning Symposium to be held in Seattle, Washington, on October 10-14, 1982. A presentation on the SSDP was made by the Manager, OSFM Engineering, to representatives of the Office of Project and Facilities Management (DOE-HQ) on April 21, 1982. The presentation included status of the SSDP to-date, justification for the proposed funding in FY 1984, an overview of the new SSDP baseline, and a summary of probable impacts should receipt of planned FY 1984 funding be delayed; and (6) San Francisco - Sodium Reactor Experiment Facility Decommissioning - Decontamination of the SRE highbay was completed. A radiological survey of the sandblasted areas is currently being conducted. Excavation of the SRE change room drains and 1000 gallon holdup tank was completed. A radiological survey of the excavation found the area clean. The excavation was subsequently backfilled. The certification survey of Building 003 by the Argonne National Laboratory survey team was completed. The building was found cleaned to acceptable release limits. Advanced Fuels Laboratory Decommissioning - Removal of security equipment from the AFL was completed. This completes project milestone No. 7, Removal of security equipment. Waste shipments recently sent to Hanford included all miscellaneous gloveboxes from the AFL. This completes project milestone No. 2, Shipment of miscellaneous gloveboxes. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report - February 1982 - Commercial Program

UNC/OSFM-82-5a; 48 pp. (1982, February)

Highlights of the progress reported by the area offices for commercial program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - Mound's AMTX 610 rail car incurred minor damage (not the contents) in an accident at INEL and may require several months for repair. Alternatives for shipping Mound's oversized TRU waste containers in the interim are being evaluated. The potential for a schedule delay is currently being assessed by Monsanto Research Corporation and DOE-DAO; (2) Nevada - Nuclear Rocket Development Station (NRDS) Decommissioning - Following satisfactory post cleanup soil sampling analysis, clean fill was trucked to the R-MAD Radioactive Waste Site to establish new cover for the decontaminated area. This completes the cleanup of the R-MAD Radioactive Waste Site one month ahead of schedule; (3) Oak Ridge - CEER Reactor Decommissioning - The Request for Proposal (RFP) for removal of the underground waste handling systems and reactor pool decommissioning was issued by DOE-OR for contract bids on February 23, 1982; Niagara Falls Storage Site (NFSS) Remedial Action - Engineering work on the NFSS R-10 decontamination pad and spoils impoundment facility have been completed. A draft NFSS Long Range Planning Study (Phase I) was issued by Bechtel for review and comment; and (4) San Francisco - Sodium Reactor Experiment Facility Decommissioning - The decontamination of Building 163 has been completed. The final survey of the building indicates the facility is acceptable for unrestricted future use. (Auth)(PTO)

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UNC Nuclear Industries, Inc., Richland, WA; Kaiser Engineers, Richland, WA

Decommissioning Services for Radioactive Facilities

Brochure; 8 pp.

A description is presented of the decommissioning services offered by UNC/Kaiser Engineers. These services include: planning, engineering, construction, operation, decontamination, and decommissioning of nuclear facilities. (PTO)

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Voight, A.F., B.W. Link, R.G. Struss, M.D. Voss, J. Cummings, and H. Haugen, Ames Laboratory, Ames, IA

Final Report: Decommissioning of the Ames Laboratory Research Reactor

IS-4789 (1982, January)

Decommissioning of the Ames Laboratory Research Reactor was accomplished within the original budget authorization of $4.5 million. It is interesting that the cost of construction for the original building and the reactor plus all site work from 1961 to 1964 was very close to the cost of decommissioning the reactor and its systems but leaving the building intact during the period 1978 to 1981. Because of escalation, these costs cannot be

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compared directly. In 1961 dollars, the cost of decommissioning would be in the range of $1.5 million to $2 million. A delay of approximately seven months occurred in one task as a result of contractor's problems and an unforeseen error in as-built drawings. Change in DOE policy on waste disposal caused a delay of about one month. With these exceptions, the original schedule was followed fairly closely. Completion was six to nine months later than scheduled, but preparation of the final report was not delayed as much. The decision to proceed with decommissioning immediately after shut-down seems to have been correct. Although this action resulted in funding on an annual rather than a continuing basis, the original staff was intact to begin the work immediately. With any lengthy postponement, the staff would have dispersed, and it probably would have been necessary to bring in more contract workers with much less knowledge of the system to be removed, in all likelihood at a greater cost. Also, the rate of inflation during the years of decommissioning has been unusually high. Although this was not predictable, if the work had been postponed, the total cost would have been considerably greater. (Auth)(PTO)

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Wittenbrock, N.G., Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning Nuclear Reactors at Multiple-Reactor Stations

NUREG/CR-1755; 342 pp. (1982, January)

Safety and cost information is developed for the conceptual decommissioning of large (1175-MWe) pressurized water reactors (PWRs) and large (1155-MWe) boiling water reactors (BWRs) at multiple-reactor stations. Three decommissioning alternatives are studied: DECON (immediate decontamination), SAFSTOR (safe storage followed by deferred decontamination), and ENTOMB (entombment). Safety and costs of decommissioning are estimated by determining the impact of probable features of multiple-reactor-station operation that are considered to be unavailable at a single-reactor station, and applying these estimated impacts to the decommissioning costs and radiation doses estimated in previous PWR and BWR decommissioning studies. The multiple-reactor-station features analyzed are: the use of interim onsite nuclear waste storage with later removal to an offsite nuclear waste disposal facility; the use of permanent onsite nuclear waste disposal, the dedication of the site to nuclear power generation, and the provision of centralized services. Five scenarios for decommissioning reactors at a multiple-reactor station are investigated. The number of reactors on a site is assumed to be either four or ten; nuclear waste disposal is varied between immediate offsite disposal, interim onsite storage, and immediate onsite disposal. It is assumed that the decommissioned reactors are not replaced in one scenario but are replaced in the other scenarios. Centralized service facilities are provided in two scenarios but are not provided in the other three. Decommissioning of a PWR or a BWR at a multiple-reactor station probably will be less costly and result in lower radiation doses than decommissioning an identical reactor at a single-reactor station. Regardless of whether the light water reactor being decommissioned is at a single- or multiple-reactor station: (1) the estimated occupational radiation dose for decommissioning an LWR is lowest for SAFSTOR and highest for DECON; (2) the estimated cost of decommissioning a PWR is lowest for ENTOMB and highest for SAFSTOR; and (3) the estimated cost of decommissioning a BWR is lowest for DECON and highest for SAFSTOR. In all cases, SAFSTOR has the lowest occupational radiation dose and the highest cost. (Auth)(PTO)

Chapter 2

NUCLEAR FACILITIES DECOMMISSIONING

- Design, Planning, and Regulations
- Site Surveys
- Decontamination Studies
- Dismantlement and Demolition
- Land Decontamination and Reclamation
- Waste Disposal
- General Studies

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Auler, I., R. Bardtenschlager, A. Gasch, and N. Majohr, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany

Safety Problems in Decommissioning Nuclear Power Plants

NIS-197; 109 pp. (1975, December)

The safety problems encountered in the decommissioning of reactors are illustrated by the example of a LWR with 1300 MW electric power after 40 years of specified normal operation. For such a facility the radioactivity in the form of activation and contamination one year after being finally taken out of service is in the order of magnitude of 10 million curies, not counting the fuel assemblies. The dose rates occurring during work on the reactor vessel at nozzle level may amount to 10,000 rem/hr. A rough estimation of the accumulated dose for the decommissioning personnel during total dismantling is about 1200 rem. During the performance of the decommissioning activities most problems are caused by direct radiation of the active components and systems and by the release of radioactive particles, aerosols and liquids if these components are crushed. The extent of later dismantling problems may be reduced by selecting appropriate materials, as well as considering the requirements for dismantling in design and arrangement of the components already in the design stage of new facilities. Apart from plant design, the concept for the disposal of the radioactive waste from decomissioning will provide important boundary conditions, (e.g. the maximum size of the pieces to be stored in the ultimate storage place will very much influence the dose expenditure for handling these parts). For complete dismantling of nuclear power plants, final storage sites must be available where large amounts of bulky decommissioning waste, containing relatively low activity, can be stored. The problems and also the cost for decommissioning may be considerably reduced by delaying complete disposal of the radioactive material for more than 40 years, keeping the radioactivity enclosed within the plant safely contained. (EDB)(PTO)

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Auler, I., and W. Buschmann, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany; Deutsche Gesellschaft fur Wiederaufarbeitung von Kernbrennstoffen, Hannover, Federal Republic of Germany

Comparison of the Main Parameters of Decommissioning Nuclear Power Plants and Reprocessing Facilities

Atomkernenergie Kerntechnik 39(2):103-104 (1981)

The decommissioning of nuclear power plants as well as the decommissioning of reprocessing plants are of interest. A comparison of the decommissioning expenditures is made. Reprocessing plants can be decommissioned utilizing previous experiences. The decommissioning expenditures will be lower for reprocessing plants than for nuclear power plants. (Auth)(PTO)

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Auler, I., D. Eder, and A. Gasch, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany; Bundeministerium fuer Forschung und Technologie, Bonn-Bad Godesberg, Federal Republic of Germany

Analysis of the Consequence of Serious Accidents on the Decommissioning of Nuclear Power Plants

NIS-203; 111 pp. (1976)

Two hypothetical accidents characterized by a double-ended-rupture of a main cooling loop are considered for a 1200 MWe PWR reference plant. As a result of damage to the reactor core, it is assumed that 100% of the fuel cladding will burst. Additionally, it is assumed in a second case that 10% of the fuel will be

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molten. The fission products, fissile materials and activated materials released into the containment are investigated and analyzed according to radiological criteria. The dominant nuclides are Cs-137 Ba-137m, Sr-90 Y-90 and Cs-134. Within the first 100 years the activity of these nuclides will decrease to 10% of its value one year after the accident. Using simplified distribution models some limits are estimated for the concentration of the activity on the surfaces within the containment as well as in the sump water. The resulting average dose rates are in the order of magnitude of some 100 rem/hr. Areas with these dose rates are not accessible without dose rate reducing methods. (EDB)(PTO)

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Auler, I., J. Essmann, G. Kukacs, and G.V.P. Watzel, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany

Anticipated Costs in the Shut-Down of Nuclear Power Plants with Light Water Reactors

Jahrestagung Kerntechnik '81 (Nuclear Technology '81), Proceedings of a Conference, Dusseldorf, Federal Republic of Germany, March 24-26, 1981. Deutsches Atomform E.V., Bonn, Federal Republic of Germany, (pp. 517-520), 628 pp. (1981)

Costs are estimated for the shut-down and demolition of light water reactor nuclear power plants, with particular emphasis on the Biblis (pressurized water) and Brunsbuttel (boiling water) type reactors. The main alternatives considered are shut-down and decontamination for safe storage and site monitoring, or complete demolition and removal. In the case of Biblio 'A' reactor, the total cost is 207 million DM, which includes costs for planning, administration, radiation monitoring, decontamination, nuclear component dismantling, packing, transport, conventional demolition and security. (INSPEC)(RHB)

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Ausmus, B.S., Battelle Columbus Laboratories, Columbus, OH

Ecosystems Analysis Methods Applied to the Assessment of Abandoned or Inactive Sites

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (pp. 108-109); Transactions of the American Nuclear Society 34:108-109 (1980, June)

A qualitative and quantitative assessment of ecosystem structure is necessary to evaluate alternative decontamination options. Newer methods of analysis are based on the loss rate of essential elements in terrestrial ecosystems. Mathematical methods can also be used to project doses, biotic accumulation, transport of nuclides, and estimates of potential occupational and public exposure in alternative scenarios. Methods that have recently been used include multivariate techniques and time series or spectral analysis. Ecosystems analysis techniques coupled to state-of-the-art assessment methods will allow increased information for planning decontamination or remedial action techniques. (CAJ)

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Birkhold, U., W. Stasch, H. Lettnin, J. Obst, W. Zimmermann, and R. Stang, Obering. Jurgen Obst, Wurzburg, Federal Republic of Germany, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany; Gesellschaft fur Kernenergie in Schiffba Schiffbau und Schiffahrt, Geesthacht. Federal Republic of Germany; Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany; Kraftwerk Union AG, Offenbach, Federal Republic of Germany

The Total Decommissioning of Nuclear Facilities

Atomkernenergie Kerntechnik 39(2):87-99 (1981)

The following nuclear facilities in the Federal Republic of Germany are now ready for total decommissioning: the power plant, Niederaichbach (KKN); the nuclear ship, "Otto Hahn"; and the research reactor FR2. Planning work on KKN commenced in 1979 and the approval procedure was begun in early 1980 when the approval contract was submitted. The contract for decommissioning the nuclear facilities on the "Otto Hahn" was awarded in early 1980. Approval was received in December 1980, and work was begun on decommissioning. The FR2 is still in operation and will be shut down at the end of 1981. Planning for decomissioning the nuclear plant began at the end of 1980. The plans and the methods which are intended to be used to decommission the three plants are described. (Auth)

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Brosche, D., and J. Essmann, Bayernwerk AG, Muenchen, Federal Republic of Germany; Preussische Elektrizataets AG, Hannover, Federal Republic of Germany

Decommissioning Aspects of Nuclear Power Plants

VGB Kraftwerkstech 57(9):598-603 (1977, September)

The operational requirements for nuclear power plants, especially those set up for in-service inspections, maintenance and repair with respect to accessibility and radiological protection can be used to advantage in decommissioning these facilities. The requirements of criterion 2.10 (of the 'Safety Criteria for Nuclear Power Plants' published by the German Federal Ministry of the Interior) can be met according to the plant owners without changing the station's design concept before construction of the plants. (EDB)(PTO)

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Brosche, D., and J. Essmann, Bayernwerk AG, Muenchen, Federal Republic of Germany; Preussische Elektrizataets AG, Hannover, Federal Republic of Germany

Shutdown of Nuclear Power Stations

Atom und Strom 22(3):81-87 (1976, May)

The federal government requires in the safety criteria the proof that it is possible to shut down nuclear power stations safely. The authors report on an investigation made by the VDEW (Association of German Power Stations) which shows that at the end of their operating life, nuclear power stations can be shut down with reasonable technical outlay. (EDB)(PTO)

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Commission of the European Communities, Luxembourg

Decommissioning of Nuclear Power Plants Involving Light-Water Reactors

EUR-5728; 116 pp. (1977)

The technical and economical aspects arising in turning off LWR nuclear power plants of 900-1300 MW are dealt with, account being taken of the differences between BWR and PWR type reactors. The possible decommissioning proposals, and the disposal or confinement of radioactivity are discussed. It is shown that decommissioning and even total dismantling of these nuclear power plants is feasible. The activity inventory, one year after shutdown is estimated to be about 30 million curies for the BWR and 4 million curies for the PWR; 40 years after shutdown the figures are reduced to 2 million and 400,000 curies respectively. The decommissioning costs to be expected are also estimated. These estimates are taken as a basis for an economic comparison by the "present worths" method. It appears that a total dismantling after a cooling time of one year is more than four times as expensive as an interim confinement followed by the total dismantling after a waiting period of 40 years. The "present worths" for an immediate dismantling are estimated to be 200 million DM for the BWR and 170 million DM for the PWR. In the other proposal, they are 45 million DM for the BWR and 42 million DM for the PWR. A question still unanswered is

posed by the final storage of the large amount of bulky radioactive waste arising from either partial or total dismantling. Since no decision has yet been made concerning the storage method, disposal in casks is stipulated as a limiting condition for cost estimation (although an unrealistic assumption). The cost for disposal is then presupposed to be reduced when a more appropriate final storage is achieved. (GRA)(PTO)

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Decommissioning as Magnox Nears Its End

Nuclear Engineering International 25(295):60 (1980, February)

To dismantle and remove the 26 Magnox reactors now in operation at 11 sites and all the UKAEA reactors in Great Britain will present a major waste disposal task. As an example of the magnitude of the problem, the Windscale AGR pressure vessel and internals are estimated to have a total activity two years after shut-down of about 150 kCi, decaying mainly through iron-55, cobalt-60, and nickel-63 to about 4 kCi after 40 years and about 2 kCi after 100 years. A table gives estimates of the tonnage of the major materials of construction excluding external ancillary plant. Future designs and selection of materials for reactors and plant should take into account their eventual decommissioning and the benefit of prolonging their lives, thereby reducing the overall decommissioning waste generation. (CAJ)(JMF)

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Decommissioning Nuclear Power Stations

Atom 262:222 (1978, June 12)

This article consists of questions addressed to, and answered by the British Secretary of State for Energy. The questions concerned the following: (1) studies or research being done on decontamination during decommissioning of a nuclear power station; (2) features of nuclear power plant design built in to facilitate eventual decommissioning; (3) estimates made of quantities of waste arising from decommissioning of a Magnox or advanced gas-cooled power station; and (4) trial techniques of dismantling for future power station decommissioning. (CAJ)

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Decommissioning of Nuclear Installations

Techniques de l'Energie 38:73-75 (1980)

The technical means now exist for decommissioning nuclear installations in complete safety and under reasonable conditions. Moreover it is believed that when decommissioning operations become more commonplace, technologies in this field will have been perfected even further. Slight modifications in the design of nuclear installations are needed to simplify decommissioning operations. But even if decommissioning, including the demolition of installations, seems to pose no insoluble problems, theoretical and applied research is nevertheless necessary. (EDB)(PTO)

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Decommissioning Plans

Nuclear News 24(1):88-89 (1981, January)

At a meeting of the German Nuclear Society (KTG), held at Bensberg, it was announced that Germany is planning for the decommissioning of six nuclear facilities. The facilities are as follows: The 25-MWe BWR at Grosswelzheim; the 100-MWe gas-cooled, heavy-water-moderated plant at Niederaichbach (KNK); the 250-MWe power station at Lingen, which used an early design of BWR in combination with oil-fired steam superheating; the 240-MWe BWR at Gundremmingen; the nuclear ship "Otto Hahn"; and the 12-MWt heavy-water research reactor FR 2 at Karlsruhe. A special company, Nuklear-Ingenieur-Service

GmbH (NIS), has been established to undertake the decommissioning operations. On the basis of preparations for the six facilities listed, NIS has produced estimates for the complete removal of a 1300-MWe plant of current commercial design. These suggest a total cost of 200 million DM ($120 million), which amounts to around 2 to 3 percent of the total electricity production costs of the plant during its lifetime. (JMF)

245

Decommissioning the N.S. Otto Hahn

Atomwirtschaft Atomtechnik 25(11):556 (1980, November)

After more than ten years of troublefree operation the German commercial nuclear vessel N.S. Otto Hahn was decommissioned in February 1979 following the burnup of its second core. The ship was decommissioned because the scientific results expected from another four years of operation with a third core would no longer have justified the financial expenditure. The activated components of the reactor will now be dismantled and removed and the other systems decontaminated. (EDB)

246
Dozinel, P., Societe de Traction et d'Electricite, Brussels, Belgium

Decommissioning of Nuclear Power Plants - Technical and Economic Aspects

Bulletin, Societe Royale Belge des Electriciens 9(1):4-16 (1978)

The decommissioning of nuclear power plants presents legal, technical, economical, radiation protection and waste disposal problems, which can all be solved. In the special case of PWR reactors, different possible solutions (mothballing, entombment, dismantling) are considered. (EDB)(PTO)

247
Francioni, W., and G. Megaritis, Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland

Influence on Activation, Decay Behaviour and Amount of Radioactive Waste Due to Various Chemical Elements in the Structural Materials Surrounding the Reactor Core

CONF-800359; Decommissioning Requirements in the Design of Nuclear Facilities, Proceedings of a Nuclear Energy Agency Specialist Meeting, Paris, France, March 17-19, 1980, (pp. 135-149), 285 pp. (1980)

Due to the activation of structural materials surrounding the reactor core, one should avoid unnecessary production of long-lived radionuclides. This paper shows that for the construction of future nuclear power plants, the contents of Co, N2, Nb and Mo in the steel (reactor pressure vessel material and its internals) and of Eu, Ni, and Co in the concrete for the biological shield, should be kept as low as possible. (Auth)(PTO)

248
Francioni, W., G. Megaritis, and P. Koehler, Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland

Decommissioning of Nuclear Power Plants - Waste of Activated Materials from the Region of the Reactor Core During the Management of a Decommissioned Pressurized Water Reaction

EIR-Berlin 79(368):1-95

By using a PWR as an example and assuming an allowable level for activated structural material, the

production of waste from the region of the reactor core was determined. The influence of the cooling time (time from the reactor-shutdown to the start of dismantling) on the amount of waste material is presented. An attempt was made to give a sound basis for evaluating and understanding the assumed allowable limits through a comparison with conventional regulations. From the chemical composition of the materials in the core region and the layout of the biological shield, recommendations are made concerning the construction of future nuclear power plants. (CAS)(PTO)

249

Gallenberger, H., and W. Harbecke, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany; Kernkraftwerk Lingen GmbH, Lingen, Federal Republic of Germany

The Safe Enclosure in Decommissioning Nuclear Power Stations

Atomkernenergie Kerntechnik 39(2):80-86 (1981)

The safe enclosure of nuclear power plants will normally consist of four phases: preparation; shut-down; conditioning; and enclosure. Prior to safe enclosure, the fuel assemblies, the cooling media and, to the extent possible, the radioactive wastes from operation, will have been disposed of externally. The rest of the activity is in the form of solid radioactive materials. The remaining radioactive materials are safely enclosed within the plant. The hazard potential inherent in a plant can be considered extremely low. The first safe enclosure of a nuclear power station in the Federal Republic of Germany was successfully demonstrated at the Niederaichbach Nuclear Power Station (KKN). Present plans for the Lingen Nuclear Power Station (KWL), include safely enclosing the plant now, and completely dismantling it after 30 years. (Auth)(PTO)

250

Gallenberger, H., J. Obst, and W. Stasch

Disposal of the Niederaichbach Nuclear Power Station (KKN)

Atomwirtschaft Atomtechnik 26(2):80-84 (1981, February)

The Niederaichbach Nuclear Power Station (KKN) was shut down in 1974 while still in its commissioning phase because of technological advances in the light water reactor. The KKN had been equipped with a heavy water moderated and carbon dioxide gas cooled pressure tube reactor. After the permit for the safe entombment mode of decommissioning had been granted in 1975, an order for final disposal followed in 1979. (EDB)(PTO)

251

International Atomic Energy Agency, Vienna, Austria

Factors Relevant to the Decommissioning of Land-Based Nuclear Reactor Plants

ISBN-92-0-623080-8; 36 pp. (1980)

This document applies to all classes of land-based nuclear fission reactors, including those reactors used for the production of electricity or heat, for testing, for research, and for the production of radionuclides. The document covers the technical and administrative aspects of decommissioning, and to the associated radiation protection of man and his enironment both during and after decommissioning. The document is intended to provide assistance to those responsible for planning or implementing the decommissioning of a land-based nuclear reactor. The user of this report is further encouraged to review past experience gained with nuclear facilities and the published technical data cited bibliography. (EDB)(PTO)

252

Jacquemin, M., CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Recommended IAEA Decommissioning Levels

CONF-7703138; Decommissioning of Nuclear Installations, Proceedings of an Information Session, Paris, France, March 31, 1977, (4 pp.) (1977)

The areas covered by each of the two terms 'decommissioning' and 'dismantling' of a nuclear installation are defined in order to distinguish them with greater accuracy. Decommissioning is an administrative decision and includes all the material operations involved by this decision. Dismantling is only one of several material operations included of the decommissioning, but it can be the most important. The IAEA classifies decommissioning operations under three main headings (stages), which we call "decommissioning levels." These levels are as follows: level 1 - shut-down with surveillance; level 2 - conditional release for another use; and level 3 - unconditional release of the site. (AIC)(PTO)

253
Kotrappa, P., P.O. Joshi, T.K. Theyyunni, B.M. Sidhwa, and M.N. Nadkarni, Bhabha Atomic Research Centre, Bombay, India

Radiation Protection Aspects in Decommissioning of a Fuel Reprocessing Plant

INIS-MF-5876; CONF-800304; Proceedings of the 5th International Radiation Protection Association International Congress, Jerusalem, Israel, March 9-14, 1980, Vol. 2, (pp. 11-14) (1980, March 8)

The decontamination of a fuel reprocessing plant which underwent partial decommissioning is described. The following radiation protection aspects of the work are discussed: (1) dismantlement and removal of process vessels, columns and process off-gas filters: (2) decontamination of various process areas; and (3) management of liquid and solid wastes. Total dose commitment for this work was approximately 3000 man-rems, including dose received by staff for certin jobs related to the operation of a section of the plant. The external dose was kept below the annual limit of 5000 mrems for any individual. No internal contamination incident occurred which caused a dose commitment in excess of 10% of the annual limit. The fact that all the work was completed by the staff normally associated with the operation of the plant contributed significantly to the management and control of personnel exposure. (EDB)

254
Lukes, R., P. Salje, and F.J. Feldmann

Financial Precautions for the Decommissioning and Dismantling of Nuclear Facilities

Energiewirtschaftliche Tagesfragen 28(11):680-686 (1978, November)

Based on the fact that the disposal of nuclear plants requires considerable means, the question is asked whether the financial guarantee for decommissioning and disposal should be requested before giving the license. The article shows the possibilities to ensure financial provisions and to describe their advantages and disadvantages. Planned decommissioning is dealt with separately from unplanned decommissioning. (EDB)(CAJ)

255
NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany

Safety Problems in Decommissioning of Nuclear Power Reactors - Technical Report

INIS-MF-6470; 106 pp. (1975, December)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

The safety problems in decommissioning are presented by the example of light water reactors with an electric power of 1300 MW and 40 years of preceding specified operation. In such a plant the radioactivity in the form of activation and contamination is on the order of 10 million curies one year after final shut-down. The fuel elements are not taken into account. During the work at the reactor vessel, dose rates of about 10,000 rem/hr may occur at the flange level. A rough estimation of the dose accumulated by the decommissioning personnel during dismantling of the radioactive components is about 1200 rem. During the decommissioning work, problems are caused predominantly by the direct radiation from the radioactive components and systems, as well as from the release of radioactive particles, aerosols and liquids resulting from cutting up the contaminated components. In designing new plants, the extent of later decommissioning problems can be reduced by selection of suitable materials and by proper design and arrangement of the components and parts of the plant. (EDB)(PTO)

256
Sefcik, J.A.

Decommissioning Commercial Nuclear Reactors

Technology Review 81(7):56-71 (1979, June/July)

The technical problems inherent in decommissioning nuclear power plants at the end of their operating lifetime are examined. Decommissioning strategies, potential radiation hazards, and decommissioning experience to date are briefly reviewed. The economics of the various options are discussed both from the costs involved and the methods by which the costs will be financed. Histories and detailed cost studies on larger reactors suggest that the retirement of the big reactors need not be excessively expensive, and can have minimal environmental impact. Several large reactors, taken through the decommissioning process, will provide a firm base of large-scale experience. (EDB)(CAJ)

257

What Can Be Done with Old Nuclear Power Plants?

Bild der Wissenschaft 16(12):54-101 (1979, December)

The average life-span of nuclear reactors has been calculated to be about 40 years. What hapens then? Are the technological methods already developed for dealing with the radioactive wastes produced and the contaminated sites that remain? The technologists are convinced that this is so. An interview with the safety experts of the West German Ministry of the Interior gives rise to doubts, at least when it comes down to details. Visits were made to the two nuclear power stations in the Federal Republic of Germany which have already been closed. (EDB)(PTO)

258

Will Nuclear Power Plants Be Shut Down

Umschau in Wissenschaft und Technik Wiss. Tech. 76(12):532-533 (1976)

The Committee for Research and Technology of the German Bundestag has conducted a hearing on the peaceful use of nuclear energy. The experts have pointed out that in the eighties a shut-down of nuclear power plants is impending if the nuclear fuel cycle is not closed. This means the creation of storage dumps for spent fuel elements, building a reprocessing plant and provision for highly radioactive waste. (Auth)(PTO)

259
Winkler, R., Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Legal Problems and Licensing Procedure of the Decommissioning of Nuclear Power Plants

Atomkernenergie Kerntecknik 39(2):76-79 (1981)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Until 1976 the Atomic Energy Act did not expressly stipulate the requirement of a decommissioning license. The question was discussed whether decommissioning constituted a material alteration of the installation or its operation. This problem of interpretation was settled by the insertion of a new sub-section 3 in section 7 of the act which provides that a license is required for the decommissioning of a nuclear power plant as well as for the safe enclosure of a decommissioned installation or the dismantling of such an installation or parts thereof. The decommissioned facility is under state supervision in the sameway as an operating one. Radiation protection problems arise from the disposal of radioactive waste. The disposal or radwaste requires a handling permit. There is no tolerance limit for waste from nuclear power plants compared to radioactive wastes resulting from activities not subject to licencing and reporting provisions. The state authorities for radioprotection may use the extraordinary tolerance limit in section 4 sub-section 4 of the radiological protection ordinance for granting a special license providing that low level waste may be disposed of as normal (non-radioactive) waste. (Auth)(PTO)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING SITE SURVEYS

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Gilbert, R.O., Pacific Northwest Laboratory, Richland, WA

Statistical Aspects of Radiological Site Assessments

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (pp. 105-106); Transactions of the American Nuclear Society 34:105-106 (1980, June)

Statistical design and analysis aspects are outlined for radiological assessment surveys conducted to determine if remedial action is required before release for unrestricted use. Emphasis is placed on the need for continuing statistical input at all stages of the assessment from initial planning through final statistical analysis and interpretation. It is recommended that a statistician experienced with radiological surveys be a permanent member of the project team. All statistical plans, analyses, and data must be carefully documented. (CAJ)

261

Gutwein, E.E., and S.S. Musser, Gilbert/Commonwealth, Reading, PA

Radiation Data Collection Program for Decommissioning Studies

Power Engineering 86(2):47-49 (1982, February)

A coordinated program for studying radiological data gathered during nuclear power plant operations provides guidance in trending data to decommissioning time. Most radiation levels can be obtained easily from operating power plants. Trends can be established allowing extrapolation of radiation levels to the final shutdown time by comparing radiation levels collected over the years. A data collection program must be developed to ensure that the data is collected annually and that the data is comparable year after year. A radiation data program shoudl encompass the following areas: (1) periodic collection of radiation levels around major system and specific components; (2) identification of specific high radiation areas due to plate-out and crud buildup; (3) correlation of crud content of primary and secondary systems with radiation levels; (4) definition of plate-out in systems exposed to primary coolant; (5) review of current decontamination technology and its application to the specific plant; and (6) neutron flux data around the reactor core to predict activation of concrete shield, metal support, or any other material located in high neutron flux areas. Volumes of radiological data are available from plant operations that indicate a wide variation due in part to differences in survey instruments, plant housekeeping practices and other conditions associated with components and systems. A well defined radiation survey and radiological data program specifying both plant and collection conditions will not only assist in decommissioning studies but also in monitoring radiation doses ALARA throughout plant life. (PTO)

262

Haywood, F.F., W.D. Cottrell, H.M. Hubbard, J.A. Auxier, D.M. Davis, and J.E. Turner, Oak Ridge National Laboratory, Oak Ridge, TN

Radiation Measurement and Assessments

ORNL-5171; Health Physics Division Annual Progress Report for Period Ending June 30, 1976, (pp. 261-274) (1976, October)

Methods are discussed that were developed to evaluate the characteristics of radiation fields in areas where selected segments in the nuclear fuel cycle or other energy-producing operations were carried out resulting in the possibility for exposure to the public. Inactive uranium mills were surveyed for radionuclides in tailings piles that might pose radiation hazards for human populations. The radiation doses from external exposure or from the inhalation or ingestion of radon-222, thorium-230, and radium-226, daughters in the mill tailings were estimated. Radiation monitoring surveys were also made at a number of decommissioned ERDA sites. Gamma sources in soil and associated dose rates in

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING SITE SURVEYS

surface air were measured at selected ORNL sites. Solid waste residues from oil shales were monitored for radium-226 content to determine if any health hazards would result from the use of spent shales as fill material or in concrete products. Progress is reported for a study of ways to reduce the radiation exposure of personnel at light water reactors. It was concluded that the occupational exposure at operating LWR sites can be reduced by 10 to 20 percent. (EDB)(PTO)

263

Lozier, D.E., and B.S. Ausmus, Battelle Columbus Laboratories, Columbus, OH

Assuring Quality in a Detailed Radiological Survey

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (p. 105); Transactions of the American Nuclear Society 34:105 (1980, June)

The purpose of this program is to establish a quality system to give assurance that complete, identifiable, and accurate data will be obtained in a limited time period while maintaining industrial and radiological safety for the survey personnel. The planning and preparatory phases of a quality assurance program are time consuming but cost effective. The plan should contain a complete operations plan, a health physics plan, specific procedures and documentation formats, complete and detailed documentation that is prepared and checked daily, instruments that have been calibrated (traceable to an accepted standard), and a quality assurance representative who is independent of the program administration. A detailed radiological survey was successfully conducted by Battelle Columbus Laboratories at the inactive DOE Niagara Falls Site, resulting in the taking of approximately 3.5 million instrument, smear, and sample analysis measurements at the site. The experience gained from this survey emphasizes the importance of planning and implementing a thorough program while conducting a detailed radiological survey. (CAJ)

264

McMurray, B.J., Battelle Pacific Northwest Laboratories, Richland, WA

Radiological Characterization of Undocumented Nuclear Sites

CONF-800607; American Nuclear Society 1980 Annual Meeting, Proceedings of a Conference, Las Vegas, NV, June 9-12, 1980, (p. 110); Transactions of the American Nuclear Society 34:110 (1980, June)

An increasing number of facilities are no longer being needed for nuclear purposes, and need to be rehabilitated or decommissioned to regain some value from the resources they represent. This paper describes a plan for assessing the radiological condition of a nuclear site even when little or no prior information about the site is available. Basic objectives of the radiological assessment for each site must be determined. A survey plan and procedure should be designed using preliminary measurements and records which defines survey blocks and specific procedures for procuring the radiological measurements, and takes into account the practicalities of time, instrumentation, and the assessment goals. The assessment then must be based on the radiological data provided, including the undisturbed or background data, and compared with the established criteria and guidelines before the final assessment is completed. (CAJ)

265

Witherspoon, J.P., Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Technology and Cost of Termination Surveys Associated with Decommissioning of Nuclear Facilities

NUREG/CR-2241; ORNL/HASRD-121; 198 pp. (1982, February)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

There are different types of nuclear facilities each having different potential residual radionuclides, different exposure pathways, and differing biological doses. Various methods of establishing residual levels of radioactivity have been suggested. All of these methods of criteria development have a common endpoint in that some radiation dose (and risk) can be estimated for inidividuals, or segments of a population information on the methods and costs of conducting *terminal* radiological surveys to verify compliance with dose standards for unrestricted use of nuclear sites following decommissioning. Nuclear fuel cycle sites considered in this study are those of a light-water reactor, a mixed oxide fuel fabrication plant, a uranium fuel fabrication plant, a fuel reprocessing plant, a spent fuel storage facility, and a uranium hexafluoride production plant. Non-fuel cycle sites considered are laboratories for the manufacture of radionuclide-labeled compounds and sealed sources and a rare metals refinery tailings pile. Residual radioactivity levels for the spectra of radionuclides associated with operations of the various facilities were used to estimate radiation doses to hypothetical individuals living in wooden frame houses on decommissionined sites. Previous analysis had indicated residential use of a site to be the most restrictive use. Realistic exposure pathways were assumed and doses were expressed as whole-body effective dose equivalents which employ weighting factors such that the total stochastic risk incurred from the irradiation of all body tissues is estimated. Residual radioactivity levels necessary to give doses of 1, 5, and 25 mrem/yr were estimated for each site and a radiological survey for compliance with each dose standard was designed and survey costs were estimated. The surveys were designed in a manner to assure that site monitoring will detect with a high probability any areas of excess radioactivity. The results of this study indicate that cost-effective and reasonably accurate radiological surveys can be performed outdoors at fuel cycle sites where residual radioactivity leads to doses around 10 mrem/yr. Building surveys are reasonable at a 1 mrem/yr level. Once a spectral analysis has identified the kind and relative abundance of residual radionuclides, a combined use of field survey instruments and laboratory analysis can be used to certify compliance with decommissioning criteria. "Signature" radionuclides which can facilitate detection were identified. Such radionulcides, while not necessarily major dose contributors, are useful when levels of others approach detection limits. Sites on which uranium and daughter radionuclides represent the residual contaminants are shown to be relatively more difficult to survey. Use of instruments such as the Enewetak proportional or Imp, however, may facilitate outdoor surveys and reduce the necessity of many expensive soil sample analyses to assure compliance with limits below around 25 mrem/yr. Non-fuel cycle facilities should pose no special problems. Building surveys seem feasible even at 1 mrem/yr limits for the manufacturing facilities considered in this study. The survey of a rare metals tailing pile area, however, poses the same difficulty as other sites contaminated with uranium and daughter radionuclides. (Auth)(PTO)

266

Batrakov, V.P., E.N. Kanin, and V.S. Porojkova, Ivanovskij Khimiko-Tekhnolgicheskij Institute, USSR

Some Problems in Electropolishing Process of Stainless Steels

Izvestiya Vysshikh Uchebnykh Zavedenii, Khimiya i Khimicheskaya Tekhnologiya 18(7):1108-1111 (1975, July)

A study has been made on the effect produced by the electrolyte composition, temperature and stirring upon the anodic behavior of stainless steels, in particular, steel Kh18N10T, in a mixture of sulfuric and phosphoric acids. It is shown that the appearance of a limiting current plateau on the anodic polarization curve is due to the concentration limitations of the process of dissolution in the electrode-adjacent layer of the electrolyte. The smooth surface and glazing effect, occurring during electrolytical polishing, are associated with the formation of oxide layers and diffusion phenomena in the electrode-adjacent layer. The highest quality of polishing is obtained at potentials above 2 V. (EDB)

267

Bost, W.E., U.S. Atomic Energy Commission, Office of Information Services, Technical Information Center, Oak Ridge, TN

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Radioactive Decontamination: A Literature Search

TID-3535; 34 pp. (1959, September)

This literature search contains 351 references to unclassified reports on radioactive decontamination. The following aspects were covered by this search; decontamination of surfaces of various materials, metals, equipment, buildings, clothing, skin, earth, etc., and in addition, volumes of solutions and atmospheres in buildings. Methods included are both physical (surface removal, protectiVe coating removal, sand-blasting, etc.) and chemical (cleaning solutions, complexing agents, ion exchange, etc.). (Auth)(PTO)

268

Decontamination of Radioactive Contaminated Surfaces - Method of Test for Ease of Decontamination and Interpretation of Results

DIN-25415(Pt. 1); 7 pp. (1979, July)

The purpose of the standard is to define objective methods for testing the ease of decontaminating surfaces rather than to describe decontamination methods in general. Direct, mechanical decontamination processes (such as scrubbing or wipping, etc.) have not been considered in this draft. (EDB)(PTO)

269

Detilleux, E.J., European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium

Decontamination of a Reprocessing Facility and Handling of the Resulting Wastes

CONF-790912; Uranium and Nuclear Energy, Proceedings of the 4th International Symposium, London, United Kingdom, September 10, 1979, (pp. 174-187) (1979, September)

A description is given of diamantling, intensive cleaning, and decontamination operations in three main facilities of the Eurochemic demonstration reprocessing plant: the spent fuel reception and storage building; the main process building; and the associated analytical control laboratory. (EDB)(PTO)

270

Dippel, T., D. Hentschel, and S. Kunze, Abteilung Behandlung Radioaktiver Abfalle, Gesellschaft fur Kernforschung GmbH, Karlsruhe, Federal Republic of Germany

Decontamination and Decommissioning

Decontamination and Decommissioning, Ch. 5, (p. 46)

Experiments on optimum working conditions with respect to working temperatures and concentrations for cleaning agents as nitric acid, nitric-hydrofluoric acid mixtures, alkaline potassium permanganate and organic acids, aimed at the reduction of waste have begun. Although essential progress can only be expected by substitution of the dipping technique by a coating technique by which the chemicals are applied only to surfaces, results indicate that: (1) the concentration of nitric acid need not be higher than 4 M as this has turned out to be an optimum with respect to decontamination efficiency and waste generation; (2) the usually applied concentration of 3% HP/20% HNO3 mixture can be reduced to 1.5% HF/10% NHO3 without reduction of cleansing efficiency, as can alkaline KMnO4; (3) the decontamination efficiency for Ru-106 is excellent; (4) oxalic acid in a concentration of 1% is an optimum; and (5) the best decontamination mixture is 0.2 M citric acid plus 0.3 M oxalic acid. These experiments have been carried out with autoclave contaminated stainless steel samples and a dipping technique. Work continues with samples from power reactor systems and a coating technique. (Auth)(CAJ)

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Hahn, V., and J. Schartz, Kraftanlagen AG, Heidelberg, Federal Republic of Germany

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Decontamination During the Decommissioning of Nuclear Facilities

Atomkernenergie Kerntechnik 39(2):100–102 (1981)

During the decommissioning of nuclear facilities, large quantities of contaminated parts and components must be handled. In order to reduce costs and dose rates for all decommissioning operations, it is essential to determine whether the equipment should be decontaminated before going on with any further decommissioning operations. Various factors must be taken into consideration and should be evaluated, in order to determine the measures that seem to be reasonable and justifiable. (Auth)(PTO)

272
Halter, J.M., and R.G. Sullivan, Pacific Northwest Laboratory, Richland, WA

Contaminated Concrete Surface Layer Removal

Surface Contamination, Volume 1, K.L. Mittal (Ed.). Plenum Publishing Corporation, New York, NY, (pp. 443–455) (1979)

Equipment is being developed to economically remove contaminated concrete surfaces in nuclear facilities. To be effective this equipment should minimize personnel radiation exposure, minimize the volume of material removed, and perform the operation quickly with the least amount of energy. Several methods for removing concrete surfaces are evaluated for use in decontaminating such facilities. Two unique methods especially suited for decontamination are described: (1) the water cannon, a device that fires a high-velocity jet of fluid causing spallation of the concrete surface; and (2) a concrete spaller, a tool that exerts radial pressure against the sides of a pre-drilled shallow cylindrical hole causing spallation to occur. Each method includes a means for containing airborne contamination. Results of tests show that these techniques can rapidly and economically remove surfaces, and leave minimal rubble for controlled disposal. (Auth)(JMF)

273
Hitachi, Ltd., Japan

Removal of Radioactive Contamination from Solid Surfaces by Sublimation

Japanese Patent 81,846,00; 4 pp. (1981, July 9)

Radioactive contaminants on solid surfaces are converted to sublimable substances and removed from the surface. An application is described for this process, which is especially useful for removing uranium contamination on a metal surface by reacting the uranium compound with fluorine. (Auth)(PTO)

274
Hitachi, Ltd., Japan

Removal of Surface Radioactive Contamination from Metals

Japanese Patent 81,115,998; 6 pp. (1981, September 11)

To reduce the volume of radioactive waste requiring disposal, a radioactively contaminated metal surface is treated with a heat source, such as a plasma torch, and the sputtered metal is converted into granules. The process is preferably carried out with an aqueous film coating the contaminated surface. (Auth)(PTO)

275
Hryniewich, T., R.H. Muller, and C.W. Tobias, Lawrence Berkeley Laboratory, Berkeley, CA

Study of Electropolishing of Ferrous Alloys Using Rotating-Disk Electrodes

LBL-12879; 127 pp. (1981, June)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

This work deals with electropolishing of ferrous materials ranging from pure iron through carbon steels, with increasing carbon content, to a few low-alloy steels. The characteristics of electropolishing stainless and acid-proof steels are well known, and for this reason were not considered in this research. Studies were performed on the rotating disk electrode system under controlled electrochemical and hydrodynamic conditions. The purpose was to establish conditions at which the best surface finish, after electropolishing of different types of ferrous alloys, may be achieved. The work involved investigations over a wide range of applied current density, mass loss, and current efficiency. (EDB)

276

Kirchheim, R., K. Maier, and G. Toelg, Max-Planck-Institut fuer Metallforsch, Stuttgart, Federal Republic of Germany

Diffusion and Solid-Film Formation During Electropolishing of Metals

Journal of the Electrochemical Society 128(5):1027-1034 (1981, May)

In this study the current-time behavior is thoroughly examined for different metals and electrolytes with constant cell voltage. The theoretical treatment is extended to describe the influence of natural and forced convection and of the formation of a solid film on the current-time function. The results of this study show that the current time behavior of potentiostatic electropolishing can be completely described with solutions of Fick's second law, assuming that diffusion in the electrolyte is the rate-determining step and different boundary conditions cause the occurrence of three stages. Even the formation of a solid film on the anode and its influence on the current can be described by backward diffusion from a supersaturated electrolyte consistent with experimental findings. (EIX)

277

Konecny, C., Ustav Jaderneho Vyzkumu Cskae, Rez, Czechoslovakia

Economic Assessment of Hot and Semi-Hot Cell Decontamination

Nukleon 2:15-17 (1980)

The costs are given for building and operating a laboratory for aqueous reprocessing of spent fuel from the WWR-S reactor during the years 1964 to 1974. For economic reasons, the closing of the laboratory was followed by the decontamination of hot and semi-hot cells and the dismantlement of the equipment. The costs are also given for the dismantlement and disposal of laboratory equipment and the decontamination of cells during the years 1974 to 1978. A survey is presented of the average and maximum dose rates for personnel. The survey shows that the cost for the recommissioning of the cells does not exceed the cost of the initial commissioning. (EDB)(PTO)

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Long, J.L., and E.L. Childs, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Investigation of a Basic Electrolyte for Decontamination

RFP-3101; 21 pp. (1979)

A discussion of an electrolyte for decontaminating metals in a basic solution (pH greater than 7) is presented. The use of a basic electrolyte simplified recovery problems with respect to radioactive contaminants and anodically dissolved base metals. The electrolyte was used on a lab scale to decontaminate stainless steel which had been exposed to plutonium and americium. Actual glove box samples, as well as artificially contaminated samples, were decontaminated to less than 0.14 disintegrations per square centimeter per minute. Separation of the radioactive species and most of the anodically dissolved materials was accomplished by filtration. In the case of chromium, the addition of lead nitrate is necessary to precipitate the hexavalent chromium formed. The anodic dissolution rates of Al, Be, Cu, Pb, Ni, and low alloy steel have been determined, and lead to the conclusion that all of these metals can be decontaminated in basic electrolyte. The basic electrolyte is expected to be useful in decontaminating other metals also. (Auth)(CAJ)

279
Matutes, A.K., and N.A. Khatanova

Artefacts Caused by Electropolishing of Austenitic Fe-Ni Based Alloys

Vestnik Moskovskogo Universiteta, Fizida, Astronomiya 22(2):82-84 (1981, April)

The formation of Fe-Ru solid solution particles in NiO during electropolishing has been detected during structure investigations in austenitic Fe-19%Ni-10%Ru, Fe-27%Ni-2%Ru, Fe-34.4%Ni alloys of face centered lattice. The formation of such particles in Fe-20%Ni alloy of alpha phase structure with cubic centered lattice was not observed. (MT)

280
Mautz, E.W., G.G. Briggs, W.E. Shaw, and J.H. Cavendish, National Lead Company of Ohio, Cincinnati, OH

Uranium Decontamination of Common Metals by Smelting, a Review (Handbook)

NLCO-1113; 42 pp. (1975, February 5)

Literature relating to the smelting of common metals scrap contaminated with uranium-bearing compounds has been reviewed. In general, standard smelting practices produce ingots having a low uranium content, particularly for ferrous, nickel, and copper metals or alloys. Aluminum recovered from uranium contaminated scrap shows some decontamination by smelting but the uranium content is generally higher than other metals. Due to the heterogeneous nature and origin of scrap metals contaminated with uranium, information is frequently missing concerning the extent of the initial contamination and the degree of decontamination obtained. The uranium content of the final cast ingots is generally all that is available. Results are summarized by the primary composition of the uranium-contaminated scrap metal. (GRA)(PTO)

281
National Technical Information Service, Springfield, VA

Electropolishing - October 1977 to October 1981 - Citations from the Engineering Index Data Base

PB-82-801812; 193 pp. (1981, November)

The cited reports from a worldwide literature survey cover different aspects of electropolishing and electro-chemical machining. Some areas that are discussed include metal cutting, electrochemistry, processes, corrosion protection, and materials. This updated bibliography contains 186 citations, 49 of which are new entries to the previous edition. (GRA)

282
Nelson, J.L., and J.R. Divine, U.S. Nuclear Regulatory Commission, Division of Engineering Technology, Washington, DC

Decontamination Processes for Restorative Operations and as a Precursor to Decommissioning: A Literature Review

NUREG/CR-1915; PNL-3706; 130 pp. (1981, April)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Pacific Northwest Laboratory (PNL) conducted a comprehensive literature review of actual reactor decontamination processes that are currently available. In general, decontamination processes should be selected on the following criteria: effectiveness; efficiency; safety; and waste production. The information that was collected and analyzed has been divided into three major categories of decontamination: chemical, mechanical, and electrochemical. Chemical methods can be further classified as either low-concentration, single-step processes or high-concentration, single- or multistep processes. Numerous chemical decontamination methods are detailed. Mechanical decontamination methods are usually restricted to the removal of a contaminated surface layer, which limits their versatility; several mechanical decontamination methods are described. Electrochemical decontamination is both fast and easily controlled, and numerous processes that have been used in industry for many years are discussed. Information obtained from this work is tabulated in Appendix A for easy access, and a bibliography and a glossary have been provided. (Auth)(PTO)

283

Remark, J.F., Babcock and Wilcox Company, Lynchburg Research Center, Lynchburg, VA

Plant Decontamination Methods Review

EPRI-NP-1168; TPS-78-816; 142 pp. (1981, May)

This document details the decontamination techniques currently employed at nuclear power generating stations and utilized by private and government laboratories. This information was obtained by surveying the personnel responsible for decontamination at their site. The investigators attempted to obtain information regarding successful as well as unsuccessful decontamination experiences. A review of some of the planning and preparation that must be performed prior to a decontamination is also presented. This section describes the technical planning that should be prepared in order to select the optimum decontamination technique for a specific application. Some of the economic considerations regarding a specific decontamination application are also presented. This report includes discussions concerning equipment availability, radioactive-waste generation, plant compatibility, and storage capacity. A brief description of corrosion-film generation, transportation, activation, and deposition is presented. This section describes the film characteristics that are found in BWRs and PWRs. (EDB)

284

Schwartz, W.

Electropolishing

Plating and Surface Finishing 68(7):42-45 (1981, June)

Practical advantages of the electropolishing process in metal finishing applications and such aspects of the process as equipment requirements, racking considerations, pre- and post-treatment requirements and control of the electrolytic solutions are presented. The compositions of various electrolytes and the associated operating conditions for several electropolishing applications are presented in a tabular form for Al, Cu, Ni, and Ti alloys, carbon and stainless steels. Brief discussions of the limitations of the process, a trouble-shooting chart outlining some of the more common electropolishing problems, their possible causes and remedies and the waste treatment of different electropolishing solutions are also presented. (KRI)(MEX)

285

Seitz, M.G., T.J. Gerding, and M.J. Steindler, Argonne National Laboratory, Argonne, IL

Decontamination of Metals Containing Plutonium and Americium

ANL-78-13; 50 pp. (1979, June)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Melt-slagging (melt-refining) techniques were evaluated as a decontamination and consolidation step for metals contaminated with oxides of plutonium and americium. Experiments were performed in which mild steel, stainless steel, and nickel contaminated with oxides of plutonium and americium were melted in the presence of silicate slags of various compositions. The metal products were low in contamination, with the plutonium and americium strongly fractionated to the slags. Partition coefficients (plutonium in slag/plutonium in steel) of 7,000,000 were measured with borosilicate slag and of 3,000,000 with calcium, magnesium silicate slag. Decontamination of metals containing as much as 14,000 ppm plutonium appears to be as efficient as for metals with plutonium levels of 400 ppm. Stages extraction, that is, a remelting of processed metal with clean slag, results in further decontamination of the metal. The second extraction is effective with either resistance-furnace melting or electric-arc melting. Slag adhering to the metal ingots and in defects within the ingots is in the important contributors to plutonium retained in processed metals. If these sources of plutonium are controlled, the melt-refining process can be used on a large scale to convert highly contaminated metals to homogeneous and compact forms with very low concentrations of plutonium and americium. A conceptual design of a melt-refining process to decontaminate plutonium-and americium-contaminated metals is described. The process includes single-stage refining of contaminated metals to produce a metal product which would have less than 10 nCi/g of TRU-element contamination. Two plant sizes were considered. The smaller conceptual plant processes 77 kg of metal per 8-hr period and may be portable. The larger one processes 140 kg of metal per 8-hr period, is stationary, and may be near the maximum size that is practical for a metal decontamination process. (Auth)(PTO)

286

Shtan'ko, V.M., P.P. Karyazin, V.G. Mosolova, and S.N. Sirotkin, Ural'skij Nauchno-Isslidovatel'skij, Turbnoj Promyshlennosti, Chelybinsk, USSR

The Problem on the Influence of Anodic Oxidation of Surfactants on the Process of Metal Electrochemical Polishing

Zhurnal Prikladnoi Khimii 48(8):1761-1764 (1975, August)

Selection of the low oxidizable additions of the surface active materials (SAM) to the electrolyte and the ways of maintaining their effectiveness was investigated. Mixture of the phosphoric and sulphuric acids 20% H2SO4, 60% H3PO4, 20% H2O, was used as the electrolyte. Sulphoponates, sulphoreid, carboxymethylcellulose and polyacrylamide, which are widely used in the electrochemical brightening, were studied. Transmitted current, temperature, nature of metal, and SAM were variables in the study. Increasing anodic polarization in the electrolyte was observed with the addition of SAM in comparison with the electrolyte without additions. Depending on the nature of SAM the degree of oxidation was different. Anodic oxidation of the SAM additions was significantly influenced by temperature. SAM oxidation depends also on the nature of the brightened metal. Investigation of the surface tension variation of the electrolyte with SAM in the process of brightening OK18N10T demonstrated that SAM oxidation increased in the presence of titanium ions. (EDB)(PTO)

287

Stefanskii, I.S., N.V. Boboyavlenskaya, A.S. Maksimenko, and V.P. Zhuravel

Electropolishing of Iron, Chromium, and Nickel Alloys

Zashchita Metallov 17(2):198-200 (1981)

Optimal electropolishing parameters were determined on Fe-Cr-Ni alloys (10-29% Cr, 11-21% Ni) in an electrolyte containing H3PO4 (density 1.62 g/cu cm) 60, H2SO4 (density 1.83-1.84 g/cu cm) 20 and water, the balance at 60 deg C. The experimental alloys were melted from reduced Fe and electrolytic Cr and Ni in an induction furnace. The reflectance capacity of alloy surfaces with min. and average contents of Cr or Ni was maximum at equal to or greater than 100 to 150 A/sq dm. Mass loss/min depended upon alloy composition, but not as clearly as upon surface roughness. (ARS)(PTO)

288

Tret'yakova, V.D.

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

A Comparative Assessment of the Polishing Properties of Electrolytes

Voprosy Khimii i Khimicheskoi Tekhnologii 55:3-7 (1979)

Mathematically planned experiments were conducted to study the quality of electropolishing of stainless steel EI-852, which contains: C, 0.1-0.15; Si, 1.4-2.1; Cr, 12.0-14.0; Ni, 1.0; and Mo, 1.2-2.0; in (i) an electrolyte containing H2SO4 20, H3PO4 60, H2O 20 mass % with additions of technical sulphoureide, and (ii) in an H3PO4 bath containing H3PO4 70-80, H2O 20-30 with addition of caprolactum. Corrosion tests were conducted with alternating immersion seawater-air tests for 2,520 hr. High corrosion resistance was achieved after treatment in (1) with sulphoureide 1 g/l and current density of 100-250 A/sq dm at 60-80 deg C for 3-4 min or in (2) containing caprolactum 20 g/l with 150 A/sq dm at 60-70 deg C for 3 min. (ADM)(PTO)

289

White, J.M., Atomic Energy of Canada Limited, Radiation and Industrial Safety Branch, Chalk River, Ontario, Canada

The Decontamination of Radium from a Commercial Building Located in a Large Canadian City

American Industrial Hygiene Association Journal 41(1):49-60 (1980, January)

A radiation survey of a commercial building located in Ontario Canada, revealed that the structure was contaminated with radium-226. Investigations also revealed that the building had previously been used for processing radium. Decontamination efforts ensued with the objective of reducing radium concentrations so that radon decay products would be less than 0.02 Working Levels. Techniques utilized in decontaminating the building are described. (EDB)(PTO)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

290

Abe, T., K. Yamada, S. Usui, and H. Nomura, Kawasaki Heavy Industries Ltd., Kobe, Japan

Application of Water Jet Arc Cutting for Nuclear Field

FAPIG (Toyko) 93:46-48 (1979)

Japan is to have 34 nuclear power stations including those in the planning stage. Accompanying the increase of nuclear facilities the concern for developing decommissioning techniques for facilities that have completed their service life. The techniques to dismantle large radioactive steel structure are the more important ones. It is advantageous to carry out the dismantlement under water to prevent the release of radioactivity and the exposure to workers. The dismantling of the structures in the Elk River power station reactor was carried out under water. The following methods of dismantling steel structures under water are discussed: submerged plasma fusion-cutting method; submerged arc saw fusion-cutting method; and melting electrode type water jet cutting method. Kawasaki Heavy Industries, Ltd. tested the performance of the melting electrode type water jet cutting method and its application to the dismantlement of nuclear facilities. The principles of the fusion-cutting method and the outline of the tests are described. (EDB)(PTO)

291

Adams, T.F.M., Adams and Company, Inc., Tokyo, Japan

Gas Cutting and Welding Equipment in Japan

PB-174543; 107 pp. (1965, October)

This report surveys welding equipment currently available in Japan. The sections include: (1) Content; (2) Production; (3) Electric welding equipment; (4) Gas cutting equipment; Acetylene, oxygen, and non-destructive testing apparatus; (5) Special welding equipment; (6) Electronic beam welders; (7) Friction welders; (8) Ultrasonic welders; (9) Plasma arc cutters; (10) Electro-slap welders; (11) LASER welders; (12) Welding rods and electrodes; (13) Manufacturers; (14) Users of welding equipment; (15) Training of welders; (16) Imports and exports; (17) Importers of welding equipment; (18) Duties and import status; (19) Distribution channels; (20) Specifications for welding equipment; and (21) Market outlook for US products. (Auth)(PTO)

292

Advanced Plate Cutting at Lindo

Metal Construction 8(12):528-531 (1976, December)

A Danish shipyard specializing in tanker constructin has acquired water injection plasma cutting equipment. The cost of cutting by this method is relatively low and the cut edge requires no further preparation. Cutting speeds are higher. The equipment is fitted to a numerical control installation and uses a specially designed transformer rectifier. The torch can cut metal 3-75 mm thick. The plate preparation shop has seven other oxyfuel cutting torches. The hull blocks are assembled by submerged arc welding. (EIX)

293

Auler, I., and W. Buschmann, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany

Survey of the Problems of Decommissioning Nuclear Facilities

Atomkernenergie Kerntechnik 39(2):73-75 (1981)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Thirty-one nuclear power stations plus many other nuclear facilities have been decommissioned. The dismantling of nuclear facilities begins either immediately after cessation of operations or after a certain retention time to allow radioactive decay. Experiences of foreign demolitions and domestic backfitting measures in nuclear facilities are described. (EDB)(PTO)

294
Aussourd, P., Electricite de France, Paris, France

Nuclear Power Plant Dismantling

CONF-7703138; Decommissioning of Nuclear Installations, Proceedings of an Information Session, Paris, France, March 31, 1977, (4 pp.) (1977)

The paper presents a technical and economical study of nuclear power plant dismantling. After a brief review of feasibility studies and cost, the economic point of view is examined in different hypotheses. (AIC)(NPK)

295
Bangs, S.

PAC for Smooth Cuts in High-Alloy Materials

Welding Design and Fabrication 53(12):43-48 (1980, December)

The addition of a MG Cutting System NC 4516 plasma arc and oxyacetylene cutting machine with a Cybermation computer control and programing center increased the productivity of the plasma arc cutting system. This plasma arc cutting (PAC) system can precision cut all high-alloy metals, e.g. Ti-6-4, Al 6061 and Monel 400, with significant reductions in material wastes and machining costs. A plasma cut reduces the kerf size and the HAZ and increases cutting speeds up to eight times faster than conventional cutting methods. Details are given on the computer control system, the antipollution controls and the water recirculation system. (GGM)(PTO)

296
Baumann, J., S. Kausch, and J. Palmowski, Kraftanlagen AG, Heidelberg, Federal Republic of Germany

Radiation Protection During Backfitting or Dismantling Work in the Controlled Area of Nuclear Facilities

FS-79-20-T; CONF-7910255; Radioactive Waste, Proceedings of the 7th IRPA Regional Conference and 13th Annual Fachverband fuer Strahlenschutz Meeting, October 16, 1979, Koeln, Federal Republic of Germany (1980, May)

Backfitting measures or dismantling activities within the controlled area put special requirements on radiological protection. The following aspects of the Karlsruhe Nuclear Research Center are discussed: waste water decontamination; equipment decontamination; incineration and packaging facility/dismantling; and disposal of high-radiation components. The decontamination of buildings of the Eurochemic reprocessing plant at Mol and the reconstruction of the HDR plant for safety experiments together with waste management for components and systems, (e.g. pressure vessel internals, pipes etc.) are discussed. A description of the plans for exchange of the steam dryer and the water separator including planning of the conditioning process in the Wuergassen nuclear power plant is also included. This paper deals with the engineering and organizational problems, especially those accounting for radiological protection and discusses the planning of measures for radiological protection, the organization and execution of these measures, and problems of direct and remote-controlled work. Personnel qualifications are also discussed. (Auth)(PTO)

297
Beitel, G.A.

Remote Disassembly of Radioactively Contaminated Vessels by Means of an Arc Saw

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

AIChE Symposium Series 75(191):145-150; CONF-770112; Nuclear Engineering Questions: Power, Reprocessing, Waste, Decontamination, Fusion, R.D. Walton (Ed.), Proceedings of the 70th Annual AIChe Meeting, New York, NY, November 13, 1971, (pp. 145-150), 228 pp. (1979; 1977)

The principles, advantages and applications of the arc saw, a newly developed toothless circular saw which cuts by means of arc erosion, are outlined. The dismantlement of large radioactively-contaminated stainless steel heat exchangers by remote control, and a demonstration test on a 2000 kg vessel are described. Cutting speeds of 20 to 30 cm/s are possible with depths up to 100 cm. Arc currents of 1000-4000 amperes are used. Advantages include: no mechanical contact with workpiece; slag-free cuts giving smooth kerf walls; choice of cooling system; high blade life; high speed of cutting; and ability to cut all metals and also many nonconductors. (Auth)(PTO)

298
Blanchard, F.A., Jr., and M.W. Lippitt, Jr., Naval Coastal Systems Laboratory, Panama City, FL

Analysis of Electroshock Circuit Configurations Relative to Underwater Cutting and Welding

NCSL-278-76; 42 pp. (1976, April)

An analytical study of the electroshock circuit configurations of the diver using electrically operated tools was attempted considering normal and failed modes of various diver equipments, including arc cutting and welding, and ac-powered hand tools. While the one-dimensional modeling techniques used do not permit exact solutions, certain conclusions regarding the relative magnitude and importance of the various circuit elements are believed to lead to a better understanding of the underwater electroshock problem. (Auth)

299
Bohm, B., and H.U. Freund, Battelle Institute, Frankfurt, Federal Republic of Germany

Explosive Separation of Contaminated Tubes and Tube Bundles During Nuclear Reactor Demolition

Jahrestagung Kerntechnik '81 (Nuclear Technology '81), Proceedings of a Conference, Dusseldorf, Federal Republic of Germany, March 24-26, 1981. Deutsches Atomform E.V., Bonn, Federal Republic of Germany, (pp. 521-524), 628 pp. (1981)

This paper discusses methods for disassembly of radioactive components which minimize radiation exposure, and refers to a project which deals with demolition of pressure vessels, steam generators and biological shields. The explosive method described is stated to launch a projectile from the inside of the tube, to achieve cutting. Time lapse photographs of explosive tube cutting are presented and experiments with steel tubes of 128 mm dia and 16 mm wall thickness are described. It is reported that the quantity of radioactive debris produced by the explosive method is smaller than that of the swarf produced when a tube is sawn up. Advantages of the explosive method are stated to include the possibility of working on pipes which are not externally accessible. (INSPEC)

300
Bohme, D.

Thermo-Cutting with Optimized Cutting Planes

Blech Rohre Profile 27(9):552-556 (1980, September)

Progress whereby higher efficiencies are achieved by optimizing the conditions of the cutting planes and edges, by means of oxy-acetylene, plasma and laser torches, is described. A 10% saving on material is reported. Automation, computerization and various types of equipment are discussed. (PMS)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

301
Braun, W.

The Protection of Labour During Thermal Cutting

Schweisstechnik 33(5):77-79 (1979, May)

Some potential hazards in plasma arc cutting arise from exposure to high noise levels, to ultraviolet light, to iron oxide dust and when cutting alloy steels to metallic fumes containing elements such as nickel and chromium. The presence of ozone or nitrous oxide also gives rise to potential hazards although the amounts are ususally below the tolerable limits. Smoke, nitrous gases, ozone, and metalic fumes can be dealt with by effective local extraction equipment. The use of the water-plasma technique is an effective alternative, the dangerous fumes and gases being dissolved or washed away and also noise reduced to a harmless level. As high voltages of 200-400 V are employed, every precaution to ensure protection against electrical shock must be taken. (DB)(PTO)

302
Braun, W., Messer Griesheim, Dusseldorf, Federal Republic of Germany

Process for Underwater Plasma Cutting of Workpieces

U.S. Patent 4291217 (1981, September 30)

Improvements in a process for the underwater plasma cutting of workpieces, such as structural steel have been made. These improvements allow the cutting to be carred out by plasma burner having a needle electrode and transmitted plasma arc at small distances under the water level. The plasma cutting arc is enveloped during the ignition cutting by a compressed-air sheath solely outside of the nozzle which strongly contracts the plasma cutting arc. The compressed-air sheath is directed to the area of the cut by flowing from slots in the nozzle, located close to the discharge opening of the nozzle. The sheath flows at a velocity in the range of 3000-15,000 m/min and utilizes a current density in the range of 50-80 A/sq mm. (MEX)(PTO)(RHB)

303
Brayton, W.C., and J.A. Hogan, Bethlehem Steel Corporation, Sparrow Point, MD

Shipyard Welding and Cutting - Plasma Processes of Cutting and Welding

MA-2-36214; PB-262162/1ST; 85 pp. (1976, February)

The report analyzes the latest developments in plasma arc cutting, welding and shape cutting machines with emphasis on their application in the shipbuilding industry. Plasma welding was found advantageous over other welding processes for only a very few shipyard requirements. Plasma cutting, on the other hand, is shown to be ideally suited for the productivity, quality and operating cost necessary in modern shipbuilding. (GRA)

304
Brosilow, R.

PAC Cuts a Smooth Path to Stainless Processing

Welding Design and Fabrication 54(12):55-58 (1981, December)

Williams and Co.'s use of plasma are cutting (PAC) in their nine metal service centers is described. The firm supplies corrosion-resistant and high-temp. alloy plate cut to order for many industries. Although a variety of cutting methods are used, PAC has been in use for 18 years as the workhorse. The newest plasma unit is a single cutting torch with 1000 A power capacity provided by Thermal Dynamics. Details are given on procedures, cutting capabilities and available equipment. (MEX)(GGM)(PTO)

305

Bruns, J., H.G. Knackstedt, and R. Rosenbaum, Kernkraftwerk Wurgassen GmbH, Wurgassen, Federal Republic of Germany

Dismantling and Demolition of a Reactor Component

Jahrestagung Kerntechnik '81 (Nuclear Technology '81), Proceedings of a Conference, Dusseldorf, Federal Republic of Germany, March 24-26, 1981. Deutsches Atomform E.V., Bonn, Federal Republic of Germany, (pp. 577-578), 628 pp. (1981)

The problems of disposing of the damaged radioactive components from operating power stations are discussed, with special reference to the disposal of a steam/water seperator from the Wurgassen Nuclear Power Station. The dose received by the dismantling staff, employed to use oxygen lances to cut up the radioactive component, is stated to have been up to 5 rem/hr. (INSPEC)(PTO)

306

Choquet, R., and F. Clapier, Institut National de Physique Nucleaire et de Physique des Particules, Paris, France; Institut de Physique Nucleaire, Orsay, France

Data on Activation and the Definitive Dismantling of the 155 MeV Synchrocyclotron at the IPN at Orsay

CONF-7703138; Decommissioning of Nuclear Installations, Proceedings of an Information Session, Paris, France, March 31, 1977, (8 pp.) (1977)

A summary is presented of measurements made during the dismantling of the Orsay 155 MeV synchrocyclotron. Measurements were taken of the activity of structural materials (steel, cooper, aluminium) after two months cooling. The method employed for reducing to the maximum the hazards to the personnel carrying out the work is described. (EDB)(PTO)

307

Cudia, B., R. Giacarelli, M. Lauro, and R. Minasi, CNEN, Rome, Italy

Dismantling, Decontamination and New Equipment Installation in the Metallographic Hot Cell at CSN Casaccia

Radiation Safety Problems in the Design and Operation of Hot Facilities, Proceedings of a Symposium, Saclay, France, October 13-17, 1969, (pp. 481-487). (1970)

The metallographic hot cell at CSN Casaccia has been in operation since 1965. Recently this cell was dismantled and decontaminated so that new and more reliable equipment could be installed. The new equipment for fast intervention into the cell and the safe transport of solid radioactive wastes were designed on the basis of previous experience with similar operations. Utilization of this equipment enabled the time required for dismantling, decontaminating and assembling the hot cell to be reduced to about a month instead of the three months required in the past. The spread of contamination in the surrounding areas was also reduced considerably. Because of the high contamination inside the cell, preliminary decontamination was conducted by means of master-slave manipulation; successful intervention with personnel has been performed by means of a box equipped with a tunnel suit and installed close to the back door. Depending on the contamination level, other plastic boxes have been built adjacent to each other to minimize progressively the spread of contamination. According to our experience, a more reliable and safe working method for in-cell intervention operations could be developed if isolation rooms were installed permanently in the loading area. (Auth)(PTO)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

308

Culbertson, T.L., and W.H. Beard, Naval Civil Engineering Laboratory, Port Hueneme, CA

Evaluation of Underwater Welding and Cutting Equipment Available in 1969

NCEL-TN-1112; 38 pp. (1970, June)

A market survey, users survey, and comparative tests on commercially available and Navy standard underwater welding and cutting equipment were conducted to determine the most suitable presently available equipment for Navy underwater salvage operations. This investigation confirmed that low weld ductility and the inadequacy of arc-welding equipment prevent in that order general acceptance of this system for underwater construction welding. While all of the arc-oxygen underwater cutting torches available in 1969 needed improvement for effective and safe utilization in Navy underwater salvage, the comparative tests showed that any of the available production-model commercial torches would provide a slightly better torch than the present standard Navy torch. For immediate improvement in Navy underwater salvage operations it is recommended that the present standard Navy torch be replaced with a commercial torch; development of an advanced arc-oxygen underwater cutting system is recommended for medium-range improvement. (Auth)(PTO)

309

DeSaw, F.A., D.W. Caudy, H.W. Mishler, and M.D. Randall, Battelle Columbus Laboratories, Columbus, OH

Determination of the Feasibility of Shielded-Metal-Arc Welding and Oxygen-Arc Cutting at a Depth of 600 Feet to the United States Navy

AD-A076 261/7; 33 pp. (1969, July 31)

Underwater arc welding and oxygen-arc cutting have been used in salvage and repair operations for many years. These processes have been used, however, only at shallow depths, typically less than 100 feet. Before extending the use of arc welding and cutting to significantly greater depths, the feasibility of these processes at the greater depths must be known and potential problem areas must be identified. (GRA)

310

Esibyan, E.M., V.D. Docenko, R. Nitzsche, and B. Heinze

Plasma Cutting Device for Mechanical Cutting With Compressed Air

Zentralinstitut fuer Schweisstechnik 23(1):61-66 (1981, January)

Tests were run by the IES (Institute for Electrowelding, E.D. Paton-Kiev, USSR) and ZIS (Central Institute for Welding Technology, Halle, GDR) on mechanical cutting with compressed air. Photos of devices at IES VPR 10 and ZIS 814 are included. Schematics of the ZIS 814 and test charts are also included, as well as VPR 10 specifications and capacities. The results show that both devices display adequate cutting speed, surface values, and cathode-jet holding times. (EEJ)(PTO)

311

Esibyan, E.M., V.B. Malin, V.T. Pestunov, M.E. Domnich, and V.P. Kozyrev, E.O. Paton Welding Institute, Academy of Science, Ukraine, USSR

The DMEPR-1 Apparatus for the Plasma-Arc Welding and Cutting of Sheet Steel

Automatic Welding 32(5):39-40 (1979)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Technological failings and low output sometimes make it difficult to weld thin mild steels by the carbon dioxide process with carbon or consumable electrodes. Plasma-arc carbon dioxide welding, using the DNEPR-1 apparatus described herein and developed at the Paton Welding Institute, does not suffer from these failings. The apparatus can be used for either welding or cutting. (Auth)(JMF)

312

Feldman, M., F. Forcinal, J. Jacquemoud, and J. Schmitt

Welding Problems Raised by the Fabrication of the Large Bubble Chamber for the CERN

Soudage et Techniques Connexes 25(9/10):359-379 (1979, October)

Topics of discussion include: (1) characteristics of the work, austenitic steel used, problems raised at the welding stage, and selection of the processes; (2) manual arc welding, cracking sensitivity, low temperature magnetic and mechanical properties, conditions of execution, inspection methods; (3) electron beam welding, use of the process on large size boiler work parts, vacuum and guilding problems; (4) vertical electroslag welding, low temperature properties of the welded joints, conditions for making the longitudinal and circular joints, measurement of welding shrinkages; and (5) plasma cutting of up to 120 mm thick stainless steel. (Auth)(PTO)

313

Feldman, M.J., Oak Ridge National Laboratory, Oak Ridge, TN

Application of Remote Technologies to Decontamination and Decommissioning

Research Project (1980)

The objective of this program is to reduce personnel exposures by developing equipment and methods which increase the application of remote technology in decontamination and decommissioning of surplus nuclear facilities. Emphasis would be placed upon adapting existing technologies and equipment to a remote or semi-remote operating capability. General areas of interest would be surface removal, size reduction, cutting, compacting, and packaging. Initial efforts would be directed towards identifying the areas of decontamination and decommissioning that would benefit most from this approach and then selecting the remote mechanisms best suited for this application. This would be a multi-year program and would interface with many tasks being conducted in the Consolidated Fuel Reprocessing Program, including the development of a force-reflective manipulator system. It also contains many of the elements proposed in Task 700 of a Field Task Proposal entitled Applicaion of Remote Technology of LWR Maintenance and Repair. (SSIE)

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Freund, H.U., Battelle Institute, Frankfurt, Federal Republic of Germany

Practicality of Explosive Dismantling of Obsolete Nuclear Power Stations

Jahrestagung Kerntechnik '81 (Nuclear Technology '81), Proceedings of a Conference, Dusseldorf, Federal Republic of Germany, March 24-26, 1981. Deutsches Atomform E.V., Bonn, Federal Republic of Germany, (pp. 529-533), 628 pp. (1981)

The problems encountered in explosive demolition of reactors include shock and vibration effects on buildings, danger of flying debris, and emission of dust and toxic gases. It is noted that up to 10,000 tons of concrete from the biological shield may be radioactively contaminated. The author suggests that the shock passed to the reactor shield and foundations due to 10 kg of explosive could be similar to that which would be caused by an aircraft impact. Experiments on model blocks of concrete are discussed, and it is recommended that explosive demolition should be based on time-sequenced explosions. The maximum speed of debris expelled during the explosion is estimated to be 200 m/s, a speed at which the debris could be restrained by rubber mats. (INSPEC)(PTO)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

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Hazelton, R.F., R.A. Lundgren, and R.P. Allen, Battelle Pacific Northwest Laboratories, Richland, WA

Benefits of Explosive Cutting for Nuclear Facility Applications

PNL-3660; 77 pp. (1981, June)

The study discussed in this report was a cost/benefit analysis to determine: (1) whether explosive cutting is cost effective in comparison with alternative metal sectioning methods and (2) whether explosive cutting would reduce radiation exposure or provide other benefits. Two separate approaches were pursued. The first was to qualitatively assess cutting methods and factors involved in typical sectioning cases and then compare the results for the cutting methods. The second was to prepare estimates of work schedules and potential radiation exposures for candidate sectioning methods for two hypothetical, but typical, sectioning tasks. The analysis shows that explosive cutting would be cost effective and would also reduce radiation exposure when used for typical nuclear facility sectioning tasks. These results indicate that explosive cutting should be one of the principal cutting methods considered whenever steel or similar metal structures or equipment in a nuclear facility are to be sectioned for repair or decommissioning. (ERA)(PTO)

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Hodge, D.

Stainless Steel Profiling: A Review

Sheet Metal Industries 57(1):37-40, 69 (1980, January)

The two cutting processes considered are plasma-arc and laser. These systems effectively cover stainless steel profiling from 1152 mm thick plate down to 0.05 mm thick strip. The benefits of air plasma-arc cutting over Ar/H2 plasma-arc cutting are outlined. Air plasma outperforms other cutting processes (Ar/H2 plasma, conventional gas) for material thicknesses up to 25 mm. The advantages of lasers especially for sheet thicknesses below 3 mm are briefly considered. Some aspects of design and cost of plasma-arc and laser systems are discussed. (MEX)(JMS)

317

Kharitonov, E.P., G.I. Chepurkov, A.I. Kurnosov, L.B. Sabun, and A.N. Zhmotov

Plasma-Arc Surface Cutting of Low-Alloy Steels 10KhSND and 10KhN1M

Svarochnoe Proizvodstvo 27(11):33-34 (1980, November)

The use of plasma-arc surface cutting in preparation of steel 10KhSND and 10KhN1M articles for welding and for removal of defective segments of the welds had no adverse effect on the structure or the mechanical properties of the welded structures. The plasma arc surface cutting insured stable channel parameters during cutting in Arc and in nitrogen. (ARS)

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Koehler, G.W., and I. Weppner, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Development of Methods and Techniques for the Decommissioning and Ultimate Disposal of Nuclear Facilities

KFK-2500; 11th Semiannual Report, (pp. 559-562) (1977, December)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

The following possibilities are eligible in principle for waste conditioning: (1) conditioning the nuclear power station using exclusively the means available in the nuclear power station (feasible only for small sized low-level components); (2) conditioning in the nuclear power station with assistance from outside (preferably for decommissionings due to age); (3) conditioning in the nuclear power station of dismountable facilities (both in case of decommissioning due to age and failure and in case of component replacement); (4) conditioning in a central facility (both in case of decommissioning due to age and failure and in case of component replacement; major transport problems might be encountered, depending on the size of the component). Time scheduling covers all activities required to decommission a nuclear power plant. A subdivision into the following steps of planning is proposed; (5) preliminary planning (selection of concept followed by planning of true-scale decommissioning); (6) detailed planning (choice of individual steps, tools, auxiliaries, safety and health physics program. (EDB)(PTO)

319

Korotkov, G.I., and V.N. Kurilov

Industrial Application of AVPR-1M Equipment for Plasma-Arc Cutting

Welding Production 19(3):71-72 (1972, March)

The tests were carried out on KH18N10T steel at thicknesses of 10, 12, 36, and 45 mm. Mains air, purified of moisture and oil, was used at a pressure of 3 atm as the plasma-forming gas. The results of the tests showed that the angle of edge bevelling increases with reduction of the thickness of the metal being cut, reduction of air consumption and increase of cutting speed. (INSPEC)

320

Kusler, L.E., Atlantic Richfield Hanford Company. Richland, WA

Survey of Decontamination and Decommissioning Techniques

ARH-CD-984; 19 pp. (1977, May 25)

Reports and articles on decommissioning have been reviewed to determine the current technology status and also attempt to identify potential decommissioning problem areas. It is concluded that technological road blocks, which limited decommissioning facilities in the past have been removed. In general, techniques developed by maintenance in maintaining the facility have been used to decommission facilities. Some of the more promising developments underway which will further simplify decommissioning activities are: electrolytic decontamination which simplifies some decontaminating operations; arc saw and vacuum furnace which reduce the volume of metallic contaminated material by a factor of 10; remotely operated plasma torch which reduces personnel exposure; and shaped charges, water cannon and rock splitters which simplify concrete removal. Areas in which published data are limited are detailed costs identifying various components included in the total cost and also the qualtity of waste generated during the decommissioning activities. With the increased awareness of decommissioning requirements as specified by licensing requirements, design criteria for new facilities are taking into consideration final decommissioning of buildings. Specific building design features will evolve as designs are evaluated and implemented. (EDB)(JMF)

321

Mosiashvili, O.Y., R.N. Suladze, and I.I. Navdarashvili, Vniieso, Tbilisi, USSR

Differences Between Water-Electric and Gas-Electric Plasma Cutting

Welding Production 19(3):55-57 (1972, March)

In contrast to the gas-electric plasma cutting process, water is used in the water-electric process to stabilize the arc column and isolate it from the nozzle walls in the plasma gun. It has the simultaneous effect of cooling those parts of the plasma gun that heat up during cutting. It follows that the heated parts of the plasma gun need not be made from materials with such outstandingly good thermal conductivity properties as those required for the gas-electric process. (INSPEC)

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322
Schaefer, R., and H. Verhoeven

Under-Water Cutting and Under-Water Welding Production Techniques Used in Deep Sea Technology

Schweissen und Schneiden 24(9):349-353 (1972, September)

In view of current developments the present state of under-water cutting and welding, flame cutting and gas welding and of arc cutting and arc welding processes are reviewed. As far as development trends are concerned these have been greatly influenced by the expansion of sea-bed technology and a short report is given of plasma cutting and flame cutting at great depths, explosion cutting, mig welding, plasma welding, electron beam welding and of the firing of rivets. Finally questions relating to the development of 'dry welding' techniques carried out in submerged welding chambers are discussed. (INSPEC)

323
Shapiro, I.S.

Efficiency Evaluation of Arc Plasmatron for Metal Cutting

Svarochnoe Proizvodstvo 28(4):33-35 (1981, April)

Analysis revealed that the possible change of all parameters determining the arc formation in the nozzle channel of arc plasmatron was caused by the self-regulating process which characterized the reaction of gas-flow rate forming the arc. The external indicators of the self-regulating process was the gradient of pressure change in the arc-forming chamber. Exceeding the limits of allowable arc-plasmatron operating parameters was caused by the disruption of the self-regulating process. The data open the possibility of creating equipment characterized by a system of automatic control of plasma arc cutting. (ARS)

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Shapiro, I.S., A.S. Shalaev, and M.V. Tkachev

Plasma Arc Cutting with Pulsed Supply of Gas

Svarochnoe Proizvodstvo 25(3):46-49 (1978, March)

A special pulsator was developed for the discontinuous supply of plasma-forming gas in plasma-arc welding. The pulsator consists of a DC drive with a controllable number of revolutions, and a small reducing valve coaxial with the shaft of the drive. On the same axis there is a cam mechanism acting on the rod of the valve connected with a spring loaded closing cone. Commercial nitrogen passes to the pulsator through a flowmeter. When the cam presses onto the rod, the valve opens and the gas travels into the chamber of the plasma gun. When there is no contact between the cam and rod, the closing cone returns to the initial condition, interrupting the supply of gas at a frequency equal to the rate of rotation of the cam (2-18 HZ). The effect of current and cutting speed on the width of cut and also on arc voltage in cutting with pulsed and continuous supply of gas is plotted and discussed. (INSPEC)

325
Spelbrink, H., Defense Research Information Centre, Orpington, England

Plasma Arc Welding and Plasma Arc Cutting Seen from the Viewpoint of Industrial Health

DRIC-TRANS-3453; 11 pp. (1974, January)

The changing concept of plasma to thermic plasma as seen by the natural scientist is explained. Basic technical and physical facts of plasma arc welding and cutting are briefly described so that possible health risks may be understood. Potential areas of technical application (temperatures up to 30,000 C) in thermochemistry, space technology, and surface welding are mentioned. Health risks which may be caused by excessive noise, ultraviolet radiation, and fumes, smoke, and gas formation are indicated various points are summarized in table form, presenting a synopsis of preventive measures for both outdoor and indoor work. (Auth)

326

Stalker, A.W.

From Oxy-Fuel to the Shaped Charge - and Beyond

Welding and Metal Fabrication 48(5):303-313 (1980, June)

The present position of underwater cutting techniques is reviewed. Oxy-arc cutting with tubular steel electrodes is the most widely used technique. It is capable of dealing with 40 mm thick steel and has largely replaced oxy-fuel gas cutting. Other techniques discussed include manual metal arc cutting for non ferrous metals, mechanical cutting, thermal lance cutting, the use of shaped explosives, exothermic reaction cutting and oxy-arc cutting using a carbon electrode and an associated water jet. Consumable electrode water jet methods and arc plasma techniques being developed look promising. Other possibilities for new methods of underwater cutting are also discussed. (DB)(PTO)

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Stalker, A.W., The Welding Institute, Research Laboratory, Abington, Cambridge, England

A Survey of Underwater Cutting Techniques - Final Report

WI-3481/1/75 (1975, August)

The only documented practical use of underwater plasma cutting is in the dismantling of nuclear reactor components in both the USA and Italy. In particular, the cutting of components in the Homogenous Reactor Equipment No. 2 (HRE-2) has been well covered in the literature. After initial laboratory trials a remotely operated torch was developed with associated manipulating devices. The torch itself was a heavy duty air welding plasma torch with minor modifications to make it waterproof. Argon was used throughout as the plasma gas and because there was no immediate hazard to personnel it was again possible to use high frequency spark starting. Cutting condtions for a wide variety of materials including aluminium, stainless steel, Zircaloy-2, copper, carbon steel and Hastelloy N in thicknesses up to 25mm and water depths down to 3.3m are presented. Typical of these conditions are those required for cutting 25mm thick carbon steel which are reported as a current of 600A, at a travel speed of 635 mm/min with an argon flow rate of 190 l/min. The extension of this technique to material thicknesses up to 37 mm at a water depth of 3.7 m, conditions encountered in the Elk River Reactor (ERR), Minnesota was described in work by Wodtke and Pluckett. Nitrogen was used as the plasma gas in this case but, because arc starting was not reliable in pure nitrogen, a pre-flow of argon was used to aid arc starting. During non-arcing periods the arc chamber was continuously flushed with air. Since that time the capability of the technique has been proved on materials up to 75 mm thick. The use of plasma cutting on these reactor components is in some respects a special case since it is a dismantling operation with a requirement for precise cuts. Most of the development work has been concentrated on the remote handling and control functions. The plasma cutting technology is merely an extension of air cutting practice with a waterproofed torch and modified cutting condtions. Because there was an essential requirement for the components to be completely severed travel speed was programmed to be slower at the start and finish of each cut. (Auth)(PTO)(NPK)

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Tips for Efficient Plasma Arc Cutting (PAC)

Welding Design and Fabrication 54(12):59-61 (1981, December)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT ANC DEMOLITION

Various guidelines are presented to assist in plasma arc cutting. Dross curves are given for water injection cutting to produce dross-fire cuts on stainless and mild steel. Parameters are listed for water-injection and water-injection high-current cutting of mild steel, stainless steel and Al. A cost comparison is presented for water-injection plasma vs. oxyacetylene cutting of various thicknesses of metal. Suggestions are also given for combating environmental problems such as smoke, noise and ultraviolet radiation. (GGM)

329

Yada, T., U. Nakamura, S. Tomidokoro, and M. Fukuzawa

Study on Underwater Plasma Arc Cutting Technology

Ishikawajima-Harima Engineering Review 20(6):406-410 (1980, November)

The zirconium alloy tube of the in-pile creep test facility had been subjected to inner pressure in the Japan Material Testing Reactor (JMTR) environment. In the near future, it will be necessary to dismantle the facility and to take out the tube for such examinations as irradiation effects on material properties. In order to establish the dismantling technology for the radioactive facility, a study on underwater plasma arc cutting has been carried out since 1977. Primarily, optimum underwater cutting sequence and conditions were studied in details for developing the remote control handling and the cutting system. Further, the amounts of particles suspended in water as well as those contained in bubbled gas were quantitatively analyzed for developing a safe removal system for contaminants which were produced by cutting the radioactive material. As a result of this study, it has been concluded that the underwater plasma arc cutting method is generally suitable and effective for dismantling such radioactive material as the in-pile creep test facility of the JMTR. (JMF)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING LAND DECONTAMINATION AND RECLAMATION

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Chester, C.V., G.A. Cristy, and H.C. Jernigan, Oak Ridge National Laboratory, Oak Ridge, TN

Environmental Decontamination

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979; 256 pp. (1981, February)

The Environmental Decontamination Workshop, conducted by the Solar and Special Studies Section of the Energy Division, Oak Ridge National Laboratory, was held in conjunction with DOE's program development toward decontamination plans and procedures. There were 27 invited papers presented to a group who have had experience with decontamination problems. The speakers represented various industries, natic nal laboratories, and DOE. Each presented state-ot-the-art information learned from actual participation in environmental decontamination projects. The data base formed by these presentations covers most of the U.S. experience (and some USSR developments) in environmental decontamination. Most of the papers have been abstracted separately. (CAJ)

331

Healy, J.W., and J.C. Rodgers, Los Alamos Scientific Laboratory, Los Alamos, NM

A Preliminary Study of Radium-Contaminated Soils

LA-7391-MS; 45 pp. (1978, October)

A preliminary study was made of the potential radiation exposure to people from radium contamination in the soil in order to provide guidance on limits to be applied in decontaminating land. Pathways included were inhalation of radium from resuspension; ingestion of radium with foods; external gamma radiation from radium daughters; inhalation of radon and daughter, both in the open air and in houses; and the intake of lead-210 and polonium-210 from both inhalation and ingestion. The depths of the contaminated layer is of importance for external exposure and especially for radon emanation. The most limiting pathway was found to be emanation of the radon into buildings with limiting values comparable to those found naturally in many areas. (Auth)

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Jayaraman, A.P., and S. Prabjakar, Bhabha Atomic Research Centre, Desalination Division, Bombay, India

The Uptake of Cs-137 and Sr-90 by Water Hyacinth and Its Decontamination Potential as an Approach to Zero Release Concept

IAEA-SM-257; Migration in the Terrestrial Environment of Long-Lived Radionuclides fr m the Nuclear Fuel Cycle, Proceedings of an International Symposium, Knoxville, TN, July 27-31, 1981, (18 pp.) (1981, July)

The decontamination potential of water hyacinths (Eichhornia crassipes) is discussed in the context of the concept of zero release of radioactivity to the aquatic environment. Series of static 24-hou laboratory experiments were conducted with Cs-137 and Sr-90 which are the two principal, long-lived and hazardous radionuclides of concern in waste management. Uptake characteristics were delineated for both the radionuclides as functions of contact time, specific activities and pH. Absorption was found to be increasing with increasing specific activities with higher percent removal at lower specific activities. The decontamination features for the radionuclides are presented under varying parameters. The response of the biomass was studied to a mixed system of Cs-137 and Sr-90 as well as to radioactive liquid effluent specimens. The distribution of radionuclides in the biomass was determined in translocation studies. Most of the radioactivity was localized in the roots with marginal translocation to leaves in the case of Sr-90. Studies demonstrated water hyacinths as a

potential sorption matrix with significant decontamination properties, volume reduction characteristics, and tolerance to pH variation. (Auth)(PTO)

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Trabalka, J.R., Oak Ridge National Laboratory, Oak Ridge, TN

Russian Experience

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 3-8), 256 pp. (1981, February)

Russian literature on radioecology and decontamination of soils indicates that most efforts have been directed toward contamination which deals with relatively large land and water areas in the Urals, resulting from a major nuclear accident. Soviet research in terrestrial decontamination has paralleled that of the U.S. except for long-term evaluations (10-20 years) which have been carried out at one nuclear accident site. New information acquisition in aquatic decontamination seems to offer the most intriguing possibility. This type of hydrologic isolation system is only possible in systems which have relatively low flow rates and a net annual evaporation-precipitation deficit, unlike the areas in the U.S. chosen because of the large volumes of water available for more efficient, flow through cooling systems. Control of accidental contamination releases could be an important criterion in nuclear plant siting, and self-contained cooling reservoirs would appear to provide an option for containment of accidental releases. The author expresses the hope that Soviet reluctance to share detailed information about the sources and consequences of extensive environmental contamination near a nuclear site in the Urals, will be overcome. Soviet experience is clearly unique, and would be invaluable to the world nuclear community. (CAJ)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

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Brewitz, W., and R. Stippler, Gesselleschaft fur Strahlen und Umweltforschung, Braunschweig, Federal Republic of Germany

Final Disposal of Decommissioning Wastes in the Federal Republic of Germany

Atomkernenergie Kerntechnik 39(2):105-111 (1981)

The waste disposal concept of the Federal Republic of Germany for nuclear power plants provides for the final disposal of radioactive waste in deep geological formations and mines. The radiological safety of such a repository depends on a system of multiple barriers of which the geological barrier is the most important one. The isolation concept must guarantee the waste to decay below the limiting values of the German Radiation Protection Regulation within the repository. The expected total decommissioning waste masses from 12 nuclear power plants operating in the Federal Republic of Germany amounts to approximately 85 million kg. Two mines are under consideration as repositories for the final disposal of the wastes. The pilot repository in the Asse II salt mine is presently being licensed, and Konrad, an abandoned iron ore mine, will probably be licensed in 1982. Capacity and efficiency calculations have shown that both mines have the technical requirements needed for the disposal of present and future decommissioning and operating wastes from nuclear power plants. (Auth)(PTO)

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Commission of the European Communities, Luxembourg; Societe Technique pour l'Energie Atomique, Centre d'Etudes Nucleaieres de Saclay, France

Management of Wastes from Dismantled Nuclear Power Plants

EUR-6359; 74 pp. (1979)

The problems associated with the management of radioactive wastes encountered in the dismantling of a 1200 MWe PWR reactor are considered. It is possible to extend the conclusions reached in these studies to BWR's or other reactors using light water as a coolant and moderator. The studies performed established the following specific waste characteristics: (1) a gamma activity due essentially to Co-60 (after some fifty years this radioisotope will have decayed sufficiently to enable it to be stored without shielding); and (2) the presence of Ni-63 and Ni-59 (these long half-life beta emitting radioisotopes need to be stored over a long or even indefinite period of time). The reselling of these contaminated components will involve costly decontaminating processes. Extensive studies have been conducted on the following aspects of waste management: packaging; transporting; processing; and storing. Further developments in concentration methods (fusion, crushing, cyrogenics etc.) and the selection of storage sites for this type of waste are necessary. Depending on the solutions chosen, the global cost of the wastes coming from a 1200 MW PWR reactor can vary between 10 and 20 million BFR. (EDB)(PTO)(JMF)

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Copeland, G.L., and R.L. Heestand, Oak Ridge National Laboratory, Oak Ridge, TN

Volume Reduction of Contaminated Metal Waste

CONF-800313; Waste Management '80: The State of Waste Disposal Technology, Mill Tailings, and Risk Analysis Models, M.E. Wacks (Coord.) and R.G. Post (Ed.), Proceedings of a Symposium, Tucson, AZ, March 10-14, 1980, Vol. 2, (pp. 425-433), 754 pp. (1980)

Two approaches are presently being investigated to minimize the volume of metal scrap through melting: simple volume reduction by melting, and removing the metal from the waste stream entirely by removing contaminants from the metal and verifying the radioactive nuclide content of the resulting ingots. The uniformity of ingots may allow the metal to be certified as uncontaminated. The results of two different types of experiments

are presented here. Laboratory melts of various metals were made to compare the observed partitioning of uranium to the slag with that calculated from thermodynamic considerations. Next an engineering-scale demonstration was conducted in which a typical batch of metal scrap was contaminated with UO2 and processed through the proposed handling plan including mechanical size reduction, drip melting, and induction melting. Conclusions are that volume reduction will be achieved by melting metal scrap into ingots of a shape and size desirable for disposition. The amount of volume reduction varies depending on the original configuration of the scrap. Another advantage of melting combined with the decontamination achieved is the ability to verify the radioactive content of the metal ingots. Then either the metal can be sold as clean scrap metal or treated as industrial waste and shallow-land buried rather than more complexly and expensively managed. (CAJ)

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Copeland, G.L., and R.L. Heestand, Oak Ridge National Laboratory, Oak Ridge, TN

Volume Reduction of Contaminated Metal Waste by Melting

Research Project; Contract No. ONL-WT03(11) (1980)

The task supports the national TRU waste program of the Rocky Flats Plant, Rockwell International, and addresses the decontamination and volume reduction of TRU contaminated metal wastes by melting. Laboratory scale work will determine the propensity of TRU contaminants to concentrate in the slag and clean the metal. Particulate products of melting (metal shot and granular slag) will be investigated for possible incorporation into grout for hydrofracture. The technology of size reduction and melting will be demonstrated on a small pilot plant scale. (SSIE)

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Copeland, G.L., B. Heshmatpour, and R.L. Heestand, Oak Ridge National Laboratory, Oak Ridge, TN

Melting Metal Waste for Volume Reduction and Decontamination

CONF-800802; Proceedings of the 89th Annual Meeting of the American Institute of Chemical Engineers, Portland, OR, August 17, 1980 (1980, August)

Melt-slagging was investigated as a technique for volume reduction and decontamination of radioactively contaminated scrap metals. Experiments were conducted using several metals and slags in which the partitioning of the contaminant U or Pu to the slag was measured. Concentrations of U or Pu in the metal product of about 1 ppm were achieved for many metals. A volume reduction of 30:1 was achieved for a typical batch of mixed metal scrap. Additionally, the production of granular products was demonstrated with metal shot and crushed slag. (ERA)(GRA)

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Copeland, G.L., B. Heshmatpour, and R.L. Heestand, Oak Ridge National Laboratory, Metals and Ceramics Division, Oak Ridge, TN

Melting Metal Waste for Volume Reduction and Decontamination

ORNL/TM-7625; 12 pp. (1981, March)

Melt slagging was investigated as a technique for volume reduction and decontamination of radioactively contaminated scrap metals. Experiments were conducted with several metals and slags in which the partitioning of the contaminant uranium or plutonium to the slag was measured. Concentrations of uranium or plutonium were reduced to about 1 ppm in many of the metals. The volume of a typical batch of mixed metal scrap was reduced 30 times. Additionally, granular metal shot and crushed slag were produced. These granular products are suitable for suspending in grout mixtures used for permanent disposal through the shale hydrofracture technique. (Auth)

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Gasch, A., and G. Loercher, NIS Nuklear-Ingenieur-Service GmbH, Frankfurt, Federal Republic of Germany

Quantitative Mass Flow Analysis for Radioactive Waste from Nuclear Power Plant Decommissioning

INIS-MF-4815; 180 pp.

The purpose of this study is to investigate the accumulation of radioactive waste resulting from the dismantlement of nuclear power plants. The study takes into consideration the installed and planned nuclear power plants until 1985. The study is based on the revised version of the energy program (November 1976) of the Bundesregierung in which an installed nuclear electric power capacity of 35000 MW in 1985 is assumed. On the basis of reference nuclear power plants, the various kinds of waste and the amount of radioactivity generated are calculated. There will be 288.69 Mg of radioactive waste, after the last considered nuclear power plant will have been dismantled, and the sum of radioactivity will be about 100 million curies at that time. A classification of the waste is made by considering the dose rates on the surface and by considering recommendations of the IAEA. The same type of investigations are made when dismantlement after a loss-of-coolant accident. The results give input data for the handling, transportation and burial of radioactive wastes. The present study has better input data and calculation methods than studies previously conducted. (EDB)(JMF)

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Gerding, T.J., M.G. Seitz, and M.J. Steindler, Argonne National Laboratory, Argonne, IL

Salvage of Plutonium- and Americium-Contaminated Metals

AIChE Symposium Series 75(191):118-127; CONF-771102; Nuclear Engineering Questions: Power, Reprocessing, Waste, Decontamination, Fusion, R.D. Walton, Jr. (Ed.), Proceedings of the 70th Annual AIChE Meeting, New York, NY, November 13, 1977, (pp. 118-127), 228 pp. (1979; 1977)

Melt-slagging techniques were evaluated as a decontamination and consolidation step for metals contaminated with oxides of plutonium and americium. Experiments were performed in which mild steel, stainless steel, and nickel metals contaminated with oxides of plutonium and americium were melted in the presence of silicate slags of various compositions. The metal products were low in contamination, with the plutonium and americium strongly fractionated to the slags. Partition coefficients (plutonium in slag/plutonium in steel) of 7 million with borosilicate slag and 3 million for calcium, magnesium silicate slag were measured. Decontamination of metals containing as much as 14,000 ppm plutonium appears to be as efficient as that of metals with plutonium levels of 400 ppm. Staged extraction, that is, a remelting of processed metal with clean slag, results in further decontamination of the metal. The second extraction is effective with either resistance furnace melting or electric arc melting. Slag adhering to the metal ingots and that in defects within the ingots are the important contributors to plutonium retained in processed metals. With control of these sources of plutonium, the melt-refining process can be used on a large scale to convert highly contaminated metals to homogeneous and compact forms with very low concentrations of plutonium and americium. (Auth)(PTO)

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Heshmatpour, B., and G.L. Copeland, Oak Ridge National Laboratory, Oak Ridge, TN

Effects of Slag Composition and Process Variables on Decontamination of Metallic Wastes by Melt Refining

ORNL/TM-7501; 35 pp. (1981, January)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

Melt refining has been suggested as an alternative for decontamination and volume reduction of low-level-contamined metallic wastes. Knowledge of metallurgical and thermochemical aspects of the process is essential for effective treatment of various metals. Variables such as slag composition, melting technique, and refractory materials need to be identified for each metal or alloy. Samples of contaminated metals were melted with fluxes by resistance furnace or induction heating. The resulting ingots as well as the slags were analyzed for their nuclide contents, and the corresponding partition ratios were calculated. Compatibility of slags and refractories was also investigated, and proper refractory materials were identified. Resistance furnace melting appeared to be a better melting technique for nonferrous scrap, while induction melting was more suitable for ferrous metals. In general, uranium content of the metals, except for aluminum, could be reduced to as low as 0.01 to 0.1 ppm by melt refining. Aluminum could be decontaminated to about 1 to 2 ppm uranium when certain fluoride slags were used. The extent of decontamination was not very sensitive to slag type and composition. However, borosilicate and basic oxidizing slags were more effective on ferrous metals and Cu; $NaNO_3$-NaCl-NaOH type fluxes were desirable for Zn, Pb, and Sn; and fluoride type slags were effective for decontamination of Al. Recrystallized alumina proved to be the most compatible refractory for melt refining both ferrous and nonferrous metals, while graphite was suitable for nonferrous metal processing. In conclusion, melt refining is an effective technique for volume reduction and decontamination of contaminated metal scrap when proper slags, melting technique, and refractories are used. (GRA)(PTO)

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Heshmatpour, B., and G.L. Copeland, Oak Ridge National Laboratory, Metals and Ceramics Division, Oak Ridge, TN

Metallurgical Aspects of Waste Metal Decontamination by Melt Refining

Nuclear and Chemical Waste Management 2(1):25-31 (1981)

Melt refining has been suggested for decontamination and volume reduction of metallic wastes. Knowledge of metallurgical aspects of the process is essential for effective treatment of various metals. Samples of several metals were contaminated and melted with various fluxes. The resulting ingots as well as the slags were analyzed for their nuclide contents. The compatibility of slags and the refractories was also investigated. Resistance furnace melting was found to be a better melting technique for nonferrous scrap, while induction melting is more suitable for ferrous metals. Analyses of the samples showed that the extent of decontamination was not very sensitive to slag type and composition. However, borosilicate and basic oxidizing slags were more effective on ferrous metals and Cu; $NaNO_3$-NaCl-NaOH fluxes were desirable for Zn, Pb, and Sn; and fluoride slags were effective for Al. Recrystallized alumina was the most compatible refractory for melt refining of both ferrous and nonferrous metals. Melt refining was shown to be an effective method for volume reduction and decontamination of contaminated metal scrap. (Auth)(PTO)

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Heshmatpour, B., G.L. Copeland, and R.L. Heestand, Oak Ridge National Laboratory, Oak Ridge, TN

Granulation of Slags and Metals after Melt Refining of Contaminated Metallic Wastes

Nuclear and Chemical Waste Management 2(1):33-37 (1981)

Melting under an oxidizing slag is an attractive method of decontaminating and reducing the volume of radioactively contaminated metal scrap. The contaminants are concentrated in a relatively small volume of slag, which leaves the metal essentially clean. A potential method of permanent disposal of the resulting slags (and metals if necessary) is to emplace them into deep shale by grout hydrofracture. Suspension of the slag and metal in grout mixtures requires that they be granular. The feasibility of size-reducing the slags and disintegrating the metals and subsequently incorporating them into grout mixtures was demonstrated. Various types of slags were crushed into particles smaller than 3 mm. Several metals were melted and water blasted into coarse powders ranging in size from 0.05 to 3 mm. Results indicated that the crushed slags and the coarse metal powders are suspendable in grout fluids, and are probably disposable by shale hydrofracture. (Auth)(CAJ)

345
Hine, R.E., EG&G Idaho, Inc., Idaho Falls, ID

D&D Waste Volume Reduction Study

PR-W-79-032; 70 pp. (1979, September)

A study to determine the types of contaminated wastes generated during the D&D of a reactor facility, the handling requirements for these waste materials, and the potential for different volume reduction techniques is presented. The types of contaminated waste generated by the D&D of a nuclear facility are identified; the most voluminous being soil and steel components, both of which are very inefficient in burial space utilization. Several waste disposal concepts are considered for metallic waste items. Their most prominent features are compared and tabulated. Mechanical compaction and smelting are recommneded over the present method of handling contaminated metals. The mechanical compactor considered was a very heavy duty machine, but it is still limited by the size and shape of material input. The smelting concept appears to be the more commonly used and economical in the long term, but a major drawback is the need for obtaining clearance to release the decontaminated metals to industry. If the smelted metals could not be sold, then the compactor is the more ecnomical system. This study demonstrates the feasibility of using a smelter for volume reduction of the projected long range D&D metallic wastes at INEL. It is recommended that a second phase study be conducted to more precisely evaluate the cost benefits and limitations of smelting industrial and defense waste metals. (CAJ)

346
Kirk, J., United Kingdom Atomic Energy Agency, Dounreay Nuclear Power Development Establishment, Dounreay, United Kingdom

DFR Decommissioning: Operating Instructions for NaK Disposal by Burning in Atomized Jet (LMFBR)

DFR/OIN-1; 4 pp. (1979, July)

The complete operation comprises four distinct phases as follows: initial plant checks; starting and maintaining good burning conditions; operational monitoring; shut down, including emergency shut down; and residue disposal. (EDB)

347

Measures for the Shut-Down of KRBI

ETR-300; Bibliography of the Eurochemic Technical Reports Published During the Period 1958-1979, W. Drent and E Delande (Eds.), Ch. 1, (pp. 13-14) (1980, April)

According to present knowledge there is no final storage available for radioactive waste from dismantling on a long term basis; therefore a safe enclosure for nuclear power plant Unit A is sought. This requires the waste management of radiation sources such as fuel elements, control rods, fuel element containers, etc., and includes planning of intermediate storing of radiated plutonium fuel elements at Gorleben. Meanwhile the utility has applied for the license to decommission Unit A according to regulations. (CAJ)

348
Nair, S., Central Electricity Generating Board, Research Division, Berkeley Nuclear Laboratories, London, England

Preliminary Assessment of the Waste Disposal Problem for Magnox Steels

CEGB-RD/B/N-4291; 78 pp. (1978, May)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

A methodology has been described which can be used to assess the relative radiological toxicities of activation products over geological timescales. A computer code, STRUMP, was written to assist in this assessment. The methodology was applied to an evaluation of the radiological implications of the waste disposal problem for decommissioned fixed steel components in Magnox reactors. The study concluded that the radiotoxicity of the activated steels was dominated, to a varying extent, by the isotopes nickel-63 and nickel-59 for timescales up to 400,000 years. An attempt was made to estimate toxicity levels corresponding to the activity limit of 1 X 10(E-11)Ci/g below which radioisotopes may be considered stable. The study indicated that steels activated in conditions typical of those encountered by large mass components in the core mid-plane of the core restraint structure became safe for unrestricted disposal only at about a million years. (GRA)(PTO)

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Nair, S., Central Electricity Generating Board, Research Division, Berkeley Nuclear Laboratories, London, England

A Preliminary Assessment of the Waste Disposal Problem for Magnox Steels

RD/B/N4291; DECOMM78/4; 24 pp. (1980, May)

A methodology has been described which can be used to assess the relative radiological toxicities of activation products over geological timescales. A computer code, called STRUMP, has been written to assist in this assessment. The methodology has been applied to an evaluation of the radiological implications of the waste disposal problem for decommissioned fixed steel components in Magnox reactors. The study concluded that the radiotoxicity of the activated steels was dominated, to a varying extent, by the isotopes Ni-63 and Ni-59 for timescales up to 400,000 years. An attempt was made to estimate toxicity levels corresponding to the activity limit of 10(E-11) Ci/g below which radioisotopes may be considered stable. The study indicated that steels activated in conditions typical of those encountered by large mass components in the core mid-plane of the core restraint structure became safe for unrestricted disposal only at about a million years. (Auth)(PTO)

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National Technical Information Service, Springfield, VA

Volume Reduction and Decontamination of Metals by Melt Refining

NTIS Technical Note; 1 p.; PB-81-970844 (1981, November)

This technical note summarizes a one-page announcement of technology available for utilization. Laboratory experiments have shown that slag melting of metals contaminated with uranium and transuranics concentrates the contaminants in the slag and cleans the metal. The maximum volume reduction obtained in melting metal scrap is 30:1. The decontamination achieved may enable some metals to be recycled, or at least placed in a less costly waste stream. The much smaller volume of contaminated slag requires less costly disposal techniques. Laboratory and bench scale experiments have demonstrated that decontamination and volume reduction is achievable by melt refining. Melting of metals under a slag cover is a well-developed, commercial process. Disposal requirements and available burial space are making the disposal of radioactively contaminated scrap increasingly difficult. Melting for volume reduction and decontamination simplifies either interim storage or final regulations. The shape and homogeneity of the ingot product allows certification of the cleanliness level which may not have been possible prior to melting. (EDB)(RHB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

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Decommissioning of Nuclear Power Plants

Naturwissenschaften 66(3):154-156 (1979, March)

A brief survey is given of some decommissioned nuclear power plants according to plant type/reactor type, thermal and electric (gross) power, mode and year of decommissioning. (EDB)(PTO)

352

Heller, H., and H. May, Gesselschaft fuer Reacktorsicherheit, Koeln, Federal Republic of Germany

Decommissioning of Nuclear Power Plants - Safety Aspects - Comments on Nuclear Energy Problems

GRS-S-31; 40 pp. (1979, December)

The stages of decommissioning a nuclear power plant are presented. The two alternatives are safe containment of activated and highly contaminated components within the nuclear power plant unit or dismantling of all components and buildings. Stage 1 provides for safe containment in (a) previously sealed buildings without any dismantling; (b) containment resp. reactor building; and c) underground structures. Stage 2 provides for partial dismantling with safe containment of the remaining parts (a) within the biological shield and (b) underground, after dismantling the parts above ground level. Stage 3 provides for total dismantling. (EDB)(PTO)

353

Korman, P., and J. Harding, Friends of the Earth Foundation, San Francisco, CA

The Nuclear Blowdown: The High Price of Burying Dead Reactors

Not Man Apart 10(12):16-17 (1980, December)

This article, written for Friends of the Earth Foundation, provides basic, non-technical information concerning reactor shutdowns. Examples are provided which detail the cost of decommissioning reactors and methods of decontamination and dismantlement. (PTO)(CAJ)

354

Pradel, M., Electricite de France, Chinon, France

Decommissioning of Chinon 1

Revue Generale Nucleaire 3:173-176 (1978)

The various alternatives considered for the decommissioning of Chinon 1 are described, and an analysis of the final alternative selected is presented. The choosen alternative is normal containment with survey of the plant. (EDB)(RHB)

355

Shepherd, L.R., International Atomic Energy Agency, Vienna, Austria

OECD/NEA High Temperature Reactor Project (DRAGON)

INFC/DEP/WG-8/100; 2 pp. (1978, October)

This report gives a survey of the history of the Dragon project and information pertaining to construction, operation and decommissioning of this reactor type. (EDB)(PTO)

356

Vesterhaug, O., T.O. Sauar, and P.O. Nielsen, Scandpower A/S, Oslo, Norway

Costs of Nuclear Power

SCP-2.34.06 (Rev. 2); 105 p. (1979, February 6)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

A study has been made by Scandpower A/S of the costs of nuclear power in Sweden. It is based on the known costs of existing Swedish nuclear power plants and forecasts of the expected costs of the Swedish nuclear power program, special emphasis has been put on the fuel cycle costs and future costs of spent fuel processing, waste disposal and decommissioning. Costs are calculated in 1978 Swedish crowns, using the retail price index. An actual interest rate of 4% is used, with depreciation period of 25 years and a plant lifetime of 30 years. Power production costs are estimated to be about 7.7 ore/kWh in 1978, rising to 10.5 ore/kWh in 2000. The cost is distributed with one third each to capital costs, operating costs and fuel costs, the last rising to 40% of the total at the end of the century. The main single factor in future costs is the price of uranium. If desired, Sweden can probably be self-sufficient in uranium in 2000 at a lower cost than assumed here. National research costs which, in Scandpower's opinion, can be debited to the commercial nuclear power programme are about 0.3 ore/kWh. (EDB)(PTO)

Chapter 3

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

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Berven, B.A., H.W. Dickson, W.A. Goldsmith, W.M. Johnson, W.D. Cottrell, R.W. Doane, F.F. Haywood, M.T. Ryan, and W.H. Shinpaugh, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Survey of the Former Kellex Research Facility, Jersey City, New Jersey

DOE/EV-0005/29; ORNL-5734; 124 pp. (1982, February)

A radiological survey has been conducted at the site of the former Kellex Corporation Research Facility in Jersey City, New Jersey. Kellex played a major role in the Manhattan Project, particularly in the area of engineering research in gaseous diffusion for uranium enrichment. As a result of those operations and subsequent work with radioactive materials, this site was selected for a radiological survey by the Department of Energy (DOE) [then Energy Research and Development Administration (ERDA)] in its program aimed at reviewing and documenting the radiological status of properties associated with early source material contracts. The survey included measurement of external gamma radiation, beta-gamma surface dose rates, alpha and beta surface contamination, concentrations of selected radionuclides in surface and subsurface soil and water on the site, and background radiation in the northern part of New Jersey. The results of the radiological survey indicate radionuclide concentrations in the soil and water on the former Kellex property are within background levels, with the exception of nine isolated and well-defined areas on the site of the former Kellex Laboratory. The mean external gamma-ray exposure rates observed on the Kelelx site (6.6 uR/hr) were similar to those mean background exposure rates observed in northern New Jersey (6.1 uR/hr). The exposure guideline for an individual in the general public is 500 mrem/yr, which is considerably higher than any conceivable exposure that an individual might receive on the Kellex site. Results of soil and water samples show the radionuclide concentrations are at normal background levels on the site except for samples originating from the nine contaminated areas. The average soil concentrations of radionuclides found on the site, exculding those nine areas, were 1.2 pCi/g of Ra-226, 1.2 pCi/g of Th-232, and 1.2 pCi/g of U-238. These were not statistically different from the background levels found in the northern part of the state of New Jersey. From the nine areas, maximum radionuclide concentrations of U-238, Ra-226, and Th-232 in surface soil were 2,100 pCi/g (Area 6), 340 pCi/g (Area 2), and 4,300 pCi/g (Area 1), respectively. Radionuclide concentrations in on-site water samples were at least an order of magnitude below accepted concentratin guidelines for drinking water. The nine areas containing higher-than-background concentrations of radioactive material constitute a total area of approximately 3,350 sq m (0.83 acre). These areas contain varying mixtures of radionuclides from the uranium and thorium decay chains in concentrations significantly above background exceeding federal guidelines. An evaluation of potential hazard relative to the contamination present in these nine areas is presented. (Auth)(PTO)

358

Berven, B.A., W.A. Goldsmith, F.F. Haywood, and K.J. Schiager, Oak Ridge National Laboratory, Oak Ridge, TN; ALARA, Inc., Lyons, CO

Proposed Training Program for Construction Personnel Involved in Remedial Action Work at Sites Contaminated by Naturally Occurring Radionuclides

CONF-791203; Proceedings of a Health Physics Society Meeting, Honolulu, HI, December 10, 1979, (11 pp.) (1979, December)

Many sites used during the early days of the U.S. atomic energy program are contaminated with radionuclides of the primordial decay chains (uranium, thorium, and actinium series). This contamination consists of residues resulting from refining and processing uranium and thorium. Preparation of these sites for release to unrestricted private use will involve the assistance of construction workers, many of whom have limited knowledge of the hazards associated with radioactive materials. Therefore, there is a need to educate these workers in the fundamentals of radioactive material handling to minimize exposures and possible spread of contamination. This training should disseminate relevant information at an appropriate educational level and should instill a cautious, common-sense attitude toward the handling of radioactive materials. The training should emphasize

basic information concerning environmental radiation within a context of relative risk. A multi-media format, including colorful visual aids, demonstration, and discussion, should be used to maximize motivation and retention. A detailed, proposed training program design is presented. (GRA)

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Berven, B.A., T.E. Myrick, F.F. Haywood, and W.A. Goldsmith, Oak Ridge National Laboratory, Oak Ridge, TN

Role of the Certifying Radiological Contractor in Decontamination and Decommissioning Projects

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (pp. 23-24), 52 pp. (1981, June)

Large-scale efforts are currently being initiated to decontaminate and decommission public and private properties designated as candidates for clean-up under the Uranium Mill Tailings Radiation Control Act of 1978, and the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). Following completion of remedial action, it is necessary to provide assurance by an independent certification agency that site conditions are within pertinent federal and state radiological guidelines. Oak Ridge National Laboratory (ORNL) will serve a major role in this capacity. The certifying agency in any decontamination and decommissioning project must perform a number of functions. The remedial action engineering plan must be reviewed with specific attention given to the radiological contractor's survey plan, instrumentation, and quality assurance program. Also, all pertinent federal and state guidelines must be reviewed for their applicability to each site. The certifying agent must prepare a radiological survey plan including independent sampling and analysis. Samples collected by the radiological contractor are normally divided into three portions for analysis by as many analytical laboratories. Through overview activities, the certifying agent should monitor compliance by the radiological contractor with the approved remedial action plan. The certifying agent should conduct a radiological survey according to his plan, following the remedial action and final radiological contractor survey. Finally, the certifying agent must review all survey results, document pertinent information, and confirm the adequacy of remedial actions. An illustration of this process is presented for a current DOE remedial action project in Middlesex, New Jersey.

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Boyer, J.W., N.D. Adair, T.A. Poff, and J.A. Brown, National Lead Company of Ohio, Cincinnati, OH

Phase 1 Remedial Action of Properties Associated with the Former Middlesex Sampling Plant Site

NLCO-006EV (1981, September)

The Phase I remedial action work was successfully completed during 1980 at the Middlesex Sampling Plant. In addition to the two properties included in the original scope of work, three other properties were decontaminated. In the playground across the street from the rectory, contaminated soil was discovered and subsequently removed. Later, at the request of the DOE, the Kays and Rosamilia properties were decontaminated. Work completed at Middlesex, together with the lessons learned during the execution of the entire project, is indicative that future decontamination assignments can be accomplished with mutual benefits for the U.S. Department of Energy, as well as the local citizens. Restoration of the rectory and the William Street property exemplifies the excellence of work performed by the remedial action subcontractors and is further evidence of the success of the Phase I work. A summary of the Phase I costs are tabulated. A report is presented on the tasks performed. (EDB)(PTO)

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Cavendish, J.H., National Lead Industries, Inc., Cincinnati, OH

Supervision and Decontamination of Niagara Falls Storage Site

Research Project (1981)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

The objective of this project is the decommissioning of the 191 acre DOE-Niagara Falls site and its return to unrestricted use. The DOE site is used as a radioactive waste storage area. No radioactive wastes were or are generated on the site. The wastes were shipped there from several production locations between 1944 and 1953. National Lead Company of Ohio currently provides supervision and caretaking activities on the site. The non-DOE owned residues are expected to be removed by a private contractor prior to FY 1983. After this is completed, the DOE-owned residues will be removed, buildings demolished, and the site decommissioned. The study of methods for reduction of radon exhalation from wastes was completed. A detailed radiological survey of the site was subcontracted to Battelle-Columbus and the majority of the field work was completed. (SSIE)

362

Cottrell, W.D., F.F. Haywood, D.A. Witt, T.E. Myrick, W.A. Goldsmith, W.H. Shinpaugh, and E.T. Loy, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Survey of the Shpack Landfill, Norton, Massachusetts

DOE/EV-0005/31; ORNL-5799; 163 pp. (1981, December)

The results of a radiological survey of the Shpack Landfill, Norton, Massachusetts, are given in this report. The survey was conducted over approximately eight acres which had received radioactive wastes from 1946 to 1965. The survey included measurement of the following: external gamma radiation at the surface and at 1 m (3 ft) above the surface throughout the site; beta-gamma exposure rates at 1 cm (0.4 in.) from the surface throughout the site; concentrations of Ra-226, U-238, and U-235 in surface and subsurface soil on the site; and concentrations of Ra-226, U-238, U-235, Th-230, and Pb-210 in groundwater on the site and in surface water on and near the site. Results indicate that the radioactive contamination is confined to the site and to the swamp immediately adjacent to the site. (Auth)(CAJ)

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Cottrell, W.D., D.A. Witt, W.H. Shinpaugh, W.A. Goldsmith, and F.F. Haywood, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Results of Subsurface Investigation of Radionuclides in Soil in Finberg Field, Attleboro, Massachusetts

ORNL/TM-7934; 37 pp. (1982, March)

A preliminary radiological survey of the Finberg Field recreation area, Attleboro, Massachusetts, conducted in late 1978, revealed the presence of radioactive materials (radium) in several wooded areas adjacent to Finberg Field. The Department of Energy (DOE) requested that a survey team from the Oak Ridge National Laboratory (ORNL) provide technical support to the Department of Public Health, Commonwealth of Massachusetts, in determining the extent of subsurface contamination in a 0.4-acre area of Finberg Field. This report describes the methods used, and presents the results of the survey performed at this site. With the exception of one sample from hole 11, concentrations of Ra-226 in soil ranged from 0.68 pCi/g to 6.9 pCi/g, average 2.9 plus or minus 1.6 pCi/g. The sample collected from hole 11 contained Ra-226 concentrations of 280 pCi/g of soil. Again this illustrates the uneven distribution of radionuclides in soil on this site, and could result from the crushing of one or more objects of the type shown in Fig. 27. Concentrations of U-238 in soil ranged from 0.52 pCi/g to 2.8 pCi/g with an average of 1.6 plus or minus 0.70 pCi/g. Concentrations of Ra-226, U-238, Th-230, and Pb-210 in water collected from drill holes are well below the concentration guides as stated in 10 CFR 20. However, it should be noted that the concentration of Ra-226 in water collected in holes 1 and 2 exceeds the EPA guideline of 5 pCi/l for Ra-226 and Ra-228 together. It should be emphasized that the data generated as a result of this study, applies only to that area of Finberg Field investigated, and in no way is it intended as a complete subsurface characterization of Finberg Field. (Auth)(PTO)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

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Dalton - Dalton - Little - Newport, Cleveland, OH

Evaluation of Some Equipment Systems for Retrieval, Packaging, Storing and Transporting Radioactive Material from Remedial Action Program Sites

DOE/EV/10299 - T2; 94 pp. (1980, October)

The purpose of this engineering evaluation report is to present equipment concepts that could be used to provide remedial action to three selected sites and to estimate the associated costs for each concept. Each concept contemplates the removal of the contaminated material from the site to a long-term storage area. The report is limited to remedial action and not waste disposal The approach of the equipment study is to specifically examine equipment requirements for the Middlesex Sampling Plant, Middlesex, New Jersey; VITRO Rare Metals Plant, Canonsburg, Pennsylvania; and VITRO Uranium Mill Tailings Pile, Salt Lake City, Utah, on the basis that these sites demonstrate the range of problems and situations to be met in the remedial action program. The study also includes an investigation of equipment systems currently in use at both Port Hope, Ontario, Canada, and Grand Junction, Colorado, to determine applicability to current DOE needs. (EDB)(PTO)

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Dalton - Dalton - Little - Newport, Cleveland, OH

Evaluation of Some Equipment Systems for Retrieval, Packaging, Storing and Transporting Radioactive Material from Remedial Action Program Sites

DOE/EV/10299 - T1; 88 pp. (1980, October)

This study examines equipment requirements for the Middlesex Sampling Plant, Middlesex, New Jersey; VITRO Rare Metals Plant, Canonsburgh, Pennsylvania; and VITRO Uranium Mill Tailings Pile, Salt Lake City, Utah, on the basis that these sites demonstrate the range of problems and situations to be met in the remedial action program. The study also includes an investigation of equipment systems currently in use at both Port Hope, Ontario, Canada, and Grand Junction, Colorado, to determine applicability to current DOE needs. Based upon data gathered from site visits, three equipment concepts were developed for retrieval, packaging, storing and transporting waste materials from remedial action projects. Equipment suppliers were contacted regarding cost, availability and performance specifications. (EDB)

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Feldman, J., J. Eng, and P.A. Giardina, U.S. Environmental Protection Agency, New York, NY

Evaluation of the Environmental Dose Commitment Due to Radium - Contaminated Soil

EPA - 520/3 - 79 - 02; CONF - 790209; Low - Level Radioactive Waste Management, J.E. Watson (Ed.), Proceedings of the Health Physics Society 12th Midyear Topical Symposium, Williamsburg, VA, February 12, 1979, (pp. 351 - 355) (1979, May)

The Middlesex Sampling Plant located in Middlesex, New Jersey, was a uranium ore sampling plant operating during the 1940s and 1950s. A radiological problem was identified during a routine program to resurvey selected former MED/AEC sites which are no longer under government control. The survey, when conducted by the U.S. Department of Energy (DOE), indicated that the Middlesex facility had a radium and radon problem on - site as well as off - site, where some of the contaminated soil was used as landfill. The old sampling plant is presently being used as a Marine Crops Reserve Training Center. Subsequent, more detailed studies have identified possible solutions to the contamination problem. The U.S. Environmental Protection Agency (EPA) is examining cleanup options based on a cost/benefit analysis utilizing the environmental dose commitment concept rather than an annual dose calculation. The practice of using dose to local populations as a basis for impact assessment can lead to a large underestimate of the total potential impact from the continuous environmental release of radon. (Auth)

367

Gunderson, T.C., and A.J. Ahlquist, Los Alamos Scientific Laboratory, Los Alamos, NM

Formerly Utilized MED/AEC Sites Remedial Action Program-Removal of a Contaminated Industrial Waste Line, Los Alamos, New Mexico: Final Report

DOE/EV-0005/14; 69 pp. (1979, April)

In 1977 parts of an abandoned industrial waste line (IWL) that carried laboratory or process chemical and radiochemical wastes were removed from Los Alamos Scientific Laboratory property and from the townsite of Los Alamos in north-central New Mexico. Most of the IWL was removed between 1964 and 1967. Some IWL segments in the townsite, which at that time were buried under newly paved roads, were left for removal during future construction projects involving these roads to minimize traffic problems and road damage, and because they posed no public health hazard. In 1977, prior to impending major road construction in several areas, 400 m (1300 ft) of IWL and two IWL manhole structures were removed from Laboratory and Los Alamos County property. Associated soil contamination was removed to levels considered to be as low as practicable. Contaminated or potentially contaminated material was removed to an approved radioactive waste disposal site on Department of Energy property. Full details of the methods, findings, and as-left conditions are documented in this report. (GRA)

368

Hagee, G.R., P.H. Jenkins, and W.G. Yates, Mound Facility, Miamisburg, OH

Radon Monitoring in the Environment Around Former MED/AEC Sites and Mill Tailings Sites

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (pp. 47-48), 52 pp. (1981, June)

Radon monitoring studies are being performed for the Department of Energy in the environment around several formerly utilized Atomic Energy Commission/Manhattan Engineering District (AEC/MED) sites and abandoned uranium mill tailings sites. The purposes of the monitoring are (1) to determine the effect of radon emanating from the site in its present condition on the ambient radon concentrations in the surrounding environment, (2) to monitor potential perturbances in radon concentrations during remedial action activities, and (3) to determine the effectiveness of the remedial action in restoring the radon concentrations in the environment to background levels. Mound personnel began monitoring: in Canonsburg, Pennsylvania, in January 1980; in Middlesex, New Jersey, in April 1980; and in Lewistown, New York, in September 1980. At each of these sites a network of 35 to 50 monitoring locations was established. A Passive Environmental Radon Monitor (PERM), which utilizes lithium fluoride thermoluminescent dosimeters (TLD's), was placed at each monitoring location, the TLD's are changed weekly by a local subcontractor and sent to Mound for processing. Thus, weekly average radon concentration measurements are obtained for each location in the network. Monitoring will continue at these sites until remedial actions are completed and sufficient data are obtained to determine the effectiveness of the remedial actions. (Auth)

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Haywood, F.F., Oak Ridge National Laboratory, Oak Ridge, TN

Ground Verification of Airborne Monitor Survey

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN,

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

December 4-5, 1979, (pp. 34-40), 256 pp. (1981, February)

Radiological characterization surveys at a number of facilities that were utilized in the early days of the atomic energy program were performed as part of an overall program conducted by the Off-Site Pollutant Measurements Group at Oak Ridge National Laboratory (ORNL). Aerial/ground-level surveys have been completed at Niagara Falls, Lewistown, NY, Middlesex, NJ, and Canonsburg, PA. Others are planned in New Jersey, Pennsylvania, Maryland, and Massachusetts. A large-area aerial survey was first conducted, followed by an investigation of elevated radiation levels carried out by a ground-level radiological monitoring team at ORNL. Results from the surveys are described for each site and shown in photos and maps. (CAJ)

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Haywood, F.F., H.W. Dickson, W.D. Cottrell, W.H. Shinpaugh, J.E. Burden, D.R. Stone, R.W. Doane, and W.A. Goldsmith, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Radiological Survey of the Former Bridgeport Brass Company Special Metals Extrusion Plant, Adrian, Michigan

DOE/EV-0005/28; ORNL-5713; 101 pp. (1982, April)

A radiological survey was made of the former Bridgeport Brass Special Metals Extrusion Plant in Adrian, Michigan, now owned by General Motors Corporation. This plant was operated to extrude uranium metal which was used in the fabrication of reactor fuel for the Hanford, Washington, and Savannah River, South Carolina, plants. Activities at the Adrian plant included preparation of material for extrusion, abrasive sawing, storing, packaging, and shipping. When the original contract was concluded, most of the equipment was dismantled and salvaged. The current property owner cleaned much of the building and conducted his own radiological survey. The results of the General Motors survey indicated that the area originally involved in the uranium handling and processing operation was within tolerances under the provision of guidelines applicable at the time the facility was decommissioned. A comprehensive survey was conducted in that area by a team of health physicists from the Oak Ridge National Laboratory (ORNL). The results of this survey tend to confirm the findings of the General Motors report, except that some floor areas were contaminated in excess of applicable guidelines and some off-gas ducts which had been used in the cutting area were found to be contaminated with uranium. These ducts were removed, the floor areas were cleaned, and subsequent resurvey of the plant was made by ORNL during February and March, 1977. In April 1979, an additional survey of a portion of the facility was conducted by ORNL health physicists after learning that service pits had existed beneath the extrusion units. Sometime after extrusion operations ceased, these pits were filled with sand and covered over at the existing floor level with concrete. Results of this survey revealed concentrations of U-238 up to 21,000 pCi/g in residue, scale, and other miscellaneous materials collected from the bottom of service pits, service manholes, and holding tanks. (Auth)(PTO)

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Haywood, F.F., and W.A. Goldsmith, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Residual Radioactivity in the Vicinity of Formerly Utilized MED/AEC Sites

CONF-800334; Proceedings of the 2nd U.S. DOE Environmental Control Symposium, Reston, VA, March 17, 1980, (pp. 149-161) (1980, March 17)

As demand for uranium and thorium was accelerated during the 1940's, services of chemical and metallurgical firms and major research facilities were contracted as needed by the Manhattan Engineer District (MED). A lack of documentation of the radiological status at the time contracts were terminated at these facilities led the Department of Energy (DOE), and its predecessor the Energy Research and Development Administration (ERDA), to develop a major radiological resurvey pro-

gram to fill this information void. A combination of aerial and ground-level radiological monitoring teams were utilized to identify and assess off-site radioactivity. Results from comprehensive aerial surveys provide the approximate areal extent of elevated radiation levels on the ground. These aerial survey results led to two types of ground-level surveys: (1) gamma-ray scanning on foot or from a motorized vehicle (mobile lab based system) to pinpoint the location of residual radioactivity; and (2) comprehensive radiological surveys to determine the amount and type of materials present on specific parcels of private and public property identified during the scanning. This type of investigation was initiated in 1978 and has been successful in identifying and assessing the potential radiation hazard from property on which materials bearing the techniques used to find and evaluate radioactive material displaced outside the boundaries of a formerly utilized site. (EDB)

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Haywood, F.F., W.A. Goldsmith, and R.W. Leggett, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Radiological Survey of the Former Uranium Recovery Pilot and Process Sites, Gardinier, Incorporated, Tampa, Florida

DOE/EV-0005/21; 110 pp. (1981, March)

A radiological survey was conducted at Gardinier Inc., a former uranium recovery plant near Tampa, Florida, operated as a part of a phosphoric acid plant. The uranium recovery operations were conducted from 1951 through 1960, the primary goal being the extraction of uranium from phosphoric acid. Pilot operations were first carried out at a small plant, and full-scale extraction was later carried out at a larger adjacent process plant. The survey included measurement of the following: beta-gamma dose rates at 1 cm from surfaces and external gamma radiation levels at the surfaces and 1 m above the floor inside the pilot operations building and process building and outdoors in areas around these buildings; fixed and transferable alpha and beta-gamma contamination levels on the floor, walls, ceilings, and roof of the process building and on the floor, walls, and ceiling of the pilot plant offices; concentrations of radium-226 and uranium-238 in soil samples taken at grid points around the buildings and in residue samples taken inside the process building; concentrations of radium-226 and uranium-238 in water and sediment samples taken outdoors on the site and the concentration of these same nuclides in background samples collected off the site. It was found that beta-gamma and/or alpha contamination levels on surfaces exceed current guidelines for the release of property for unrestricted use at some points inside the process building and in the outdoor area near the process building and pilot operations building. Some samples of soil and residue taken from the floor and equipment on the second level of the process building contained natural uranium in excess of 0.05% by weight and contained natural radium in excess of 900 pCi/g. (Auth)(PTO)

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Hinerman, K.B., and R.E. Smith, Dalton-Dalton-Little-Newport, Washington, DC

FUSRAP Equipment Concept Development Study

CONF-791234; Environmental Decontamination, Proceedings of a Workshop, Oak Ridge, TN, December 4-5, 1979, (pp. 236-242), 256 pp. (1981, February)

An engineering evaluation to generate equipment concepts for performing remedial action for retrieval, packaging, storing, and transporting contaminated soil and other debris is presented. Equipment requirements for the Middlesex Sampling Plant, Vitro Rare Metals Plant, and Vitro Uranium Mill Tailings Pile are specifically examined. An analysis was made of state and federal regulations that had a significant impact on the equipment selected and costs for each remedial action concept. (CAJ)

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Humphrey, H.W., National Lead Company of Ohio, Cincinnati, OH

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

Review of Radon Monitoring at the DOE-Niagara Falls Storage Site

NLCO-004EV; 85 pp. (1980, March 31)

Radon-222 monitoring results over the period May 1978 to February 1980 are reviewed and summarized. Radon-222 levels in inhabited areas surrounding the storage site were all found to be no greater than 0.5 pCi/l compared to an average ambient air background for the region of 0.23 plus or minus 0.01 pCi/l. Ambient air radon levels rapidly approach background within 0.5 to 1.0 mile from the storage site. Weekly surveillance information, averaged over a year, indicates that six of the eight fence-line ambient air monitoring stations showed concentrations well within the concentration guide limit of 3.0 pCi/l for uncontrolled areas. The remaining two adjacent stations (along the western boundary fence) showed elevated average radon levels of 4.28 and 5.68 pCi/l, respectively. The higher levels at the western boundary fence are attributed to the Spoil Pile area, which is within a hundred feet of the present boundary fence. Maxima were observed in both soil air and ambient air monthly radon levels, which correlate closely with meteorological parameters. A spoil pile radon flux survey is described which identifies radon source isopleths and quantifies yearly average pile emissions. Average offsite radon flux from soil was found to be 0.14 plus or minus 0.07 pCi/sq m/s. Weighted average (yearly) radon flux from the spoil pile was found to be 407 pCi/sq m/s. The effects of applying asphaltic emulsion, or water, to reduce radon emissions are discussed. Application of an asphalt emulsion to residues in storage buildings resulted in an average reduction in radon emissions of 94%. Variables affecting radon emanation and measurement are discussed, including: instrumentation; meteorological conditions; and source distribution and magnitude. Recommendations are suggested to improve the existing radon monitoring program and future useful innovations are discussed. (GRA)(PTO)

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Hutchinson, S.W., University of Nevada, Water Resources Center, Reno, NV

Radiological Characterization of the Kellex Site

DOE/DP/01253-20; University of Nevada Publication No. 45020 (1981, March)

A radiological characterization has been conducted at the former Kellex Corporation Site in Jersey City, New Jersey. Although several prior surveys and a remedial action were conducted, there was still a need for more information about the radiological condition of the site. A grid was established on the site and the surface was surveyed by a mobile in situ detection system. Trenches were systematically dug in an attempt to find subsurface areas of contamination. Material from the trenches was surveyed by the in situ measurement system and trench sidewalls were soil sampled and surveyed using portable dose rate and count rate instrumentation. Results of the survey indicated that radioactivity levels on the site were at or near background. Small amounts of contaminated material were found but not enough to exceed the guideline specified. (EDB)

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Leggett, R.W., F.F. Haywood, and W.D. Cottrell, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Radiological Surveys of Properties in the Middlesex, New Jersey, Area

DOE/EV-0005/1 (Suppl.); ORNL-5680; 131 pp. (1981, March)

The U.S. Department of Energy (DOE) has determined that the former Middlesex Sampling Plant in Middlesex, New Jersey, and some associated private properties in the Middlesex area are presently contaminated with radioactive residues resulting from previous uses of the sampling plant property. Thirteen areas with above-background radiation levels were identified. These areas included the sampling plant and a former municipal landfill on Mountain Avenue, both of which are the subject of separate DOE reports. The levels at eight of the other 11 areas are attributed to the presence of natural outcroppings of a reddish-brown shale, and the use of granite products. The remaining three areas are private properties which were suspected to contain materials originating from the former sampling plant. The properties are: the Church of Our Lady of Mount Virgin on Harris Avenue, the parking lot at the north end of the Union Carbide Plant in Bound Brook, and a private residence on William Street in Piscataway. Their report will provide the results of the radiological surveys conducted at these three properties, as well as one additional location downstream from the Middlesex Sampling Plant (Willow Lake). These surveys, performed by the Oak Ridge National Laboratory, were conducted to characterize the extent of the contamination at each location for input to the decision on what remedial action might be necessary under the Formerly Utilized Sites Remedial Action Program (FUSRAP) of the DOE. (JMF)

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Los Alamos National Laboratory, Los Alamos, NM

Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Site of a Former Radioactive Liquid Waste Treatment Plant (TA-45) and the Effluent Receiving Areas of Acid, Pueblo, and Los Alamos Canyons, Los Alamos, New Mexico

DOE/EV-0005/30; LA-8890-ENV; 252 pp. (1981, May)

Current radiological conditions were evaluated for the site of a former radioactive liquid waste treatment plant and the interconnected canyons that received both treated and untreated effluents between 1944 and 1951. The liquid radioactive wastes were generated by research with nuclear materials at Los Alamos, New Mexico, for the World War II Manhattan Engineer District atomic bomb project and subsequently by work conducted for the Atomic Energy Commission. After decommissioning of the treatment plant and decontamination of the site and part of one canyon, ownership of some of the land in question was transferred to Los Alamos County by the Federal Government in 1967. Some residual radioactivity attributable to the effluents remained and is found on soils and sediments at the former plant site and in the channels of the canyons. The study considered all relevant information including historical records, environmental data extending back to the 1940s, and new data acquired by special field sampling and measurements. Potential exposures to radiation were evaluated for conditions of current and possible future land uses. Maximum estimated doses were about 12% of radiation protection standards, and most were less than 2%. Detailed data and interpretations are given in extensive appendixes. (Auth)

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Mann, S.A., U.S. Department of Energy, Chicago Operations Office, Chicago, IL

Decommissioning of the New Brunswick Laboratory

Research Project

The objective of the project is to return to unrestricted use the site of the old New Brunswick Laboratory facilities in New Jersey. The laboratory consists of several building complexes on a 4.7 acre site. Radioactive contamination in the buildings will be reduced to acceptable levels by removal of equipment, materials, and portions of the structure as necessary. The underground piping system will be removed as well as a stockpile of pitchblende contaminated soil buried on the site. Following decontamination, all remaining structures will be demolished and the site released for unrestricted use. Initial decontamination was accomplished by a commercial firm under contract to DOE during FY 1978. This work involved removal of all contaminated furniture, equipment, ventilation, and filter systems and the entire above grade piping systems. An architect-engineer firm is presently under contract to prepare a Phase II design package for further decontamination work at the site. This will consist of procedures for removal of the remainder of building contamination including the underground sewer system and demolition of all structures. (SSIE)

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Mayfield, D.L., A.K. Stoker, and A.J. Ahlquist, Los Alamos Scientific Laboratory, Los Alamos, NM

Formerly Utilized MED/AEC Sites Remedial Action Program: Radiological Survey of the Bayo Canyon, Los Alamos, New Mexico - Final Report

DOE/EV-0005/15; 125 pp. (1979, June)

A portion of Bayo Canyon, located in Los Alamos County in north-central New Mexico, was used between 1944 and 1961 as a site for experiments employing conventional high explosives in conjunction with research on nuclear weapons development. Radiochemistry operations conducted at the site resulted in the generation of liquid and solid radioactive wastes, which were disposed into subsurface pits and leaching fields. The site was decommissioned by 1963. The resurvey utilized information from a number of routine and special environmental surveillance studies as well as extensive new instrumental measurements, soil sampling, and radiochemical analyses. Results showed that residual surface contamination due to strontium-90 averaged about 1.4 pCi/g or approximately 3 times the level attributable to worldwide fallout. Surface uranium averaged about 4.9 ug/g or about 1.5 times the amount naturally present in the volcanic-derived soils of the area. Subsurface contamination associated with the former waste disposal locations is largely confined within a total area of about 10,000 sq m and down to depths of about 5 m. Of 378 subsurface samples, fewer than 12% exceeded 13 pCi/g of gross beta activity, which is comparable to the upper range of activities for uncontaminated local soils. Health physics interpretation of the data indicates that the present population of Los Alamos living on mesas adjacent to Bayo Canyon is not receiving any incremental radiation doses due to the residual contamination. Potential future land use of Bayo Canyon includes development of a residential area. (EDB)(PTO)

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Myrick, T.E., and B.A. Berven, Oak Ridge National Laboratory, Oak Ridge, TN

Determination of Radionuclide Concentrations in Surface Soil and External Gamma-Ray Exposure Rates in the United States

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 31), 52 pp. (1981, June)

Background radiation levels across the United States have been measured by the Off-Site Pollutant Measurements Group of the Health and Safety Research Division at Oak Ridge National Laboratory (ORNL). These measurements have been conducted as part of the ORNL program of radiological surveillance at inactive uranium mills and sites formerly utilized during Manhattan Engineer District and early Atomic Energy Commission projects. The measurements included determination of Ra-226, Th-232, and U-238 concentrations in surface soil samples and measurement of external gamma-ray exposure rates at 1 m above the ground surface at the location of soil sampling. This information is being utilized for comparative purposes to determine the extent of contamination present at the survey sites and surrounding off-site areas. The sampling program to date has provided background information at 356 locations in 33 states. External gamma-ray exposure rates were found to range from less than 1 to 34 uR/hr, with a U.S. average of 8.5 uR/hr. The nationwide average concentrations of Ra-226, Th-232, and U-238 in surface soil were determined to be 1.1, 1.0, and 1.0 pCi/g, respectively. (Auth)(CAJ)

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Politech Corporation, Washington, DC

Federal Government Information Handbook: Formerly Utilized Sites Remedial Action Program

DOE/OR/20769-T11; 92 pp. (1980, December 31)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

This volume is one of a series produced under contract with the U.S. Department of Energy, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This information handbook series contains information about all relevant government agencies at the federal and state levels, the pertinent programs they administer, each affected state legislature, and current federal and state legislative and regulatory initiatives. This volume is a compilation of information about the federal government. It contains: a summary of the organization and responsibilities of agencies within the executive branch of the federal government which may be relevant to FUSRAP activities; a brief summary of relevant federal statutes and regulations; a description of the structure of the U.S. Congress, identification of the officers, relevant committees and committee chairmen; a description of the federal legislative process; a summary of legislation enacted and considered in the recently-adjourned 96th Congress; a description of the federal budgetary process; a summary of the Carter administration's comprehensive radioactive waste management program; and excerpts from the text of relevant federal statutes and regulations. (EDB)(PTO)

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Politech Corporation, Washington, DC

Missouri State Information Handbook: Formerly Utilized Sites Remedial Action Program

DOE/OR/20769-T10; 291 pp. (1980, December)

This volume is one of a series produced under contract with the U.S. Department of Energy, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This information handbook series contains information about all relevant government agencies at the federal and state levels, the pertinent programs they administer, each affected state legislature, and current federal and state legislative and regulatory initiatives. This volume is a compilation of information about Missouri. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; a description of the organization and structure of local governments affected by remedial action at the St. Louis area sites; a summary of relevant local ordinances and regulations; an identification of relevant public interest groups; a list of radio stations, television stations and newspapers that provide public information to the St. Louis area or to Jefferson City; and the full text of relevant statutes and regulations. (EDB)(PTO)

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Politech Corporation, Washington, DC

New Mexico State Information Handbook: Formerly Utilized Sites Remedial Action Program

DOE/OR/20769-T9; 214 pp. (1980, December)

This volume is one of a series produced under contract with the U.S. Department of Energy, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Formerly Utilized Sites Remedial Action Program. This information handbook series contains information about all relevant government agencies at the federal and state levels, the pertinent programs they administer, each affected state legislature, and current federal and state legislative and regulatory initiatives. This volume is a compilation of information about New Mexico. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislative, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations. (EDB)(PTO)

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Politech Corporation, Washington, DC

New Jersey State Information Handbook: Formerly Utilized Sites Remedial Action Program

DOE/OR/20769-T1; 212 pp. (1980, October)

Under the implied authority of the Atomic Energy Act of 1954, as amended, radiological surveys and research work has been conducted to determine radiological conditions at former MED/AEC sites. As of this time, 31 sites in 13 states have been identified that require or may require remedial action. This volume is one of a series produced under contract with U.S. Department of Energy, Office of Nuclear Waste Management, by Politech Corporation to develop a legislative and regulatory data base to assist the FUSRAP management in addressing the institutional and socioeconomic issues involved in carrying out the Remedial Action Program. This information handbook series contains information about all relevant government agencies at the federal and state levels, the pertinent programs they administer, each affected state legislature, and current federal and state legislative and regulatory initiatives. This volume is a compilation of information about the state of New Jersey. It contains: a description of the state executive branch structure; a summary of relevant state statutes and regulations; a description of the structure of the state legislature, identification of the officers and committee chairmen, and a summary of recent relevant legislative action; and the full text of relevant statutes and regulations. The loose-leaf format used in these volumes will allow the material to be updated periodically as the Remedial Action Program progresses. (EDB)(PTO)

385
Smyth, H.D., Princeton University, Department of Physics, Princeton, NJ; U.S. Corps of Engineers, Manhattan Engineering District, New York, NY

A General Account of the Development of Methods of Using Atomic Energy for Military Purposes Under the Auspices of the United States Government, 1940-1945

TK-914558; 182 pp. (1945)

This report describes in detail the operations involved in developing nuclear weapons by the Manhattan Engineer District (MED). The purpose of this report is to describe the scientific and technical developments that resulted from work performed in the U.S. under the authorization of the MED. The chapters that comprise the book are as follows: (1) Introduction; (2) Statement of the Problem; (3) Administrative History up to December 1941; (4) Progress up to December 1941; (5) Administrative History 1942-1945; (6) Metallurgical Project at Chicago in 1942; (7) Plutonium Production Problem - February 1943; (8) Plutonium Problem, January 1943-June 1945; (9) General Discussion of the Separation of Isotopes; (10) Diffusion Separation; (11) Electromagnetic Separation; (12) The Work on the Atomic Bomb; and (13) General Summary. (PTO)

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U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Remedial Actions at Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites

DOE/EV-0015; Division of Environmental Control Technology Program 1977, Decontamination and Decommissioning, (pp. 133-134), 138 pp. (1978, June)

The objective of this program is to plan and implement program of remedial actions at approximately 30 sites that have been found to have residual radioactive contamination above currently acceptable levels for unrestricted use. The program includes a review of the files of the operating programs for Manhattan Engineer District (MED) and Atomic Energy Commission (AEC) to identify all facilities and determine the status of radiological conditions at the termination of operations. Approximately 150 such files were reviewed. Where the status is unclear (about 82 cases), additional steps have been taken including site visits to determine if additional survey work is needed. In 30 cases, surveys were conducted to establish the degree of residual contamination; about 12 of these will require engineering stuidies to select the course of remedial action. The other 18 have more localized contamination that can be cleaned up with less effort. (Auth)(PTO)

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U.S. Department of Energy, Washington, DC

Remedial Actions at Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites

DOE/EV-0128; Division of Environmental Control Technology Program - 1979, (pp. 183-192) (1980, June)

The objective of this program is to identify and characterize the condition of sites formerly used by the Manhattan Engineer District and the Atomic Energy Commission and, where appropriate, implement remedial action programs at sites found to have residual radioactive contamination above levels currently acceptable for unrestricted use. Full radiological surveys were performed or scheduled to be performed on 39 of those sites. Based on preliminary results, the Department of Energy currently estimates that some form of remedial action may be required for about 33 of the sites. The remedial actions that may be required range from control of a property through restricted use or decontamination of small areas, to major efforts involving the removal of contaminated soil and either decontamination or demolition of entire structures. Engineering evaluations were completed for three of these sites and were initiated at three other sites to identify options for remedial action, their estimated costs, and potential environmental impacts. (EDB)

Chapter 4

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

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Anderson, J.B., E.C. Tsivoglou, and S.D. Shearer, U.S. Public Health Service, Dallas, TX; R.A. Taft Sanitary Engineering Center, Cincinnati, OH

Effects of Uranium Mill Wastes on Biological Fauna of the Animas River (Colorado-New Mexico)

Radioecology, V. Schultz and A.W. Klement, Jr. (Eds.), Proceedings of the 1st National Symposium, Fort Collins, CO, September 10-15, 1961. Reinhold Publishing Corporation, New York, NY, and American Institute of Biological Sciences, Washington, DC, (pp. 373-383) (1963)

Detailed studies of the effects of waste discharges from a uranium ore refinery on the aquatic biota of a western river were made in 1958 and 1959. The biological investigation included a detailed census of bottom fauna populations and bioassay studies of the individual waste streams having their origin in the mill process. The study was undertaken to measure radioactive, chemical, organic and bacterial characteristics and effects of pollution on the legitimate water uses. Radium-226 concentration factors for algae, insects, and the skeletons and flesh of large suckers have been derived and appear to be consistent among themselves and among the types of biota. A concentration factor of about 500 to 1000 has been shown for filimentous algae and the corresponding factor for aquatic insects is no different. The radium-226 concentrations one mile above the pollution source and two miles below the pollution source as reported for algae, water and sediments are 10 and 400 ug/g, 0.5 and 10.5 ug/g, and 1.5 and 230 ug/g, respectively. (PTO)

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Beard, H.R., I.L. Nichols, and D.C. Seiderl, U.S. Bureau of Mines, Salt Lake City Metallurgy Research Center, Salt Lake City, UT

Absorption of Radium and Thorium from Wyoming and Utah Uranium Mill Tailings Solutions

Bureau of Mines Report of Investigation RI-8396; 15 pp. (1979)

The Bureau of Mines investigated the absorption of radium and thorium from waste uranium leach liquor by clays and other materials. This work was conducted in support of the Bureau's goal of minimizing the environmental conflicts, impacts, and occupational hazards associated with mining and mineral processing operations. Tailings and soil samples from Wyoming and Utah were contacted with tailings liquors to determine the degree of absorption. Absorption ranged from 0 to 99 percent for radium and from 0 to 31 percent for thorium. Some samples, which readily absorbed radium, were contacted with various salt solutions that could be present in tailings solutions to determine their effectiveness as desorbents. The desorption of radium ranged from 0.06 to 100 percent. An alpha-spectrometric method was used to determine the radium and thorium concentrations in the solutions and the solids. (Auth)(PTO)

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Beard, H.R., H.B. Salisbury, and M.B. Shirts, U.S. Bureau of Mines, Salt Lake City Metallurgy Research Center, Salt Lake City, UT

Absorption of Radium and Thorium from New Mexico Uranium Mill Tailings Solutions

Bureau of Mines Report of Investigation RI-8463; 14 pp. (1980)

The Bureau of Mines investigated the absorption of radium and thorium from waste uranium leach liquor by clays and other materials. This work was conducted in support of the Bureau's goal of minimizing the environmental conflicts, impacts, and occupational hazards associated with mining and milling operations. Tailing and soil samples from New Mexico were evaluated for their potential to absorb radium and thorium from tailing liquors. Absorption ranged from 0 to 97 pct for radium and 0 to 60 pct for thorium. Some samples that readily absorbed radium were contacted with various salt solutions that could be present in tailing solutions to determine whether desorption would be a potential problem. The desorption of radium ranged from 0 to 75 pct. An alpha spectrometric method was used to determine the radium and thorium concentrations in the solutions and solids. (Auth)

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Bengson, S.A., ASARCO, Incorporated, Tucson, AZ

Irrigation Techniques for Tailing Revegetation in the Arid Southwest

Tailing Disposal Today, Volume 2, G.O. Argall, Jr. (Ed.), Proceedings of the 2nd International Tailing Symposium, Denver, CO, May 1978, (pp. 487-503), 599 pp. (1979)

Two primary types of irrigation used by Asarco to revegetate mill tailings slopes are sprinkler irrigation and drip or trickle irrigation. Sprinkler irrigation is used where uniform area coverage is required. The most serious drawback to sprinkler irrigation is the increased hazard of erosion due to oversaturation. The compaction of tailings by the impaction of water droplets is another consideration. Other drawbacks of sprinkler irrigation include the large volume of water required, which is often a problem in the southwest, and the cost, which often exceeds $3,000 per acre. Drip irrigation, a relatively new technique, is used to establish sparse tree and shrub cover in areas that have too low an annual rainfall to maintain grasses. The main advantage of drip irrigation is the conservation of water and the decreased risk of erosion because of the smaller volume of water. The problem of surface runoff is eliminated if the drip rate is not greater than the infiltration rate. The main disadvantage is the limited area which is moistened for seed germination and plant establishment. The cost of drip irrigation is about $1,200 per acre. Maintenance is more of a problem with drip irrigation than with sprinkler irrigation, as the filters must be cleaned frequently. Water conservation techniques such as using moisture barriers to reduce evaporation and using paper or excelsior mats to aid in providing a suitable germination environment, as well as to prevent erosion around the plant, have been shown to be successful. The cost of these techniques is high as the materials are expensive and require considerable hand installation. Another means of conserving water is to use native plants with low water requirements. (PTO)

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Berven, B.A., T.E. Myrick, and D.A. Witt, Oak Ridge National Laboratory, Oak Ridge, TN

A Summary of Radiological Surveys at 22 Uranium Mill Sites

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 37), 52 pp. (1981, June)

In 1974, the Atomic Energy Commission (AEC) initiated a study of 22 inactive uranium mill sites in cooperation with the Environmental Protection Agency (EPA), and health authorities in eight affected western states. One phase of this study was to conduct an engineering assessment of existing conditions at the inactive mill tailings sites. Oak Ridge National Laboratory (ORNL) provided radiological measurements at each of these sites in support of the engineering contractor. A summary of the radiological conditions at these 22 uranium mill sites is presented. Included in the discussion are comparisons between sites relating uranium processing methods, estimated average concentration of Ra-226 in the tailings piles, the on-site external gamma-ray exposure rates, the depth and volume of tailings, and the degree to which contamination has spread off-site. The potential for radiation exposure to local human populations from these tailings is briefly discussed.

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Beverly, R.G., Union Carbide Corporation, Grand Junction, CO

Unique Disposal Methods are Required for Uranium Mill Waste

Mining Engineering 20(6):52-56 (1968, June)

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Special disposal methods have resulted from regulations aimed at limiting the concentration of radionuclides such as Ra-226, Th-230, and Pb-210 in liquid effluents, and stabilizing inactive uranium mill tailings. Several methods are described for the disposal of liquid wastes resulting from uranium extraction techniques and from tailing ponds. All uranium mills use conventional techniques to impound solid tailings in large tailing ponds; about one-third of the existing uranium mills release liquid to adjacent rivers and streams, while the tailing ponds at two-thirds of the mills are of sufficient size that the liquids evaporate or seep into the ground. Several methods of liquid effluent disposal have been used at Union Carbide mills, including the use of barium chloride and barium carbonate. A more efficient means of liquid disposal was developed using evaporation-percolation ponds. Various methods are being used to stabilize tailing piles, such as leveling, covering with earth, and where practical, planting with vegetation. Today pollution control bills are being introduced by the hundreds. It is becoming increasingly urgent to follow legislation and inform legislators of the company's problems, plans and accomplishments. (CAJ)

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Beverly, R.G., Union Carbide Corporation, Grand Junction, CO

Waste Management in Mining and Milling of Uranium

CONF-740935; Radiation Protection in Mining and Milling of Uranium and Thorium, Proceedings of a Symposium, Bordeaux, France, September 9-11, 1974, (pp. 301-324) (1976, September)

The accumulation of 100 million metric tons of uranium mill tailings has led to the establishment of regulations in at least one state, Colorado, for the stabilization of inactive uranium mill tailing piles. Methods of stabilization include covering with different materials, seeding and establishing vegetation directly in the tailings. Liquid effluents from uranium mills are commonly evaporated but in some cases must be treated for radium removal before discharging to rivers. New environmental regulations require consideration of other parameters such as acidity, heavy metals, toxic materials and dissolved salts. Stack emissions and dust from uranium operations must be monitored not only for radioactivity but also for solids and chemical contents. Various waste regulations and the government agencies administering them are discussed and numerous references are cited. (EIX)

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Bieke, J.R., and D.B. Cook, Shea and Gardner, Washington, DC

Legal-Institutional Framework and Environmental Requirements Applicable to Uranium Mine and Mill Wastes in the United States

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 573-598), 626 pp. (1980)

This paper discusses the general framework of the United States laws and regulations relating to environmental regulation and control of waste disposal from uranium mining and milling operations, including disposal of uranium mill tailings. This general framework includes a description of the various federal and state agencies with jurisdiction over aspects of waste disposal from uranium mining and milling. The paper also discusses in some detail particular legal requirements under various of these laws and regulatons, and means of complying with those requirements. Particular requirements covered include the following: (1) requirements under the Atomic Energy Act, both in states where uranium milling is regulated directly by the Nuclear Regulatory Commission (NRC) and in states which have agreements with the NRC under which the states exercise regulatory authority (Colorado will be used as an example of such an agreement state. The discussion relates to the requirements applicable to uranium mills generally and to those

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dealing specifically with the disposal of uranium mill tailings. This section also covers: (1) Environmental Protection Agency's environmental radiation protection standards for the nuclear fuel cycle); (2) requirements under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) (This section covers Title I of the UMTRCA, which provides for federal remedial action at inactive uranium mill sites and the requirements imposed under Title II of the UMTRCA relating to the disposal of tailings from active uranium mills, including the NRC's and EPA's regulatory activities thereunder); (3) requirements under Water Pollution Control Laws including the applicability of requirements under the Federal Water Pollution Control Act, as well as state water pollution control laws, to possible discharges from uranium mining and milling operations - the matters covered will include seepage from tailings ponds and seepage and runoff at uranium mines; (4) requirements under the Resource Conservation and Recovery Act of 1976 (RCRA) and Other Solid Waste Disposal Laws (This discusses first the applicability to uranium mining and milling of EPA's proposed regulations under RCRA relating to the generation, possession, treatment, storage, and disposal of hazardous wastes. This discussion will include requirements applicable to "waste rock and overburden from uranium mining" which EPA has listed as a hazardous waste. This section also discusses other applicable requirements, under RCRA and other solid waste disposal laws, dealing with the disposal of other waste at uranium mines and mills); and (5) requirements under Surface Mining Legislation (This section discusses briefly the possible requirements that could eventually result from a study done for Congress by the National Academy of Sciences relating to environmental control and reclamation at surface mines other than coal mines). In addition, other miscellaneous requirements relating to waste disposal at uranium mines and mills are covered. (Auth)(NPK)(JMF)

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Breslin, A.J., U.S. Energy Research and Development Administration, Health and Safety Laboratory, New York, NY

Radon Workshop

HASL-325; Proceedings of the 3rd Seminar, New York, NY, November 1977; 166 pp. (1977, July)

The Health and Safety Laboratory (HASL) Radon Workshop was organized mainly because of the growing number of investigations of radon in its various manifestation in recent years. These investigations reflect a variety of interests. Recently, there has been a developing interest in radon as an important, perhaps dominant, component of background radiation exposure. Superimposed on the normal circumstances of exposure, there are special situations that result in enhanced concentrations such as the "tailings houses" in Grand Junction, Colorado, radium contaminated buildings in Port Hope, Ontario, the phosphate regions of Florida and various caverns. These special situations gave particular impetus to organizing the workshop. In order to maintain a reasonable limit on total time, a single topic, metrology, was selected. Metrology is a fundamental consideration in all investigations. It is a complex subject in itself, as became obvious during the workshop. Questions arise not only about how to measure but also what to measure and why. Satisfactory resolutions are difficult to achieve but participants had an opportunity to express and hear various points of view. (Auth)(RHB)

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Buelt, J.L., Pacific Northwest Laboratory, Richland, WA

Liner Evaluation for Uranium Mill Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October Through December 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 24.1-24.2) (1981, March)

The objective of the liner program is to evaluate prospective materials for preventing moisture transport of radionuclides and hazardous chemicals from uranium mill tailings over a long-term period. The approach embodies conducting a tailings site characterization study to determine the liner exposure conditions and evaluating the effectiveness of the liner through field studies and accelerated laboratory tests. A selection study was performed to identify eight liner materials for laboratory testing under accelerated exposure conditions. The results of these tests will determine the most likely material or composite of materials for field testing in the summer of 1981. Also, characterization of surface samples of the tailings at the Durango, Shiprock and Salt Lake sites have been completed. The results of these analyses will provide the data base for determining the exposure conditions in the laboratory tests representative of a thousand years. An exhaustive search identified a number of promising lining materials. The material properties were evaluated in accordance with their long-term compliance with proposed regulatory requirements. The following eight liner materials were chosen for laboratory study: (1) natural soil amended with sodium-saturated montmorillonite (Vorclay); (2) typical local clay with an asphalt emulsion radon-suppression cover; (3) typical local clay with a multibarrier radon-suppression cover; (4) rubberized asphalt membrane; (5) hydraulic asphalt concrete; (6) chlorosulfonated polyethylene (Hypalon) or high-density polyethylene; (7) bentonite, sand and gravel mixture; and (8) catalytic airblown asphalt membrane. (Auth)(PTO)(JMF)

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Buelt, J.L., and V.Q. Hale, Pacific Northwest Laboratory, Richland, WA

Liner Evaluation for Uranium Mill Tailings

PNL-3000-9; Nuclear Waste Management Quarterly Progress Report, January Through March 1981, T.D. Chikalla and J.A. Powell (Eds.), Ch. 27, (pp. 27.1-27.2) (1981, June)

The exposure conditions have been identified to which the eight selected liner materials will be subjected in 0.6 m diameter exposure columns. These conditions were chosen to chemically and physically accelerate the degradation of the liners. Because degradation mechanisms differ for clay liners and processed material liners (asphalts and synthetics), different acceleration techniques were used for these materials. (Auth)(PTO)

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Buelt, J.L., V.Q. Hale, S.M. Barnes, and D.J. Silviera, Battelle Pacific Northwest Laboratories, Richland, WA

Evaluation of Liners for a Uranium-Mill Tailings Disposal Site: A Status Report

DOE/UMT-0200; PNL-3679; 67 pp. (1981, May)

The United States Department of Energy is conducting a program designed to reclaim or stablize inactive uranium-mill tailings sites. This report presents the status of the Liner Evaluation Program. The purpose of the study was to identify eight prospective lining materials or composites for laboratory testing. The evaluation was performed by (1) reviewing proposed regulatory requirements to define the material performance criteria; (2) reviewing published literature and communicating with industrial and government experts experienced with lining materials and techniques; and (3) characterizing the tailings at three of the sites for calcium concentration, a selection of anions, radionuclides, organic solvents, and acidity levels. The eight materials selected for laboratory testing are: natural soil amended with sodium-saturated montmorillonite (Volclay); locally-available clay in conjunction with an asphalt emulsion radon suppression cover; locally available clay in conjunction with a multibarrier radon suppression cover; rubberized asphalt membrane; hydraulic asphalt concrete; chlorosulfonated polyethylene (hypalon) or high-density polyethylene; bentonite, sand and gravel mixture; and catalytic airblown asphalt membrane. The materials will be exposed in test units now being constructed to conditions such as wet/dry cycles, temperature cycles, oxidative environments, ion-exchange elements, etc. The results of the tests will identify the best material for field study. The status report also presents the information gathered during the field studies at Grand Junction, Colorado. Two liners, a bentonite, sand and gravel mixture, and a catalytic airblow asphalt membrane, were installed in a prepared trench and covered with tailings. The liners were instrumented and are being monitored for migration of moisture, radionuclides, and hazardous chemicals. The two liner materials will also be subjected to accelerated laboratory tests for a comparative assessment. (ERA)

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Cadwell, L.L., N.R. Hinds, M.C. McShane, R.H. Sauer, J.R. Skalski, and B.E. Vaughan, Battelle Pacific Northwest Laboratories, Richland, WA

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Revegetation of Inactive Uranium Tailing Sites

PNL-3700 (Part 2); Pacific Northwest Laboratory Annual Report for 1980 to the DOE Assistant Secretary for Environment, Part 2: Ecological Sciences, (p. 25-26) (1981, February)

Soil placed over any sealant/barrier system can provide a protective mantle if the soil is not lost by erosion. Vegetation is an attractive choice for controlling erosion because it can provide an economical self-renewing cover that serves to reduce erosion by both wind and water. The objective of this research and development effort is to select and test vegetation strategies, including the choice of species and methods for revegetation that are compatible with sealant/barrier systems and are suited to soils and climates at inactive uranium mill tailings sites. (EDB)

401

Carr, G., and J.T. Tappan, Nelson, Haley, Patterson and Quirk, Inc., Grand Junction, CO

Phase I Demonstration and Study of Ventilation/Filtration Techniques as a Uranium Mill Tailings Remedial Action

Report; 78 pp.

Phase 1 of the demonstration project consists of measuring and evaluating radon/radon daughter concentrations and other variables associated with operation of ventilation/filtration air cleaning equipment in an easily controlled structure affected by uranium mill tailings. The study structure is a single story, masonry residential building with a full basement, and a main floor area of approximately 1,270 sq ft. Remedial action measurements have shown relatively high radon concentrations inside the structure. The types of possible radon daughter control measures evaluated were dilution ventilation, air cleaning with "high efficiency" filter units, and air cleaning with electrostatic precipitation units. Accumulated data indicates that dilution ventilation provides the most cost effective method of radon daughter reduction within a structure, with electrostatic precipitation of a close second, and high efficiency filtration providing the least cost efficient method. All three methods are feasible remedial action techniques within mechanical equipment maintenance limitations; however, further evaluation of high efficiency filtration is not recommended due to estimated cost effectiveness. Recommendations are to further evaluate, choosing two demonstration structures of similar design, volumes and radon concentrations, install a fresh air dilution system in one structure and an electrostatic filtration system in the other, and compare remedial action effectiveness. (Auth)(CAJ)

402

Clements, W.E., S. Barr, and M.L. Marple, Los Alamos Scientific Laboratory, Los Alamos, NM

Uranium Mill Tailings Piles as Sources of Atmospheric Radon-222

CONF-780422; Natural Radiation Environment III, Proceedings of a Symposium, T.F. Gesell and W.M. Lowder, (Eds.), Houston, TX, April 23-28, 1978. U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, Vol. 2, (pp. 1559-1583), 881 pp. (1980)

Uranium mill tailings piles are anomalous local area sources of radon (Rn-222) to the atmosphere as a result of their high Ra-226 content. Measured values of the radon flux from tailings piles obtained by us and by other investigators show a range of 2 to 2820 atoms/sq cm/s compared with about 1 atom/sq cm/s for background soils. This wide range reflects the variation in radium content of tailings material and in the meteorological and substrate conditions under which measurements are made. Similarly, concentrations of Rn-222 in the air near the ground are reported from 0.8 to 282 pCi/l on tailings piles whereas measurements within 1 km of the piles show values from near background up to 42 pCi/l. In general, the lack of detailed meteorological and substrate data makes both these radon flux and air concentration measurements difficult to interpret. Although tailings piles represent high local sources of radon, it is estimated that all the uranium mill tailings that will exist in the U.S. by the year 2000 will at most increase the mean atmospheric radon content by 0.2%. Results, obtained by a simple two-layer diffusion model which yields an analytical solution for the surface radon flux from a tailings pile, agree reasonably well with measured values. A molecular diffusion coefficient of 0.004 sq cm/s was inferred from this model and from actual flux measurements for a particular location on an inactive tailings pile. The model is also used to evaluate the attenuating effects of overburdens on the escape of radon from tailings piles. Simple atmospheric dispersion techniques for treating area sources produce results that are in general agreement with measured radon concentrations on and near isolated piles, whereas other methods work well in regions of spatially varying wind fields containing several such sources. (Auth)(PTO)(JMF)

403

Cokal, E.J., D.R. Dreesen, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM

Chemical Characterization and Hazard Assessment of Uranium Mill Tailings

LA-UR-81-2731; 18 pp. (1981)

The rational development of processing technologies for the chemical treatment of uranium mill tailings requires knowledge about both the chemical composition and the mineralogical constitution of the tailings. Knowledge of the tailings composition is also required to evaluate the hazard posed by disposal of either treated or untreated tailings. The potential hazards include not only radiological hazards such as radon and its precursors radium-226 and thorium-230 but also nonradiological hazards such as molybdenum, other heavy metals, and non-metals such as fluoride, nitrate, and sulfate. As a part of the Los Alamos effort in support of UMTRA, a program of chemical and mineralogical analysis of thirty-six mill tailings samples collected at three of the priority sites (Durango, Salt Lake City, and Shiprock) has been undertaken. In addition, data has been obtained on the water leachability of the tailings samples collected at these sites. The analytical techniques employed include neutron activation analysis and atomic absorption spectrophotometry for metals, ion chromatography for anions, a variety of techniques including fluorimetry and delayed neutron activation analysis for uranium, alpha counting for emanated radon, and low-energy gamma spectrometry for radium and thorium-230. Data is presented to indicate both the degree of hazard posed by the tailings and the potential for economic recovery of metal values remaining in the tailings piles. Three points are particularly noteworthy: (1) assumptions of secular equilibrium in the tailings are inappropriate; (2) recovery of uranium and vanadium may be economically justifiable; and (3) the mobility of soluble arsenic and some metals may present environmental problems at certain sites. (GRA)

404

Cunningham, M.C., S.W. Ferguson, and T. Foreman, Colorado Department of Health, Disease Control and Epidemiology Division, Denver, CO

Excess Cancer Incidence in Mesa County, Colorado: Final Report - Lack of Correlation Between Leukemia Incidence and Use of Uranium Mill Tailings as Construction Materials

NUREG/CR-0635; 99 pp. (1979, July)

The initial phase of this investigation has determined that there is a twofold excess of leukemia incidence for all ages in Mesa County, Colorado, for the period 1970 to 1976. The greatest excess was observed among residents over 65 years of age who developed leukemia 2.5 times the expected rate. No excess incidence of lung cancer has been identified. The second phase of the investigation has been case-control study of all adult leukemia deaths since 1960. No significant differences were found between cases and controls with respect to years of residence in Mesa County, general health status prior to diagnosis and radiation exposure from tailings buildings. Only two cases and two controls had ever lived in houses with elevated gamma radiation from uranium mill tailings used in construction. Only one case and one control has a cumulative and average annual exposure significantly higher than the other subjects. Leukemia cases had higher socioeconomic levels and more positive family histories of leukemia than controls. No association between tailings structures and leukemia excess was observed. (EDB)(PTO)(JMF)

405

Douglas, R.L., and J.M. Hans, Jr., U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Gamma Radiation Surveys at Inactive Uranium Mill Sites

ORP/LV-75-5; 97 pp. (1975, August)

This report presents the results of gamma radiation surveys conducted by the Office of Radiation Programs at twenty inactive uranium mill sites in the Western United States. The purpose of these surveys was to measure the extent to which radioactive material had been spread into the environment from the sites by the action of wind and/or water erosion, and by milling activities. The results indicate that hundreds of acres of land exclusive of the tailings piles have been contaminated to above-background levels. Some of the contaminated land is private, off-site property. Survey techniques were developed to locate the spread radioactive materials and to estimate the gamma exposure rates resulting from them. These measurements were complicated by the presence of direct gamma radiation from the tailings piles. Iso-exposure rate lines were located around each site and plotted on site maps to facilitate site decontamination decisions. (GRA)

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Dreesen, D.R., E.S. Gladney, and J.W. Owens, Los Alamos Scientific Laboratory, Los Alamos, NM

Interlaboratory Comparison of Arsenic, Molybdenum and Selenium Analyses from Uranium Mill Tailings

Journal of the Water Pollution Control Federation 51(10):2447-2456 (1979, October)

In order to evaluate the analytical results coming from various laboratories on water samples analyzed for leached elements from uranium mill tailings piles or ponds, groundwater samples were collected from wells on top of and hydrologically downgradient from tailings piles produced by a uranium mill using a carbonate leach process. These samples were spiked with As, Mo, and Se at levels of 500 micrograms/l, 250 micrograms/l, and 500 micrograms/l, respectively, and submitted to various laboratories for analysis. The various methods used by the different laboratories for the analyses were broadly categorized as follows: flameless atomic absorption, flame atomic absorption, hydride generation flame atomic absorption, spectrophotometric-calorimetric, instrumental neutron activation analysis, neutron activation analysis with radiochemical separation, x-ray fluorescence spectroscopy, and fluorimetry. For comparison, the results of the different analyses for each element are tabulated. It was concluded that the wide spectrum of laboratories provide questionable data for trace elements in complex matrixes. It was felt that much improvement of methods and better understanding of the complexities of the matrixes are necessary before results of analyses are available on which to base judgments concerning the environmental pollution by these elements, particularly Se. (BLM)(JMF)

407

Dreesen, D.R., M.L. Marple, and E.J. Cokal, Los Alamos National Laboratory, Los Alamos, NM

Plant Uptake Assay of Uranium Mill Tailings

LA-8948-PR; The Los Alamos Life Sciences Division's Biomedical and Environmental Research Programs, January-December 1980, (pp. 92-93), 111 pp. (1981, September)

A technique to rapidly assay the contaminant uptake potential of a wide variety of native and agronomic plants grown in a variety of tailings is described. The develped method was a synthesis of nutrient absorption techniques used by Stanford and DeMent and a potting mixture for Western shrubs and forbs used by Ferguson and Monsen. A preliminary proof-of-concept experiment was performed with the grass species SPOROBOLUS AIROIDES, and the shrub ATRIPLEX CANESCENS. The assayed material was fine tailings (slimes) from an inactive alkaline leach mill at Ambrosia Lake, New Mexico. The molybdenum content of the aboveground plant material is reported in a table for the two species, two potting mixes (controls), and three tailings treatments. The authors conclude that the plant uptake assay techniques holds promise as a generic method to assess contaminant uptake from solid wastes. (CAJ)

408

Dreesen, D.R., and C.L. Wienke, Los Alamos Scientific Laboratory, Los Alamos, NM

Gross Alpha Activity as an Estimator of Radium-226 Activity in Soils and Tailings at an Inactive Uranium Mill Tailings Site

LA-7529-MS; 9 pp. (1978, October)

Gross alpha activity is an accurate estimator of Ra-226 activity. An exponential regression, Ra-226 = 387 (E-0.0016 alpha), where Ra-226 activity is in picocuries per gram and gross alpha activity is in counts per minute per sample, gave a good fit for samples ranging in gross alpha activity from 3 to 1082 cpm/sample. A linear regression, Ra-226 = 1.05 alpha + 1.78, has been calculated, which shows gross alpha activity to be an excellent estimator of Ra-226 activity in soils contaminated with tailings. The percentage of gross alpha activity attributable to Ra-226 activity has been calculated to be 7.2, 17.6, 18.3, and 17.0 for uncontaminated soils, contaminated soils, tailings, and the total set of samples, respectively. (EDB)(PTO)

409

Dreesen, D.R., J.M. Williams, and E.J. Cokal, Los Alamos National Laboratory, Los Alamos, NM

Thermal Stabilization of Uranium Mill Tailings

LA-UR-81-2734; CONF-811049; Uranium Mill Tailings Management, Proceedings of a Symposium, Fort Collins, CO, October 26, 1981, (16 pp.) (1981)

The sintering of tailings at high temperatures (1200 deg C) has shown promise as a conditioning approach that greatly reduces the Rn-222 emanation of uranium mill tailings. The structure of thermally stabilized tailings has been appreciably altered to produce a material that will have minimal management requirements and will be applicable to on-site processing and disposal. The mineralogy of untreated tailings is presented to define the strucutre of the original materials. Quartz predominates in most tailings samples; however, appreciable quantities of gypsum, clay, illite, or albites are found in some tailings. Samples from the Durango and Shiprock sites have plagioclase-type aluminosilicates and non-aluminum silicates as major components. The iron-rich vanadium tailings from the Salt Lake City site contain appreciable quantities of alpha-hematite and chloroapatite. The reduction in radon emanation power and changes in mineralogy as a function of sintering temperature (500 to 1200 deg C). The calculated activity data of the various carbonate sulfate and hydroxide species in the Li+, Ni+, and K+ systems have been determined and estimated error limits are given for each system. (EDB)(PTO)

410

Duncan, D.L., and G.G. Eadie, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Environmental Surveys of the Uranium Mill Tailings Pile and Surrounding Areas, Salt Lake City, Utah

EPA-520/6-74-006; 131 pp. (1974, August)

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Environmental surveys have been conducted for the Utah State Division of Health's Occupational and Radiological Health Section at the former Vitro Corporation uranium mill and in the Salt Lake City, Utah, area. The surveys included measurement of external gamma radiation and airborne radioactivity. The results of the surveys indicated that: the external gamma radiation levels on the tailings area exceed recommended exposure limits. Ambient levels of radon over the pile and in structures built immediately adjacent to the tailings pile are above the currently recommended concentration. Tailings material has been removed from the Vitro site by persons and used around dwellings and businesses; and tailings material has become windborne and deposited against dwellings and structure in the vicinity. (GRA)

411
Federal Water Pollution Control Administration, Denver, CO

Disposition and Control of Uranium Mill Tailings Piles in the Colorado River Basin

PB-228363/8; 71 pp. (1966, March)

In addition to the more usual organic and inorganic liquid waste disposal problems encountered at many industrial installations, the uranium milling industry produces large quantities of solid wastes in the form of radioactivity laden sand tailings pile material. This report evaluates the radioactivity content of uranium mill tailings piles in the Colorado River Basin, evaluates their radioactivity water pollution potential insofar as this is possible, and on a case-by-case basis, indicates feasible and desirable remedial measures for controlling and limiting the spread of radioactivity from the piles. (GRA)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Durango Site, Durango, Colorado

DOE/UMT-0103 (1981, June)

Radon gas released from the nearly 1.6 million tons of tailings at the Durango site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the seven options range from about $10,700,000 for stabilization in-place, to about $21,800,000 for disposal at a distance of about 10 mi. Three principal alternatives for the reprocessing of the Durango tailings were: heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $30/lb U3O8 by either heap leach or conventional plant processes. The spot market price for uranium was $28/lb in October and November 1980, therefore reprocessing of the Durango tailings would be of marginal economic attractiveness at present. (Auth)(CAJ)

413
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah

DOE/UMT-0102; FBDU 360-00 (1981, April)

Ford, Bacon & Davis Utah Inc. has reevaluated the Vitro site in order to revise the April 1976 assessment of the problems resulting from the existence of radioactive uranium mill tailings at Salt Lake City, Utah. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 1.9 million tons of tailings at the Vitro site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites, and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $36,400,000 for stabilization in-place, to about $91,000,000 for disposal at a distance of about 85 mi. Three principal alternatives for the reprocessing of the Vitro tailings include heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $200/lb by heap leach and $130/lb by conventional plant processes. Spot market price for uranium was $28.00 in November 1980, thus reprocessing the tailings for uranium recovery is not economically feasible at present. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah

DOE/UMT-0102S; FBDU 360-00S (1981, April)

A summary of the main report, issued under separate cover, and entitled: "The Engineering Assessment of Inactive Uranium Mill Tailings" is presented. These reports represent revisions of an earlier report dated April 1976, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Vitro Site, Salt Lake City, Utah," which were necessary as a result of changes occurring since 1976 pertaining to the Vitro site and associated properties, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report, and are essential to assessing the impacts associated with the suggested options. (CAJ)

415
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Green River Site, Green River, Utah

DOE/UMT-0114S; FBDU 360-14S (1981, August)

This report is a summary of a parent report (issued under separate cover), entitled "Engineering Assessment of Inactive Uranium Mill Tailings for Green River Site, Green River, Utah." These reports are revisions of an earlier report dated December 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Green River Site, Green River, Utah," These assessments became necessary as a result of changes occurring since 1977 which pertain to the Green River site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the tailings. (Auth)(CAJ)

416
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Green River Site, Green River, Utah

DOE/UMT-0114; FBDU 360-14 (1981, August)

Ford, Bacon & Davis Utah Inc. has reevaluated the Green River site in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Green River, Utah. This evaluation has included the preparation of topographic maps, the performance of core drillings and radiometric-measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. Radon gas released from the 123,000 tons of tailings at the Green River site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The five alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through V). Cost estimates for the five options range from about $4,300,000 for stabilization in-place, to about $9,600,000 for disposal at a distance of about 30 mi. Three principal alternatives for the reprocessing of the Green River tailings are heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $1,800/lb by heap leach and $1,600/lb by conventional plant processes. The spot market price for uranium was $25/lb early in 1981; thus reprocessing the tailings for uranium recovery is extremely impractical economically. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Naturita Site, Naturita, Colorado

DOE/UMT-012; FBDU 360-08 (1981, July)

The Naturita site was reevaluated in order to revise the November 1977 engineering assessment of the problems resulting from the existence of radioactive contamination at the former uranium mill tailings site at Naturita, Colorado. This evaluation has included the preparation of topographic maps, the drilling of boreholes and radiometric measurements sufficient to determine areas and volumes of contaminated materials and radiation exposures of individuals and nearby propulations, and the evaluation and costing of alternative remedial actions. Radon gas released from the estimated 344,000 tons of contaminated materials that remain at the Naturita site constitute the most significant environmental impact, although external gamma radiation also is a factor. The two alternative actions presented in this engineering assessment are stabilization of the site in its present location with the addition of 3 m of stabilization cover material (Option I), and removal of residual radioactive materials to a disposal site and decontamination of the Naturita site (Option II). Cost estimates for the two options are about $7,200,000 for stabilization in-place, and about $8,200,000 for disposal at the Ranchers Exploration and Development Corporation's reprocessing site. Truck haulage would be used to transport the contaminated materials from the Naturita site to the selected disposal site. Ranchers Exploration and Development Corporation removed the tailings from the site, reprocessed and disposed of them from 1977 to 1979. There is no noteworthy mineral resource remaining at the former tailings site and recovery of residual mineral values was not considered in this assessment. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona

DOE/UMT-0120; FBDU 360-05 (1981, September)

The Tuba City site was evaluated in order to revise the March 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Tuba City, Arizona. This assessment includes the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 0.8 million tons of tailings at the Tuba City site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to unspecified disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $17,800,000 for stabilization in place, to about $23,100,000 for disposal at a distance of about 15 mi. Three principal alternatives for the reprocessing of the Tuba City tailings are heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. Processing the Tuba City tailings by heap leach is not feasible because of the impermeability of the tailings to leach solution. The cost of the uranium recovered would be about $56/lb of U3O8 by conventional plant processes. The spot market price for uranium was $25/lb early in 1981, thus reprocessing the tailings for uranium recovery appears to be economically unattractive under present market conditions. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona

DOE/UMT-0120S (1981, September)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona." These reports are revisions of an earlier report dated March 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona," which became necessary as a result of changes since 1977 which pertain to the Tuba City site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the tailings. (Auth)(CAJ)

420
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings Spook Site Converse County, Wyoming

DOE/UMT-0119S; FBDU 360-15S (1981, October)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings for Spook Site, Converse County, Wyoming." These reports are revisions of an earlier report dated December 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Spook Site, Converse County, Wyoming," which became necessary as a result of changes occurring since 1977 pertaining to the Spook site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the tailings. (Auth)(CAJ)

421
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Shiprock Site, New Mexico

DOE/UMT-0104S; FBDU 360-02S (1981, July)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings for Shiprock Site, Shiprock, New Mexico." The Shiprock site was reevaluated in order to revise the March 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Shiprock, New Mexico. This assessment included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Shiprock Site, Shiprock, New Mexico

DOE/UMT-0104; FBDU 360-02 (1981, July)

Radon gas released from the 1.5 million dry tons of tailings at the Shiprock site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The eight alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through VIII). Cost estimates for the eight options range from about $13,400,000 for stabilization in place to about$37,900,000 for disposal at a distance of about 16 mi. Three principal alternatives for the reprocessing of the Shiprock tailings were: heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $230/lb by heap leach and $250/lb by conventional plant processes. Since the spot market price for uranium was $25/lb early in 1981, reprocessing the tailings for uranium recovery is not economically attractive. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Maybell Site, Maybell, Colorado

DOE/UMT-0116; FBDU 360-11 (1981, September)

The Maybell site has been reevaluated in order to revise the October 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Maybell, Colorado. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 2.6 million dry tons of tailings at the Maybell site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The two alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to disposal of the tailings in a nearby open pit mine and decontamination of the tailings site (Option II). Cost estimates for the two options are about $11,700,000 for stabilization in-place and about $22,700,000 for disposal within a distance of 2 mi. Three principal alternatives for the reprocessing of the Maybell tailings were: heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $125 and $165/lb of U3O8 by heap leach and conventional plant processes, respectively. The spot market price for uranium was $25/lb early in 1981; therefore, reprocessing the tailings for uranium recovery is not economically attractive at present. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Maybell Site, Maybell, Colorado

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

DOE/UMT-0116S; FBDU 360-11S (1981, September)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Maybell Site, Colorado." These reports are revisions of an earlier report dated October 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Maybell Site, Maybell, Colorado," which was authorized by DOE, Grand Junction, Colorado. These reports have become necessary as a result of changes that have occurred since 1977 which pertain to the Maybell site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the tailings. (Auth)(CAJ)

425
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Gunnison Site, Gunnison, Colorado

DOE/UMT-0107S; FBDU 360-12S (1981, September)

Ford, Bacon & Davis Utah Inc. has reevaluated the Gunnison site in order to revise the November 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Gunnison, Colorado. This evaluation has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings for Gunnison Site, Gunnison, Colorado." (Auth)(CAJ)

426
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Falls City Site, Falls City, Texas

DOE/UMT-0111; FBDU 360-16 (1981, October)

Radon gas released from the 2.5 million tons of tailings at the Falls City site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $21,700,000 for stabilization in place, to about $35,100,000 for disposal at a distance of about 15 mi. Three principal alternatives for the reprocessing of the Falls City tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The tailings piles are presently being rewashed for uranium recovery by Solution Engineering, Inc. The cost for further reprocessing would be about $250/lb of U3O8. Since the spot market price for uranium was $25/lb early in 1981, reprocessing of the tailings for uranium recovery does not appear to be economically attractive for the foreseeable future. (Auth)(CAJ)

427
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Falls City Site, Falls City, Texas

DOE/UMT-0111S; FBDU 360-16S (1981, October)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

The Falls City site has been reevaluated in order to update the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Falls City, Texas. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and cost of alternative corrective actions. This report is a summary of a parent report enttiled "Engineering Assessment of Inactive Uranium Mill Tailings, Falls City Site, Falls City, Texas." (Auth)(CAJ)(JMF)

428
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Gunnison Site, Gunnison, Colorado

DOE/UMT-0107; FBDU 360-12 (1981, September)

Radon gas released from the combined 540,000 dry tons of tailings and the 435,400 tons of contaminated waste at the Gunnison site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The 10 alternative actions presented in this engineering assessment range from stabilization of the site in its present location with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to disposal sites along with decontamination of the Gunnison site (Options II through X). Cost estimates for the 10 options range from about $8,900,000 for stabilization in-place, to about $14,000,000 for disposal in the North Alkali Creek area at a distance of about 18 mi. Truck haulage would be used to transport the tailings and contaminated materials from the Gunnison site to the selected disposal site. Three principal alternatives for the reprocessing of the Gunnison tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $250 and $230/lb of U3O8 by heap leach and conventional plant processes, respectively. The spot market price for uranium was $25/lb early in 1981; therefore, reprocessing the Gunnison tailings for uranium recovery does not appear to be economically attractive. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Mexican Hat Site, Mexican Hat, Utah

DOE/UMT-0109S; FBDU 360-03S (1981, September)

The Mexican Hat site has been reevaluated in order to revise the March 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Mexican Hat, Utah. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and cost of alternative corrective actions. This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Mexican Hat Site, Mexican Hat, Utah". (Auth)(CAJ)(JMF)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Mexican Hat Site, Mexican Hat, Utah

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

DOE/UMT-0109; FBDU 360-03 (1981, September)

Radon gas released from the 2.2 million tons of tailings at the Mexican Hat site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $15,200,000 for stabilization in place, to about $45,500,000 for disposal at a distance of about 16 mi. Three principal alternatives for the reprocessing of the Mexican Hat tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $115/lb of U3O8 whether by heap leach or conventional plant processes. Since the spot market price for uranium was $25/lb early in 1981, reprocessing the Mexican Hat tailings for uranium recovery is not economically attractive under present conditions. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Phillips/United Nuclear Site, Ambrosia Lake, New Mexico

DOE/UMT-0113S; FBDU 360-13S (1981, October)

The Phillips/United Nuclear site has been reevaluated in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Amborsia Lake, New Mexico. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and cost of alternative corrective actions. This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Phillips/United Nuclear Site, Ambrosia Lake, New Mexico." (Auth)(CAJ)(JMF)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Phillips/United Nuclear Site, Ambrosia Lake, New Mexico

DOE/UMT-0113; FBDU 360-13 (1981, October)

Radon gas released from the 2.6 million dry tons of tailings at the Phillips/United Nuclear site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $21,500,000 for stabilization in-place, to about $45,200,000 for disposal at a distance of about 15 mi. Three principal alternatives for the reprocessing of the Phillips/UnitedNuclear tailings were heap leachings, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $87/lb of U3O8 by either heap leach or conventional plant process. The spot market price for uranium was $25/lb early in 1981; thus reprocessing these tailings for uranium recovery does not appear to be economically attractive under present or foreseeable market conditions. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

Engineering Assessment of Inactive Uranium Mill Tailings, Riverton Site, Riverton, Wyoming

DOE/UMT-0106; FBDU 360-19 (1981, August)

Radon gas released from the 900,000 tons of tailings materials at the Riverton site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The nine alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IX). Cost estimates for the nine options range from about $16,600,000 for stabilization in-place, to about $23,200,000 for disposal at a distance of 18 to 25 mi. Three principal alternatives for the reprocessing of the Riverton tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $260 and $230/lb of U3O8 by heap leach and conventional plant processes, respectively. The spot market price for uranium was $25/lb early in 1981; therefore, reprocessing the tailings for uranium recovery does not appear to be economically attractive. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Bowmar Site, Bowman, North Dakota

DOE/UMT-0121; FBDU 360-22 (1981, November)

An engineering assessment was performed of the problems resulting from the existence of radioactive residues from the burning of uranium-bearing lignite at Bowman, North Dakota. This assessment includes the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of ash residues and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meterology, and the evalution and costing of alternative corrective actions. Radon gas released form the 97,000 tons of ash and contaminated materials at the Bowman site constitutes a significant environmental impact, although windblown ash and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the contaminated materials to remote disposal sites and decontamination of the ashing site (Options II through IV). Cost estimates for the four options range from about $1,740,000 for stabilization in-place, to about $3,060,000 for disposal at a distance of about 4 mi. Reprocessing the ash for uranium recovery is not feasible because of the extremely small amount of material available at the site and because of its low U3O8 content. (Auth)

435
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Bowman Site, Bowman, North Dakota

DOE/UMT-0121S; FBDU 360-22S (1981, November)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Bowman Site, Bowman, North Dakota." These reports present important engineering and environmental information gathered from many federal, state, and local sources. This information is essential to assess the impacts associated with the options suggested for remedial actions for the contaminated residues from the former ashing operations at the Bowman site. Although the reports may at times refer to uranium mill tailings, the information given is also relevant to the contaminated materials at the Bowman site.

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Belfield Site, Belfield, North Dakota

DOE/UMT-0122; FBDU 360-21 (1981, November)

The Belfield site was evaluated in order to assess the problems resulting from the existence of radioactive ash at Belfield, South Dakota. This engineering assessment has included drilling of boreholes and radiometric measurements sufficient to determine areas and volumes of ash and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meterology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 55,600 tons of ash and contaminated material at the Belfield site constitutes a significant environmental impact, although external gamma radiation also is a factor. The four alternative actions presented in this engineering assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the ash and contaminated materials to remote disposal sites, and decontamination of the Belfield site (Options II through IV). Cost estimates for the four options range from about $1,500,000 for stabilization in-place, to about $2,500,000 for disposal at a distance of about 17 mi from the Belfield site. Reprocessing the ash for uranium recovery is not feasible because of the extremely small amount of material available at the site and because of its low U3O8 content. (Auth)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Belfield Site, Belfield, North Dakota

DOE/UMT-0122S; FBDU 360-21S (1981, November)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Belfield Site, Belfield, North Dakota." Engineering and environmental information gathered from many federal, state, and local sources is presented. This information is essential to assess the impacts associated with the options suggested for remedial actions for the contaminated residues from the former ashing operations at the Belfield site. Although the reports may at times refer to uranium mill tailings, the information is also relevant to the contaminated materials on the Belfield site. (Auth)(CAJ)

438
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Slick Rock Sites, Slick Rock, Colorado

DOE/UMT-0115; FBDU 360-07 (1981, September)

Radon gas released from the 387,000 tons of tailings at the Slickrock sites constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The five alternative actions presented in this engineering assessment include millsite decontamination with the addition of 3 m of stabilization cover material (Option IA), consolidation of the piles (Options IB and IC), and removal of the tailings to remote disposal sites and decontamination of the tailings sites (Options II and III). Cost estimates for the five options range from about $6,800,000 for stabilization in-place, to about $11,000,000 for disposal at a distance of about 6.5 mi. Three principal alternatives for the reprocessing of the Slickrock tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be over $800/lb of U3O8 whether by conventional or heap leach plant processes, however, the spot market price for uranium was $25/lb early in 1981, and reprocessing the tailings for uranium recovery is not economically attractive at present, nor for the foreseeable future. (Auth)(CAJ)

439
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Radioactive Sands and Residues, Lowman Site, Lowman, Idaho

DOE/UMT-0118S; FBDU 360-17S (1981, September)

This report is a summary of a parent report entitled "Engineering Assessment of Radioactive Sands and Residues, Lowman Site, Lowman, Idaho". These reports are revisions of an earlier report dated December 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Lowman Site, Lowman, Idaho," and became necessary due to changes that have occurred since 1977 which pertain to the Lowman site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the radioactive sands and residues. (Auth)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment and Inactive Uranium Mill Tailings, Monument Valley Site, Monument Valley, Arizona

DOE/UMT-0117; FBDU 360-04 (1981, October)

The Monument Valley site has been reevaluated in order to revise the March 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Monument Valley, Arizona. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations. These data are sufficient to determine site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 1.1 million tons of tailings at the Monument Valley site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $6,600,000 for stabilization in-place, to about $15,900,000 for disposal at a distance of about 15 mi. Three principal alternatives for reprocessing the Mounument Valley tailings were heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be more than $500/lb of U3O8 by heap leach or conventional plant processes. The spot market price for uranium was $25/lb early in 1981; therefore, reprocessing the tailings for uranium recovery is economically unattractive. (Auth)(PTO)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Lakeview Site, Lakeview, Oregon

DOE/UMT-0110; FBDU 360-18 (1981, October)

The Lakeview site has been reevaluated in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Lakeview, Oregon. This engineering assessment has included the preparation of topograhic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 130,000 tons of tailings at the Lakeview site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The three alternative actions presented in this engineering assessment include millsite decontamination with the addition of 3 m of stabilization cover material (Option I) and removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II and III). Cost estimates for the three options range from about $6,000,000 for stabilization in-place, to about $7,500,000 for disposal at a distance of about 10 mi. Three principal alternatives for the reprocessing of the Lakeview tailings were: heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be over $450/lb of U3O8, whether by heap leach or conventional plant process. Since the spot market price for uranium was $25/lb early in 1981, reprocessing the tailings for uranium recovery is not economically attractive under present or foreseeable conditions. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Lakeview Site, Lakeview, Oregon

DOE/UMT-0110S; FBDU 360-18S (1981, October)

This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Lakeview Site, Lakeview, Oregon." These reports are revisions of an earlier report dated December 1977, entitled "Phase I - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Lakeview Site, Lakeview, Oregon," which have become necessary as a result of changes that have occurred since 1977 pertaining to the Lakeview site and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. Evaluation of the current conditions is essential to assessing the impacts associated with the options suggested for remedial actions for the tailings. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Durango Site, Durango, Colorado

DOE/UMT-0103S (1981, June)

Ford, Bacon and Davis Utah Inc. has reevaluated the Durango site in order to revise the November 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Durango, Colorado. This engineering assessment has included the preparation of topographic measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the nearly 1.6 million tons of tailings at the Durango site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the seven options range from about $10,700,000 for stabilization in-place, to about $21,800,000 for disposal at a distance of about 10 mi. Three principal alternatives for the reprocessing of the Durango tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. (Auth)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Slick Rock Sites, Slick Rock, Colorado

DOE/UMT-0115S; FBDU 360-07S (1981, September)

The Slickrock sites have been reevaluated in order to revise the October 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Slickrock, Colorado. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. This report is a summary of a parent report entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Slickrock Sites, Slickrock, Colorado". These reports are revisions of an earlier report dated October 1977, entitled "Phase II - Title I Engineering Assessment of Inactive Uranium Mill Tailings, Slickrock Sites, Slickrock, Colorado". These reports have become necessary as a result of changes that have occurred since 1977 which pertain to the Slickrock sites and vicinity, as well as changes in remedial action criteria. The new data reflecting these changes are summarized in this report. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Phase 2 - Title 1 Engineering Assessment of Inactive Uranium Mill Tailings, Shiprock Site, Shiprock, New Mexico

GJT-2S (1977, March 31)

An engineering assessment was made of the problems resulting from the existence of radioactive uranium mill tailings at Shiprock, New Mexico. The Phase II, Title I services include the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and other radium-contaminated materials, the evaluation of resulting radiation exposures of individuals and nearby populations, the investigation of site hydrology and meteorology and the evaluation and costing of alternative corrective actions. Radon gas release from the 1.7 million tons of tailings at the Shiprock site constitutes the most significant environmental impact in addition to windblown tailings and external gamma radiation. The 11 alternative actions range from completion of the present ongoing EPA site decontamination plan (Option I), to stabilizing in-place with varying depths of cover material (Options II-IV), to removal to an isolated long-term disposal site (Options V-XI). All options include remedial action costs for off-site locations where tailings have been placed. Cost estimates for the 11 options range from $540,000 to $12,500,000. It is concluded that reprocessing the tailings for uranium is not economically feasible. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Riverton Site, Riverton, Wyoming

DOE/UMT-0106S; 57 pp. (1981, August)

Ford, Bacon, and Davis Utah Inc., has reevaluated the Riverton site in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Riverton, Wyoming. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 900,000 tons of tailings materials at the Riverton site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The nine alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IX). Cost estimates for the nine options range from about $16,600,000 for stabilization in-place, to about $23,200,000 for disposal at a distance of 18 to 25 mi. Three principal alternatives for the reprocessing of the Riverton tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $260 and $230/lb ob U308 by heap leach and conventional plant processes respectively. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery does not appear to be economically attractive. (EDB)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Radiation Pathways and Potential Health Impacts from Inactive Uranium Mill Tailings

GJT-22; FBDU 130-41; 114 pp. (1978, July)

Radiation exposure pathways and potential health impacts have been estimated as part of the Phase II - Title I Engineering Evaluation of radioactive uranium mill tailings at the sites of inactive mills in eight western states. A brief description of the pathways and a summary of the results are contained in the Title I Engineering Evaluation Reports. The methodology used in performing the pathway analysis and health effects estimations is described in detail. In addition, specific parameters are presented for each of the 22 uranium millsites that were evaluated. Finally, a computer program RADAD, developed as part of this evaluation, is described and listed. The extent of radiation transport from the tailings piles into the environment is discussed in chapter 2. Chapter 3 contains a discussion of the methodology used in determining the radon concentrations and the population distributions. This chapter also contains the radon pathway parameters for each of the sites. A discussion of the potential health effects resulting from the radon is presented in chapter 4. Appendix A contains the users manual for the RADAD program. The mathematical formulation and programming specifics are given in this appendix as are input instructions, program listing and sample problems. Appendix B contains details of the groundwater evaluation and appendix C contains additional detail concerning the calculations for each site. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Phase 2 - Title 1 Engineering Assessment of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona

GJT-5; FBDU 130-4 (1977, March 31)

This engineering assessment includes the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and other radium-contaminated materials, the evaluation of resulting radiation exposures of individuals residing nearby, the investigation of site hydrology and meteorology and the evaluation and costing of alternative corrective actions. Radon gas release from the tailings on the site constitutes the most significant environmental impact to the inhabited area near the site. In the downwind direction, to the northeast of the site, airborne radioactivity is greater than federal guidelines but there are no dwellings in that direction within the area. Gamma radiation is significant over the tailings but is near background levels in the housing area. The sparse population and relatively low radiation levels yield minimal immediate environmental impact; hence, the four alternative actions presented are directed towards restricting access to the site (Option I), and returning the windblown tailings to the pile and stabilizing the pile with cover material (Options II, III, and IV).

Fencing around the site or the tailings pile and the removal or decontamination of mill buildings is included in all options. Option II provides 2 ft of cover material on the tailings, Option III provides 4 ft of cover, and Option IV provides 13 ft of cover. Costs of the options range from $671,000 to $2,904,000. Reprocessing the tailings for uranium is only marginally feasible and would require a more detailed economic evaluation before any action was taken. (Auth)(CAJ)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Naturita Site, Naturita, Colorado

DOE/UMT-012S; FBDU 360-08S; 51 pp. (1981, July)

Ford, Bacon and Davis Utah Inc. has reevaluated the Naturita site in order to revise the November 1977 engineering assessment of the problems resulting from the existence of radioactive contamination at the former uranium mill tailings site at Naturita, Colorado. This evaluation has included the preparation of topographic maps, the drilling of boreholes and radiometric measurements sufficient to determine areas and volumes of contaminated materials and radiation exposures of individuals and nearby populations, and the evaluation and costing of alternative remedial actions. Radon gas released from the estimated 344,000 tons of contaminated materials that remain at the Naturita site constitutes the most significant environmental impact, although external gamma radiation also is a factor. The two alternative actions presented in this engineering assessment are stabilization of the site in its present location with the addition of 3 m of stabilization cover material (Option I), and removal of residual radioactive materials to a disposal site and decontamination of the Naturita site (Option II). Cost estimates for the two options $8,200,000 for disposal at the Ranchers Exploration and Development Corporation's reprocessing site. Truck haulage would be used to transport the contaminated materials from the Naturita site to the selected disposal site. Ranchers Exploration and Development Corporation removed the tailings from the site, reprocessed them, and disposed of them from the 1977 to 1979. There is no noteworthy mineral resource remaining at the former tailings site; therefore, recovery of residual mineral values was not considered in this assessment. (ERA)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Summary of the Phase 2 - Title 1 Engineering Assessment of Inactive Uranium Mill Tailings, Gunnison Site, Gunnison, Colorado

GJT-125; 56 pp. (1977, November)

Ford, Bacon and Davis Utah Inc. has performed an engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Gunnison, Colorado. The Phase II - Title I services include the preparation of topographic measurements sufficient to determine areas and volumes of tailings and other radium-contaminated materials, the evaluation of resulting radiation exposures of individuals and nearby populations, the investigation of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas release from the 0.5 million tons of tailings at the Gunnison site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation are also factors. The nine alternative actions presented range from millsite decontamination (Option I), to adding various depths of stabilization cover material (Options II and III), to removal of the tailings to long-term storage sites and decontamination of the present site (Options IV through IX). Cost estimates for the nine options range from $480,000 to $5,890,000. Reprocessing the tailings for uranium does not appear to be economically attractive at present. (EDB)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

Engineering Assessment of Inactive Uranium Mill Tailings - Canonsburg Site, Canonsburg, Pennsylvania

DOE/UMT-0101; FBDU 360-20 (1982, April)

Ford, Bacon & Davis Utah Inc. has evaluated the Canonsburg site in order to assess the problems resulting from the existence of radioactive residues at Canonsburg, Pennsylvania. This engineering assessment has included the preparation of topographic maps, radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. Radon gas released from the approximately 300,000 tons of tailings and contaminated soil at the Canonsburg site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings and contaminated materials to a remote disposal site and decontamination of the Canonsburg site (Options II through IV). Cost estimates for the four options range from $23,244,000 for stabilization in-place, to $27,052,000 for disposal at a distance of about 17 miles. Three principal alternatives for the reprocessing of the Canonsburg tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. As required by Public Law 95-604, under whose auspices this project is conducted, the U.S. Department of Energy has solicited expressions of interest in reprocessing the tailings and residues at the Canonsburg site for uranium recovery. Since no such interest was demonstrated, no effort has been made to estimate the value of the residual uranium resource at the Canonsburg site. (Auth)(PTO)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings - Canonsburg Site, Canonsburg, Pennsylvania

DOE/UMT-0101S; FBDU 360-20S (1982, April)

This report is a summary of a parent report (issued under separate cover), entitled "Engineering Assessment of Inactive Uranium Mill Tailings, Canonsburg Site, Canonsburg, Pennsylvania." An evaluation has been made of the Canonsburg site in order to assess the problems resulting from the existence of radioactive residues at Canonsburg, Pennsylvania. This engineering assessment has included the preparation of topographic maps, radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. Radon gas released from the approximately 300,000 tons of tailings and contaminated soil at the Canonsburg site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings and contaminated materials to a remote disposal site and decontamination of the Canonsburg site (Options II through IV). Cost estimates for the four options range from $23,244,000 for stabilization in-place, to $27,052,000 for disposal at a distance of about 17 miles. (Auth)(PTO)

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Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Spook Site, Converse County, Wyoming

DOE/UMT-0119; FBDU 360-15 (1981, October)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

The Spook site was evaluated in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings 48 miles northeast of Casper, Wyoming. The assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 187,000 tons of tailings at the Spook site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The four alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IV). Cost estimates for the four options range from about $710,000 for stabilization in-place, to about $1,950,000 for disposal at a distance of about 15 mi. Three principal alternatives for the reprocessing of the Spook tailings are heap leaching, treatment at an existing mill, and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $40/lb of U3O8 by treatment in an existing conventional plant. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery might be economically feasible if they could be treated as supplementary feed to a nearby operating mill, provided the price of uranium returns to the 1978-1979 levels. (Auth)(CAJ)

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Gee, G.W., A.C. Campbell, D.R. Sherwood, R.G. Strickert, and S.J. Phillips, Battelle Pacific Northwest Laboratories, Richland, WA; U.S. Nuclear Regulatory Commission, Washington, DC

Interaction of Uranium Mill Tailings Leachate with Soils and Clay Liners: Laboratory Analysis/Progress Report - Technical Report

PNL-3381; NUREG/CR-1494; 83 pp. (1980, June)

Laboratory tests were conducted to evaluate leachate from uranium mill tailings and its interaction with materials taken the Morton Ranch Uranium Mill site in central Wyoming. Laboratory tests included: (1) physical and chemical characterization of geologic materials from the Morton Ranch; (2) physical and chemical characterization of acid leach tailings and tailings solution from the nearby Exxon Highland Mill; (3) leaching tests with selected tailings materials and leach solutions; and (4) adsorption studies measuring the sorption characteristics of heavy metals and radionuclides on the Morton Ranch geologic materials under low and neutral pH conditions. (EDB)(PTO)(JMF)

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Goldsmith, W.A., Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Aspects of Inactive Uranium-Milling Sites: An Overview

Nuclear Safety 17(6):722-732 (1976)

Radioactive residues from discontinued uranium-milling operations are present at 23 locations in the western United States. The short-lived progeny of the radon-222 emanating from the tailings gives rise to most of the public radiation exposure resulting from present management of these tailings. Since precursors of radon-222 have extremely long half-lives, long-term management policies and techniques are required if further reduction of radiation exposure to the public is desired. (EDB)(PTO)

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Goldsmith, W.A., F.F. Haywood, and R.W. Leggett, Oak Ridge National Laboratory, Oak Ridge, TN

Transport of Radon Which Diffuses from Uranium Mill Tailings

CONF-780422; Natural Radiation Environment III, Proceedings of a Symposium, T.F. Gesell and

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

W.M. Lowder, (Eds.), Houston, TX, April 23-28, 1978. U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, Vol. 2, (pp. 1584-1601), 881 pp. (1980)

Considerable attention has been given recently to potential hazards of radon exposure in the vicinity of large piles of uranium mill tailings. A procedure has been developed, using the results of numerous independent investigations, to describe the average annual behavior of radon that escapes from a tailings pile. The radon source term is developed from known profiles of Ra-226 in soil and is treated as an area source. Dispersion is calculated by using local meteorological data in a Gaussian diffusion model. A comparison has been made between calculated annual average radon concentrations attributable to the tailings pile in Salt Lake City, Utah, and a series of radon measurements which were made in the vicinity of the tailings pile over a period of 1 year. Population exposures were estimated and compared to those associated with exposure to background concentrations of Rn-222. It was found that annual exposures to Rn-222 of tailings-pile origin are about 10% of those associated with background Rn-222 in the Salt Lake City metropolitan area. (Auth)

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Goldsmith, W.A., and W.G. Yates, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN; Mound Facility, Miamisburg, OH

Finding and Evaluating Potential Radiological Problems in the Vicinity of Uranium Milling Sites

IAEA-SM-262/67; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The Oak Ridge National Laboratory (ORNL) has been performing radiological surveys at former uranium and thorium milling and processing sites since 1975. Normally, the major source of radiation exposures at the processing sites is the waste which was generated during the processing operations. The waste, called tailings, represents a large area source of technologically enhanced natural radioactivity. Inactive mill tailings usually have a low frequency of human occupancy but continuously generate radon-222 into the atmosphere. Thus, independent radon-222 surveys are conducted at the inactive mill sites and their environs by the Mound Facility. Measurements of airborne radon-222 and radon-222 flux are made on the sites to define the tailings source term. Concurrently with these measurements, an ambient radon-222 monitoring network is established offsite and a meteorological station is established at or near the mill site. These data are collected for a period of about 16 months at each site. The comprehensive radiological surveys conducted at these sites include the vicinity properties where off-site radioactivity has been detected. The radioactivity can migrate to these properties through natural mechanisms or human transport. The surveys are conducted to determine the amount, type, and location of tailings materials. Structures on a vicinity property are carefully surveyed to determine the presence or absence of construction-related uses of tailings. (Auth)(RHB)

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Gonzalez, D.D., Sandia National Laboratories, Albuquerque, NM

Hydrogeochemical Characterization of Inactive Uranium Tailings, UMTRAP

IAEA-SM-262/46; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The U.S. Department of Energy conducts the Uranium Mill Tailings Remedial Action Project (UMTRAP), whose purpose is to provide for the safe disposal of uranium mill tailings from 24 designated inactive milling sites. Under this program, the hydrogeochemical characterization of the tailings piles has been undertaken as a

means of defining release and transport mechanisms for the contaminants contained in the tailings. The transport phenomena may occur vertically (upwards and downwards), horizontally, and across the tailings interface and into the foundation material, which may be in an unsaturated or saturated state. The program will identify off-pile migration in terms of active or inactive plume-fronts migrating below and away from the pile. An extensive field program is in progress at two tailings sites that typify "wet" and "dry" environments; these are, respectively, the Riverton, Wyoming and Maybell, Colorado piles. In addition, eleven other tailings piles, part of the UMTRAP mineral assay program, are being investigated to define existing hydrologic conditions and the extent of contaminant migration, if any. As a result of conclusions derived from field investigations, transport scenarios will be developed for each site based on existing and historical conditions. Numerical codes, depicting unsaturated and saturated solute transport, will be verified and calibrated on the basis of field data and generalized to provide a basis for predicting radionuclide migration at other sites. This technology will provide an important input for decisions as to the most cost-effective disposal scenario for each of the UMTRAP sites, as well as to presently active sites (which do not fall within the purview of this program). Geoscientists from Lawrence Berkeley Laboratory, Colorado State University and Sandia National Laboratories are the principal investigators; Sandia National Laboratories serves as technical coordinator. (Auth)(JMF)

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Grammer, E.J., Pierson, Semmes, Crolius, and Finley, Washington, DC

Uranium Mill Tailings Radiation Control Act of 1978 and NRC's Agreement State Program

Natural Resources Lawyer 13(3):469-522 (1981)

The Uranium Mill Tailings Radiation Control Act of 1978 sought to remedy an earlier failure to regulate this environmental hazard and to provide funding for cleanup and management. The act also links standards set in the agreement state program of 1959 to minimum federal standards of the U.S. Nuclear Regulatory Commission. Analysis of the act and the agreement states program shows that the effort to merge the best of both programs has had success, but it also reveals some remaining regulatory gaps - the act excludes federally owned lands from the program and does not cover mining wastes. Critics disagree on whether the federal or state authorities are best able to protect health and safety, some claiming that the federal government puts national interests above local protection and others claim that states lack objectivity. (DCK)(PTO)

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Groelsema, D.H., U.S. Department of Energy, Office of the Deputy Assistant Secretary for Nuclear Waste Management and Fuel Cycle Programs, Washington, DC

The Management of Uranium Mill Tailings in the United States

IAEA-SM-262/60; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The management of uranium mill tailings in the United States consists of two main lines of activity: the management of the tailings at active uranium processing sites, and the cleanup and stabilization of tailings and residual contaminated material at designated inactive uranium processing sites. The tailings at the active sites are managed by the mill opeators under licenses and regulations issued by the U.S. Nuclear Regulatory Commission (NRC) or th[illegible]tes that have acquired authority through a forma[illegible]ment with the NRC. Twenty-two mills, located in western states, were operating early in 1982. The accumulated tailings at these processing sites are estimated to total approximately 100 million tons and are projected to total approximately 200 million tons by the year 2000. Currently, the NRC regulations for tailings management are being contested in the courts and are unenforceable by Congressional edict, at least until the end of FY 1982. The promulgation of general standards by the U.S. Environmental Protection Agency (EPA), in accordance with Public Law 95-604, is expected to provide a firm basis for the issuance of revised regulations. The program of remedial action at the inactive sites is being conducted by the U.S. Department of Energy, in cooperation with the affected States and Indian tribes according to standards promulgated by the EPA and with the concurrence of the NRC. Twenty-four sites, containing approximately 50 million tons of tailings have been designated for remedial action. In accordance with the authorizing legislation (P.L. 95-604) the program is scheduled for completion within the 7-year period following the promulgation of the EPA standards. Preliminary estimates indicate a total project cost of $540 million. The actual time for completion of the project and the actual cost will be heavily dependent on the level of funding provided and the level of the EPA standards finally issued. (Auth)(JMF)

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Hanchey, L.A., Sandia National Laboratories, Albuquerque, NM

Uranium Mill Tailings and Radon

SAND-80-2142 (Rev.) (1981, April)

The major health hazard from uranium mill tailings is presumed to be respiratory cancer resulting from the inhalation of radon daughter products. A review of studies on inhalation of radon and its daughters indicates that the hazard from the tailings is extremely small. If the assumptions used in the studies are correct, one or two people per year in the United States may develop cancer as a result of radon exhaled from all the Uranium Mill Tailings Remedial Action program sites. The remedial action should reduce the hazard from the tailings by a factor of about 100. (EDB)

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Hans, J.M., Jr., U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Miscellaneous Data and Information Collected During Radiation Surveys at the Former Monument Uranium Mill Site (1974 - 1975) - Technical Note

PB-285938; 49 pp. (1978, July)

The purpose of the surveys was to delineate the spread and depth of ore and mill tailings in order that cost estimates could be made for their removal and interim stabilization of the tailings piles. The results of the surveys were prepared in summary form and very little data was made available. This report presents the data and information collected at the former Monument Uranium Mill site. The data includes gamma radiation background measurements, bore hole logging data, ground water analysis, gamma surveys, and radionuclide concentrations versus depth in soil. Interpretation of the data is made where possible. It appears, from bore hole logs, that a substantial amount of uranium is still present at the mill site. (EDB)

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Hans, J.M., Jr., and R.L. Douglas, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Radiation Survey of Dwellings in Cane Valley, Arizona and Utah, for Use of Uranium Mill Tailings - Final Technical Note

ORP/LV-75-2; 43 pp. (1975, August)

A radiation survey was conducted in the Cane Valley area of Monument Valley, on the Navajo Reservation, to identify dwellings in which uranium mill tailings had been used and to assess the resulting radiation exposures. Sixteen of the 37 dwellings surveyed were found to have tailings and/or uranium ore used in their construction. Tailings were used in concrete floors, exterior stucco, mortar for stone footings, cement floor patchings, and inside as cement 'plaster'. Uranium ore was found in footings, walls, and in one fireplace. Other structures, not used as dwellings, were also identified as having tailings and ore use. Gamma ray exposure rates were measured inside dwellings and structures identified as having tailings and/or ore used in their construction. Indoor radon progeny samples were collected in occupied dwellings where practical. (GRA)

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Harmon, D.F., and J.J. Davis, U.S. Nuclear Regulatory Commission, Washington, DC

U.S. Nuclear Regulatory Commission Research Program for the Management of Wastes from Uranium Milling Operations in the United States

IAEA-SM-262/15; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

In the United States, past methods and practices for managing uranium milling wastes were essentially the same as for wastes from non-uranium milling operations. These methods and practies lead to serious environmental consequences at a number of mill sites, particularly at several mills which were shut down and essentially abandoned. At several mill sites in the United States, seepage from tailings ponds lead to contamination of underground aquifers, wind erosion of radioactive particulates from tailings piles contaminated off site environs, and radon releases to the atmosphere were uncontrolled. The U.S. Nuclear Regulatory Commission (NRC), now regulates uranium milling operations in the United States and has recently promulgated stringent regulations for the control and management of uranium milling wastes. The regulations are based in part on technical data obtained through research projects established and sponsored by the NRC. Ongoing research sponsored by the Commission is underway to improve methods for managing and controlling tailings and mitigating environmental effects from mill wastes especially from the long-term standpoint. Ongoing research includes: assessment of leachate movement from ponded tailings; mitigation of long-term erosion of radon suppression covers for uranium mill tailings; attenuation of radon emissions from in situ uranium recovery operations; tailings dewatering techniques; interim stabilization techniques; and tailings neutralization and other alternatives for immobilizing toxic materials in tailings. This paper will provide an in depth description and discussion of the problems associated with managing uranium mill wastes in the United States and NRC's research program for developing the technical data and information needed to support the NRC regulatory program. (Auth)(JMF)

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Hartley, J.N., G.W. Gee, H.D. Freeman, J.F. Cline, P.A. Beedlow, J.L. Buelt, J.F. Relyea, and T. Tamura, Pacific Northwest Laboratory, Richland, WA; Oak Ridge National Laboratory, Oak Ridge, TN

Uranium Mill Tailings Remedial Action Project (UMTRAP) Cover and Liner Technology Development Program

IAEA-SM-262/39; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Cover and liner systems for uranium mill tailings in the United States must meet stringent requirements regarding long-term stability, radon control and radionuclide and hazardous chemical migragation. For example, the U.S. Nuclear Regulatory Commission (NRC) presently requires a minimum of 3 m of earthen cover material and allows a maximum surface flux of 2 pCi/m/s. These standards are presently under critical review. The cover placed over a tailings pile serves three basic puaposes: 1) to reduce the release of radon, 2) to prevent the intrusion of plant roots and burrowing animals into the tailings, and 3) to limit surface erosion. The liner placed under a tailings pile prevents the migragation of radionuclides and hazardous chemicals to ground water. The cover and liner technology program being conducted at the Pacific Northwest Laboratory for the Department of Energy's UMTRAP Office includes 1) single and multilayer earthen cover systems, 2) asphalt emulsion radon barrier systems, 3) asphalt, clay and synthetic liner systems, 4) biobarrier systems, and 5) revegetation and rock covers. (Auth)(JMF)

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Haywood, F.F., D.J. Jacobs, B.S. Ellis, H.M. Hubbard, and W.H. Shinpaugh, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Survey of the Inactive Uranium-Mill Tailings at Rifle, Colorado

ORNL-5455; 95 pp. (1980, June)

Results of radiological surveys of two inactive uranium-mill sites near Rifle, Colorado, in May 1976 are presented. These sites are referred to as Old Rifle and New Rifle. The calculated radium-226 inventory of the latter site is much higher than at the older mill location. Data on above-ground measurements of gamma exposure rates, surface and near-surface concentration of radium-226 in soil and sediment samples, concentration of radium-226 in water, calculated subsurface distribution of radium-226, and particulate radionuclide concentrations in air samples are given. The data serve to define the extent of contamination in the vicinity of the mill sites and their immediate surrounding areas with tailings particles. Results of these measurements were utilized as technical input for an engineering assessment of those two sites. (Auth)(JMF)

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Haywood, F.F., P.T. Perdue, K.D. Chou, and B.S. Ellis, Oak Ridge National Laboratory, Oak Ridge, TN

Radiological Survey of the Inactive Uranium-Mill Tailings at Slick Rock, Colorado

ORNL-5452; 87 pp. (1980, June)

Results of a radiological survey of two inactive mill sites near Slickrock, Colorado, in April 1976 are presented. One mill, referred to in this report as North Continent (NC), was operated primarily for recovery of radium and vanadium and, only briefly, uranium. The Union Carbide Corporation (UCC) mill produced a uranium concentrate for processing elsewhere and, although low-level containation with Ra-226 was widespread at this site, the concentration of this nuclide in tailings was much lower than at the NC site. The latter site also has an area with a high above-ground gamma dose rate (2700 uR/hr) and a high-surface Ra-226 concentration (5800 pCi/g). This area, which is believed to have been a liquid disposal location during plant operations, is contained within a fence. A solid disposal area outside the present fence contains miscellaneous contaminated debris. The estimated concentration of Ra-226 as a function of depth, based on gamma hole-logging data, is presented for 27 holes drilled at the two sites. (Auth)

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Hazle, A.J., G.A. Franz, and R. Gamewell, Colorado Department of Health, Denver, CO

Colorado's Prospectus on Uranium Milling

IAEA-SM-262/44; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

This paper includes a discussion of Colorado's control of uranium mill tailings under Titles I and II of the Uranium Mill Tailings Radiation Control Act of 1978 Colorado has a legacy of nine inactive mill sites requiring reclamation under Title I, and two presently active plus a number of new mill proposals which must be regulated in accordance with Title II. Past failures in siting and control on the part of federal jurisdictions have left the state with a heavy legacy requiring extensive effort to address impacts to the state's environment and population. The second part of this paper is a discussion of the remedial action program authorized under Public Law 92-314 for Mesa County, where lack of federal control led to the dispersal of several hundred thousand tons of uranium mill tailings on thousands of properties, including hundreds of homes, schools and other structures. Successful completion of the State efforts under both programs will depend on a high level of funding and on the maintenance of adequate regulatory standards. (Auth)(JMF)

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Horton, T.R., U.S. Environmental Protection Agency, Eastern Environmental Radiation Facility, Montgomery, AL

A Preliminary Radiological Assessment of Radon Exhalation from Phosphate Gypsum Piles and Inactive Uranium Mill Tailings Piles

EPA-520/5-79-004; 15 pp. (1979, September)

The EPA Office of Radiation Programs has conducted a series of studies to determine the radiological impact of the phosphate mining and milling industry. This report describes the efforts to estimate cumulative working level months (CWLM) from radon-222 daughters produced from radium-226 in phosphate gypsum piles and how these estimates compare with CWLM from inactive uranium mill tailngs piles. Two Florida phosphate gypsum piles were selected for radon exhalation rate measurements. Indoor radon concentration, indoor working level, and individual and population CWLM were computed from the exhalation rate and source size for each source category. The calculated results for each source category are tabulated and compared. (Auth)(JMF)

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Ibrahim, S.A., S.L. Flot, and F.W. Whicker, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Concentrations and Observed Behavior of Ra-226 and Po-210 Around Uranium Mill Tailings

IAEA-SM-262/32; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

This study is designed to determine polonium-210 and radium-226 concentrations in soil and native plants from various sites around a conventional acid leach uranium operation in the western U.S., and to estimate plant/soil concentration rations. Relatively little literature on this topic and the potential ecological transport of these nuclides warranted this investigation. In general, concentration factors for plants growing on exposed tailings and at the edge of a tailings pond were significantly greater than for those in background and reclamation areas. Concentration factors for Po-210 were usually considerably greater than for Ra-226. Frequency distributions of concentration factor values were highly skewed, with arithmetic mean values 3-4 times larger than modal values. The results of a leaching study indicated that both Ra-226 and Po-210 in uranium tailings from the sulfuric acid leaching process are highly insoluble in water, and the resulting evological mobility appears significantly reduced as a result. (Auth)(RHB)

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King, K.B., and R.A. Levander, International Engineering Company, Inc., Fill Dams Department, San Francisco, CA; Chevron Resources, Mining Operations, San Francisco, CA

Design and Construction of Uranium Disposal Facilities for the Panna Maria Project, Texas

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 457-466), 626 pp. (1980)

The Panna Maria Uranium Project is located in South Texas, between San Antonio and Corpus Cristi, approximately 10 kilometers (6 miles) north of Karnes City, Texas. The tailings disposal facilities are located immediately south of the mill area and the central portion of the west pit. The mine and mill drainage pond is located north of the tailings pond. The tailings pond is a disposal area for mill process wastes and has a capacity for storage

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of approximately 9 million metric tons (10 million tons) of tailings. This capacity is adequate for approximately 10 years of milling, at a maximum rate of 2,700 metric tons (3,000 tons) per day. The tailings disposal facilities were designed to essentially eliminate discharge of contaminated waters to preclude degradation of surface streams or ground water. Water levels in the ponds will be maintained through reuse in the mill and by evaporation. (Auth)(NPK)

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Kisieleski, W.E., Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL

Immobilization of Uranium Mill Tailings

An Update on Nuclear Waste Management, Proceedings of the AIChE Annual Meeting, New Orleans, LA, November 8-12, 1981, (10 pp.) (1981, November)

A pressing problem associated with the nuclear fuel cycle is that of adequate long-term management of wastes associated with the milling of uranium ore. Historical management practice for solid wastes from uranium mills has been to pile the milling waste or tailings on the mill property. These tailings piles consist of the original ore deplected of its uranium. Since the chemical processing removes minimal amounts of the uranium daughter products, those naturally-occurring radionuclides remain in the tailings. Thus the piles represent a potential or actual source of radiation exposure to man. Under the "Uranium Mill Tailings Radiation Control Act of 1978" the Department of Energy (DOE) has been authorized to establish remedial action programs at 25 inactive uranium mill tailings sites in 10 states. A technology development program has been initiated to develop stabilization and cleanup techniques in a safe and environmentally acceptable manner. The potential radiological and environmental impacts associated with specific reclamation procedures will be discussed relative to the requirements of propsoed and existing EPA regulations. (Auth)

473

Koster, J., South Dakota Resources Coalition, Rapid City, SD

TVA to be First at Cleaning Up Old Uranium Site

High County News 10(23):1-3 (1978, December)

Scores of western towns share the problem of defunct uranium mills and millions of tons of mill tailings. People who live in these towns may run a higher risk of contracting cancer and birth defects, and may have a generally decreased life expectancy due to radiation from tailings piles. Remedial action has begun in Edgemont, South Dakota. Its uranium mill will probably be the first in the country to be decommissioned and have its tailings buried. The population could be exposed to radiation from the mill site in five possible ways: inhaled radon gas and radon daughters; gamma radiation from the tailings and contaminated mill structures; inhalation and ingestion of alpha radiation from radium and thorium in the windblown tailings; contaminated water; and internal radiation due to uptake of radioactive elements by plants and animals. Plans for decommissioning the mill site are discussed. (EDB)

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Lankston, R.W., and N.J. Lehrman, G-Cubed, Inc., Spokane, WA

Integration of Geophysical and Drilling Data to Map a Proposed Uranium Mill Tailings Site

Proceedings of the AIME 1980 Annual Meeting, Las Vegas, NV, February 24-28, 1980. American Institute of Mechanical Engineers, Society of Mining Engineers, Littleton, CO, (14 pp.)

Dawn Mining Company, operator of a uranium mill in Washington, undertook geological and geophysical studies relative to planned expansion of existing disposal facilities. Seismic refraction and reflection, resistivity, and ground magnetics data were integrated with limited drill data to determine the configuration of Quaternary sediments and the underlying basaltic and granitic bedrock. (EIX)

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Lichtman, S., U.S. Environmental Protection Agency, Washington, DC

Proposed Remedial Action Standards (40 CFR 192) for Uranium Mill Tailings for Inactive Processing Sites

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 33), 52 pp. (1981, June)

The U.S. Environmental Protection Agency has proposed standards (40 CFR 192) for uranium mill tailings from inactive processing sites. The standards apply to 25 sites that have been designated for a Federal/State remedial action program under The Uranium Mill Tailings Radiation Control Act of 1978. Public hearings on the proposals were held in April/May 1981. The proposed standards and major comments on them wil be described. EPA's proposed cleanup standards for contaminated buildings require remedial actions to provide reasonable assurance that indoor radiation levels do not exceed a radon decay product concentration of 0.015 Working Level (including background) and a gamma radiation exposure rate of 0.02 mR/hr (above background) because of tailings. Reasonable assurance that contaminated open land is cleaned to a level of 5 pCi/g of radium-226 in soil is also required. The proposed disposal standards for tailings piles require the disposal system to provide a reasonable expectation that the average radon flux from each pile to the air will be less than 2 pCi/sq m-s for at least 1000 years. Proposed standards for ground water and surface water are designed to preserve their usefulness for a similarly long time. The standards apply to all designated sites and do not specify remedial methods. The U.S. Department of Energy will select and perform remedial actions with U.S. NRC's concurrence. In order to provide for reasonable implementation of the standards under the varied circumstances at the designated sites, EPA also proposed criteria for determining exceptional circumstances. In such exceptional cases, DOE may select and perform remedial actions which come as close to meeting the standards as is reasonable. (Auth)(PTO)

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Macbeth, P.J., R.F. Overmyer, and K.K. Nielson, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Research on Radon Gas Diffusion and Attenuation from Uranium Mill Tailings

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 315-323), 626 pp. (1980)

Samples were deemanated and processed to determine the emanation coefficient of gross composite uranium mill tailings. The effects of HCl acid leaching on the emanation coefficient of typical Vitro tailings from Salt Lake City, Utah, were examined to determine the nature of the radium deposition in the tailings. Cover materials were evaluated. The mining regions were the Powder River and Shirley Basins of Wyoming, and the Ambrosia Lake region of New Mexico. The non-mining region selected was Rawlins, Wyoming. (EDB)(PTO)

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Magee, J.

Uranium Mill Tailings Radiation Control Act of 1978

Ecological Law Quarterly 8(4):801-809 (1980)

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The long-term environmental effects of the Uranium Mill Tailings Radiation Control Act of 1978 address the public health hazards of radioactive wastes and recognize the significance of this issue to public acceptance of nuclear energy. Title I of the Act deals with stabilizing and controlling mill tailings at inactive sites and classifies the sites by priority. It represents a major Federal commitment. Title II changes and strengthens Nuclear Regulatory Commission authority, but it will have little overall impact. It is not possible to assess the Act's effect because there is no way to know if current technology will be adequate for the length of time required. (DCK)

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Marple, M.L., S. Barr, D.R. Dreesen, D.F. Petersen, and E.M. Sullivan, Los Alamos Scientific Laboratory, Los Alamos, NM

Saltation as a Transport Mechanism of Tailings at an Inactive Uranium Mill Site

LA-7254-PR; Biomedical and Environmental Research Program of the LASL Health Division, Progress Report, January-December 1977, M.L. Marple, et al., (Comp.), (pp. 96-100) (1978, October)

The saltation of radioactive tailings particulates from inactive uranium mill tailings piles has been a health concern because some piles are located near residential areas. Little has been done to characterize dust particles blowing from tailings piles. Breslin and Glauberman characterized the radionuclide concentrations in dust at various distances downwind from three inactive mill tailings piles. As an extension of this work, a study was initiated to characterize physically and chemically the tailings material transported by particle creep and saltation processes. Information is summarized on the amount, physical size, and alpha radioactivity of particles moved by saltation from two inactive tailings piles in the Grants Mineral Belt of New Mexico. (EDB)(RHB)

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Marple, M.L., E.T. Louderbough, L.D. Potter, D.R. Dreesen, and E.J. Cokal, Los Alamos National Laboratory, Los Alamos, NM; University of New Mexico, Albuquerque, NM

Adsorption of Soluble Contaminants from Uranium Mill Tailings by Marine Shales

LA-8948-PR; The Los Alamos Life Sciences Division's Biomedical and Environmental Research Programs, January-December 1980, (pp. 89-91), 111 pp. (1981, September)

The adsorptive capacities of four shales from the Colorado Plateau were evaluated for a variety of major and trace element constituents in aqueous tailings leachates and for their potential usefulness in reducing the leaching transport of environmental pollutants. Results of the study indicated that the adsorptive capacities of shales as substrates beneath a tailings pond show varying capacities to adsorb trace element contaminants from tailings solutions, depending on the chemical characteristics of both the shales and the uranium mill tailings. Such shales could be useful in reducing seepage from tailings ponds, but individual assessments for specific tailings and specific shales must be made to characterize accurately the adsorption of aqueous tailings contaminants by these shales. (CAJ)

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Marple, M.L., and L.D. Potter, Los Alamos National Laboratory, Los Alamos, NM; University of New Mexico, Albuquerque, NM

Uptake of Radium-226 by Plants at Inactive Uranium Mill Sites in the Southwestern United States

IAEA-SM-257; Migration in the Terrestrial Environment of Long-Lived Radionuclides from the Nuclear Fuel Cycle, Proceedings of an International Symposium, Knoxville, TN, July 27-31, 1981, (10 pp.) (1981, July)

The uptake of radium by native and naturalized plant species growing at inactive uranium mill sites in the southwestern United States could be an important pathway of biological transfer for this element. The objectives of this study were to measure the uptake and translocation of radium to aboveground parts of plants growing in uranium mill tailings, to compare these results to plants growing in local soils and to compare radium uptake in different species and at different locations. Field plant samples and associated substrates were analyzed from two carbonate tailings sites in the Grants Mineral Belt of New Mexico. Radium activities in air-cleaned samples ranged from 5 to 368 pCi/g (dry weight) depending on species and location; activities in plants growing on local soils averaged 1.0 pCi/g. The tailings and local soils contain 140-1400 pCi/g and 2.1 pCi/g, respectively. A survey of 18 inactive uranium mill sites in the Four Corners Region was performed. Radium activity in plant tissues from nine species ranged from 2 to 210 pCi/g on bare tailings and from 0.3 to 30 pCi/g on covered tailings. The radium content in most of the soil overburdens on the covered tailings piles was 10 to 17 pCi/g. An experiment was performed to measure contaminant uptake by two species grown on tailings covered with a shallow (5 cm) soil layer. A grass, SPOROBOLUS AIROIDES (alkali sacaton) and a shrub, ATRIPLEX CANESCENS (four-wing saltbush), were studied. The tailings were a mixture of sands and slimes from a carbonate pile. The tailings treatments were plants grown in a soil cover over tailings; the controls were plants grown only in soil. Three soil types, dune sand, clay loam, and loam, were used. The radium activity of the plant tissue from the tailings treatment compared to that of the appropriate control was 1 to 19 times greater for the grass and 4 to 27 times greater for the shrub. Elevated uranium, selenium and molybdenum levels were also found in the plants grown in tailings. (Auth)(PTO)

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Matthews, M.L., U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

The Technology Development Effort of the Uranium Mill Tailings Remedial Actions Project

IAEA-SM-262/42; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

An extensive technology development effort was developed by the Uranium Mill Tailings Remedial Action (UMTRA) Project Office of the U.S. Department of Energy (DOE) in order to develop better techniques, designs and systems for the stabilization of uranium mill tailings piles. By virtue of a law passed by the U.S. Congress in 1978, the DOE has the responsibility for performing remedial actions at 24 inactive uranium mill tailings piles. It was determined that a major research and development program needed to be initiated so that we would have a high degree of assurance that compliance with strict remedial action standards could be achieved. The purpose of the technology development program is to push the state of the art in the area of stabilization systems. Therefore, an applied research effort was undertaken to determine the characteristics, phenomena, and dynamics of the inactive tailings piles. In addition, a development effort commenced that consisted of testing advanced cover and liner systems as well as evaluating scheme to recondition the tailings. (Auth)(JMF)

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McDowell-Boyer, L.M., A.P. Watson, and C.C. Travis, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Foodchain Transport of Lead-210 Resulting from Uranium Milling Activities

CONF-790325; STI/PUB-522; IAEA-SM-237/43; Biological Implications of Radionuclides Released from Nuclear Industries, Proceedings of an International Symposium, Vienna, Austria, March 26, 1979, Vol. 2 (1979, March 26)

The milling of uranium in western United States has resulted in an enhanced release of radon-222 from the residual tailings produced. The purpose of the present study was to evaluate the potential significance of lead-210 deposited on soil as a result of radioactive decay of the atmospheric radon-222 released. Environmental transport of lead-210, persisting in soils for 100 years following a unit release of radon-222 from four generic mill sites in the western United States, was evaluated. Resulting dietary exposure and dose commitment for the U.S. population were estimated with the use of derived environmental transport parameters, U.S. dietary and demographic information, and appropriate dose conversion factors for lead. Soil concentration of lead in U.S. crop production areas were determined by the National Oceanic and Atmospheric Administration, using a regional-scale atmospheric dispersion and deposition model applied to the four deisgnated release sites. A comparison between estimated dose commitment from lead in soil, and that due to inhalation of radon and short-lived daughters from a unit radon release from each mill site was made. The results indicate that the lead in soil is a potentially significant source of radiation dose from uranium milling activities with respect to the radon inhalation dose. (EDB)(PTO)

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Mill Tailings Act: Industry and Congress Continue Assault on UMTRCA

Mine Talk 1(3):23-26 (1981, September)

UMTRCA, Uranium Mill Tailings Radiation Control Act (also known as the Mill Tailings Act), provides that states regulating uranium milling and mill tailings under authority delegated by NRC, adopt rules and regulations equal to or more stringent than NRC's before November 8 or lose their agreement status. NRC promulgated a list of uranium-licensing criteria for dealing with mills and mill wastes on Oct. 3, 1980. Industry is seeking removal of most of the rules, claiming they are excessive and will not provide any extra protection for public health and the environment. The congressional debate has centered around how to prevent NRC from implementing and enforcing the licensing criteria without jeopardizing the agency's primary jurisdiction over licensing or uranium processing facilities. Environmentalists and public interest groups criticized the industry and congressional moves as clearly disguised methods to bail out an industry in decline and gut the requirements of the Mill Tailings Act itself. The Stratton strategic and special nuclear materials during transport at sea. Applicable federal regulations and international guidelines have been considered with the expectations that TRANSEAVER will assist in meeting legal and regulatory considerations when used to monitor shipments. Utilizing existing RECOVER components and commercially available sensors, TRANSEAVER'S link to a land-based command console is via MARISAT ship-to-shore communications equipment. Licensed shipping casks are enclosed in a security container and placed into a required closed van cargo container for a multiple boundary configuration which allows effective use of multiple sensor configurations. Any deviation from planned course or attempted tampering with the protected cargo automatically produces an Alerting Report at the command console. (EDB)(PTO)

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Miller, H.J., D.E. Martin, and K.J. Hamill, U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, DC

Generic Environmental Impact Statement and Proposed Regulations on United States Uranium Milling Industry

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 607-617), 626 pp. (1980)

In April 1979, the U.S. Nuclear Regulatory Commission (NRC) issued a draft Generic Environmental Impact Statement (GEIS) on Uranium Milling. In August of 1979, NRC proposed regulations incorporating conclusions of the GEIS and recent federal legislation, the Uranium Mill Tailings Radiation Control Act of 1978. The primary focus of the GEIS and proposed rules is on the problem of mill tailings management and disposal. Major technical and institutional requirements of the proposed rules, and the basis for them, are reviewed. In addition, major comments made by the U.S. milling industry, the public, and other governmental agencies on the GEIS and proposed rules are discussed. (Auth)

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Momeni, M.H., Argonne National Laboratory, Argonne, IL

Pattern of Temporal Diffusion of Radon-222 in the Canyon at Uravan, Colorado

CONF-8106144; Proceedings of the 26th Annual Health Physics Society Meeting, Louisville, KY, June 21-25, 1981, (p. 47), 52 pp. (1981, June)

The pattern of dispersion of radon-222 from uranium mill tailings in the complex topography of the Uravan mill was studied during November and December 1977. Diffusion was simulated by means of smoke tracers during calm weather which revealed a coupled cold drainage, upflow, and vertical mixing pattern to synoptic transport. The airborne radon concentration was measured continuously within the canyon and on the adjacent mesas. The concentration of radon at the toe of the tailings and adjacent to the canyon varied diurnally between 1 pCi/l at midday to about 20 pCi/l at midnight, with an average of 7.0 pCi/l. At a distance of about 1 km from the mill and within Uravan Club Ranch village the diurnal variation ranged between 0.5 pCi/l at midday to 5 pCi/l at midnight, with an average of 3.5 pCi/l. Similarly, the radon concentration at a remote location from the mill varied between 0.05 pCi/l at midday to 2.5 pCi/l at midnight, with an average of 1.35 pCi/l. The radon daughter concentration in working level units (WL) was continuously measured at a distance of about 1 km from the mill and within the Uravan Club Ranch village. The concentration varied between 0.005 WL at midday to 0.14 WL at midnight, with an average of 0.04 WL. This study suggests that airborne effluents from the mill are effectively trapped in the canyon during calm night conditions. (Auth)(CAJ)

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Momeni, M.H., Argonne National Laboratory, Argonne, IL

Environment in the Vicinity of Uravan Mill: Characterization of Radioactive Effluents

ANL/ES-110 (1981, June)

The principal objectives of this study were (1) to identify and measure release rates of radioactive effluents from the milling operations, (2) to measure temporal and spatial variations in concentrations of the airborne radionuclides, and (3) to determine size distribution of airborne particulates. The sources of release are ore pad, ore grinding and yellowcake drying operations, and radon exhalation and fugitive dust from the surface of tailings. Analysis of monthly composited ore samples indicated average specific activities of about 470 pCi/g for each of the radionuclides in the uranium series. The size distribution of airborne particles was measured at four locations, and the specific activities of U-238, Th-230, Ra-226, and Pb-210 were measured as a function of particle size. The dispersion of airborne effluents at sunrise and sunset was simulated using smoke tracers both on the mesa and within the canyon. The results indicated that at night the effluents released in the canyon remained in the canyon, and that radon from the tailings deposited on the mesa accumulated in the canyon during the sunset and sunrise periods. (GRA)

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Nelson, Haley, Patterson and Quirk, Inc., Grand Junction, CO

Operational Evaluation of the CSU Sealant Demonstration Report Presented by NHPQ

Report; 16 pp. (1974, October)

Field aspects associated with epoxy sealant as a remedial technique to reduce radon gas emanation are discussed. The first section in this evaluation deals with radiological measurements and includes radon daughter and gamma measurements, radon flux can technique, and continuous radon monitoring. Structural considerations made on floors and foundation walls are then described. Conclusions are discussed, and cost comparisons indicated that sealant was the most economical approach in all instances of the demonstration. Application of "OmniTech" epoxy sealant was recommended as a routine remedial action procedure with consideration to gamma exposure rate and accessibility of the influx surface. (CAJ)

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Nelson, R.W., A.E. Reisenauer, and G.W. Gee, Battelle Pacific Northwest Laboratories, Richland, WA; U.S. Nuclear Regulatory Commission, Division of Safeguards, Washington, DC

Model Assessment of Alternatives for Reducing Seepage from Buried Uranium Mill Tailings at the Morton Ranch Site in Central Wyoming - Technical Progress Report

PNL-3378; NUREG/CR-1495; 86 pp. (1980, June)

A model assessment was made to evaluate contaminant transport to groundwater from clay lined and partially lined pits containing uranium mill tailings. The assessment involved combined subsurface fluid flow and contaminant transport modeling for four alternatives for controlling seepage from buried tailings. The input hydrologic soil characteristics were measured on materials typical of those found at the Morton Ranch, uranium mill site in central Wyoming. The assessment included combined saturated and partially saturated flow and contaminant transport models for two dimensional vertical cross sections typical of the tailings burial pits proposed for use at Morton Ranch. The results obtained from the models were contaminant flow paths away from the tailings pits, the advancing contaminant flow fronts for various sorbed and non-sorbed constituents of major environmental concern and the associated quantities of contaminant flow for each of the alternatives. (GRA)

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Neuhauser, S., Sandia National Laboratories, Albuquerque, NM

Sandia's Activities in Uranium Mill Tailings Remedial Action

SAND-80-1319C; CONF-800584; Proceedings of a Fish and Wildlife Service Workshop, Fort Collins, CO, May 28, 1980 (1980, May 28)

The Uranium Mill Tailings Radiation Control Act of 1978 requires that remedial action be taken at over 20 inactive uranium mill tailings sites in the United States. Standards promulgated by the U.S. Environmental Protection Agency under this act are to be the operative standards for this activity. Proposed standards must still undergo internal review, public comment, and receive U.S. Nuclear Regulatory Commission concurrence before being finalized. Briefly reviewed, the standards deal separately with new disposal sites (Part A) and cleanup of soil and contaminated structures at existing locations (Part B). In several cases, the present sites are felt to be too close to human habitations or to be otherwise unacceptably located. These tailings will probably be relocated. New disposal sites for relocated tailings must satisfy certain standards. The salient features of these standards are summarized. (ERA)(PTO)

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O'Brien, P.D., Sandia National Laboratories, Albuquerque, NM

UMTRAP Technology Development Program: A Progress Report

SAND-81-1799C; CONF-811049; Uranium Mill Tailings Management, Proceedings of a Symposium, Fort Collins, CO, October 26, 1981, (6 pp.) (1981)

Serving as interim technical assistance contractor to DOE's Uranium Mill Tailings Remedial Action Project Office, Sandia National Laboratories assists the Project Office in directing and monitoring technology development programs directed toward assuring compliance with EPA standards for tailings disposal. This paper summarizes progress to date in the areas of cover technology, liner technology and conditioning. The presently proposed EPA standards for tailings disposal include very stringent specifications for long-term stability, radon exhalation and ground water contamination.

These standards are now under review, and some relaxation appears likely. The author offers purely personal speculations as to the content of the revised standards and their effect on the technology development program. (EDB)(RHB)

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Olson, H.G., and J.T. Tappan, Colorado State University, Department of Mechanical Engineering, Fort Collins, CO; Nelson, Haley, Patterson and Quirk, Inc., Grand Junction, CO

The Sealant Demonstration Program

Report; 92 pp. (1974, September)

This report presents the data, data anlaysis, problems and conclusions for each of the 15 houses comprising the Sealant Demonstration Program. Some of the technical routes that were followed before, during and after the sealant process are presented. Some conclusions were: if either the basement wall or floor contain mill tailings in the concrete aggregate or tailings under the floor, then both surfaces should be sealed; a substantial quantity of mill tailings (5 in.) under the basement floor would probably require breaking up the floor and removing the tailings instead of sealing; it would be better to make a background determination and one sampling 2 hours later at five or six locations instead of taking 8 hr of runs at one or two locations; and portable scintillation detectors are satisfactory rather than the pressurized ionization chamber (PIC). It was recommended that additional air monitor data should be gotten first, and a plan of sealant action be decided for each building so that repeat sealing would not be required. Considering cost, the $160,000 savings over conventional remedial action would probably seal 30-40 more residences. (CAJ)

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Rogers, V.C., G.K. Gantner, and W.A. Goldsmith, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT; Oak Ridge National Laboratory, Oak Ridge, TN

Alternative Management Techniques for the Uranium Mill Tailings Site at Salt Lake City, Utah

CONF-761031; Proceedings of the 10th Midyear Health Physics Society Topical Symposium, Saratoga Springs, NY, October 11-13, 1976, (pp. 81-92) (1976, October)

The concentrations of the radium-226 and other uranium-chain radionuclides present in tailings piles at uranium-milling sites are on the order of 1000 times higher than those usually found in soil-surface minerals. The public radiation exposure attributable to these sites is primarily due to inhalation of radon-222 progeny. This paper presents the radiological assessment of the uranium-milling site at Salt Lake City, Utah. Adverse health effects are estimated from present and projected public radiation exposures. Three alternative remedial action measures can be used to reduce radiation exposures: (1) decontamination of off-site areas contaminated by tailings materials, (2) covering the tailings with contamination-free material, and (3) removal of the tailings to a more remote location. These three measures are examined in terms of costs incurred and serious health effects avoided. (Auth)(JMF)

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Rogers, V.C., K.K. Nielson, and G.M. Sandquist, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Uranium Mill Tailings Impoundment Performance and Cost Optimization

IAEA-SM-262/43; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

It is well established that the major environmental pathways for radioactive contaminant emissions from uranium mill tailings are radon releases to the atmosphere and leaching into an underlying groundwater system. An important feature of a uranium mill tailings reclamation program is the proper long-term stabilization of the tailings pile to adequately reduce radon emissions and contaminant leaching. The significance of these pathways generally depends upon the geological, hydrological, and climatological factors at the disposal site. For example, in many uranium mining and milling areas of the semi-arid western U.S., the groundwater migration pathway is not of major concern; however, this pathway receives major consideration in many Canadian mining regions. A model has been developed which performs the following determinations: radon migration through tailings cover systems; contaminant transport through tailings liner systems and underlying aquifers; first-order cost estimates for the cover and liner system; and optimization of cover and liner costs subject to externally imposed constraints. (Auth)(JMF)

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Rogers, V.C., R.F. Overmyer, K.M. Putzig, C.M. Jensen, K.K. Nielson, and B.W. Sermon, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Characterization of Uranium Tailings Cover Materials for Radon Flux Reduction

NUREG/CR-1081; FBDU 218-2; 166 pp. (1980, May)

The attenuation of radon through uranium tailings cover material is usually described with diffusion theory expressions. One of the main parameters characterizing the diffusion is the diffusion coefficient. Measured values of the diffusion coefficient for several Wyoming and New Mexico soils are presented. An interpretation of various approximations to the diffusion equation is also given. Finally, the diffusion coefficient dependence on moisture is presented and the data are represented by a simple correlation. (Auth)

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Sanathanan, L.P., R.R. MacDonald, W.E. Kisieleski, and C.J. Roberts, Argonne National Laboratory, Division of Environmental Impact Studies, Argonne, IL

Statistical Decision Procedures for Uranium Mill Tailings Remedial Action

IAEA-SM-262/16; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Radiological data which will form the bases for decisions pertaining to the inactive uranium mill tailing piles being considered for remedial action under the DOE-sponsored Uranium Mill Tailings Remedial Action Program (UMTRAP) are currently being compiled and updated by the Environmental Impact Division of ANL. In addition to costs and risks associated with remedial action decisions, uncertainties caused by variability and gaps in the data must be dealt with in the choice of appropriate decision criteria. This paper describes some statistical procedures for handling such uncertainties and also for incorporating them in to the overall uncertainty in the health risk assessments and corresponding decisions. These procedures are illustrated with data on the uranium mill tailings site at Salt Lake City, Utah. (Auth)

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Scarano, R.A., U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, DC

Review of Uranium Mill Tailings Management Programs Involving Below Grade Disposal

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 121-143), 626 pp. (1980)

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The NRC developed guidelines in May 1977, for the industry in the form of the following performance objectives for tailings management: Siting and Design - (1) locate the tailings isolation area remote from people such that population exposures would be reduced to the maximum extent reasonably achievable; (2) locate the tailings isolation area such that disruption and dispersion by natural forces is eliminated or reduced to the maximum extent reasonably achievable; (3) design the isolation area such that seepage of toxic materials into the groundwater system would be eliminated or reduced to the maximum extent reasonsably achievable; - During Operations - (4) eliminate the blowing of tailings to unrestricted areas during normal operating conditions; - Post Reclamation - (5) reduce direct gamma radiation from the impoundment area to essentially background; (6) reduce the radon emanation rate from the impoundment area to about twice the emanation rate in the surrounding environs; (7) eliminate the need for an ongoing monitoring and maintenance program following successful reclamation plan; and (8) provide surety arrangements to assure that sufficient funds are available to complete the full reclamation plan. The paper gives some examples of below-grade tailings management programs that have been authorized or are in final review. (Auth)(PTO)

497

Scarano, R.A., U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, DC

Uranium Mill Tailings Licensing Requirements in the United States

IAEA-SM-262/53; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

A comprehensive review of the mill tailings licensing requirements developed and implemented by the United States Nuclear Regulatory Commission. Recently authorized tailings management programs will be discussed, including the bases for determining their conformance with the new regulations. (Auth)

498

Schwendiman, L.C., G.A. Sehmel, T.W. Horst, C.W. Thomas, and R.W. Perkins, Pacific Northwest Laboratory, Richland, WA

A Field and Modeling Study of Windblown Particles from a Uranium Mill Tailings Pile

PNL-3345; NUREG/CR-1407; 240 pp. (1980, June)

An extensive field study whose primary objective was to obtain knowledge and understanding of the nature and quantity of windblown particles from uranium mill tailings piles was conducted in the Ambrosia Lake District of New Mexico. The following major field tasks were undertaken: determination of physical, chemical, and radioactivity characteristics of mill tailings particles; an investigation of the nature and quantity of tailings particles in soil in the vicinity of tailings piles; and the determination of the nature and flux of particles being transported by wind as a function of wind speed and height. Results of the field study are presented. Particle size distributions and associated radioactivity were measured. (GRA)

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Schwendiman, L.C, G.A. Sehmel, T.W. Horst, C.W. Thomas, and R.W. Perkins, Pacific Northwest Laboratory, Richland, WA

A Field and Modeling Study of Windblown Particles from a Uranium Mill Tailings Pile

PNL-2890;NUREG/CR-0629; 128 pp. (1979, April)

A field study is reported, showing that for a carbonate-leach-process mill tailings pile in the Grants, New Mexico region much of the residual radioactive constituents in the tailings is found associated with particles 7 um in diameter and smaller. As the tailings material dries,

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particle attachment and aggregation occurs with the result that radioactive constituents become associated more with larger particles. Soil samples taken at surface and subsurface on radial lines extending from the tailings pile for 5 miles showed the distribution of radium-226 and other radionuclides in the soil. The radium-226 deposited on the soil was distributed in such a manner that about 1.6 Ci of radon-222 per day enters the atmosphere from this secondary source. The suspension and transport of particles were studied using an array of sampling towers and wind speed and velocity instrumentation that signaled designated samplers at upwind sped criteria were satisfied. Flux of particles in various size ranges was determined as a function of wind speed. The radionuclide content of airborne particles as a function of particle size was measured for some samplers. A significant fraction of airborne radioactive material is associated with respirable particles. (GRA)(PTO)

500

Sehmel, G.A., Battelle Pacific Northwest Laboratories, Richland, WA

Airborne Particulate Concentrations and Fluxes at an Active Uranium Mill Tailings Site

CONF-780740; Management, Stabilization and Environmental Impact of Uranium Mill Tailings, Proceedings of a Nuclear Energy Agency Seminar, Albuquerque, NM, July 24-28, 1978, (pp. 65-84), 498 pp. (1978)

The purpose of this paper is to present an overview of current research results from airborne particulate measurements begun in August, 1977, at this site. Selected overview results will be discussed within the framework of the allotted time. To be discussed are equipment used in collecting airborne particulates, the experimental sampling array for measuring airborne particulates, results in terms of the dpm/g of airborne radionuclide, airborne solids concentrations in g/cu m, and the average airborne fluxes of nonrespirable particles in g/(sq m day). In all cases, results are reported as average values for a selected wind direction and wind speed increments. Direct measurements of airborne particulate concentrations and fluxes of transported mill tailing materials were measured at an active mill tailings site. Experimental measurement equipment consisted of meteorological instrumentation to automatically activate total particulate air samplers as a function of wind speed increments and direction, as well as particle cascade impactors to measure airborne respirable concentrations as a function of particle size. In addition, an inertial impaction device measured nonrespirable fluxes of airborne particles. Calculated results are presented in terms of the airborne solid concentration in g/cu m, the horizontal airborne mass flux in g/(sq m day) for total collected nonrespirable particles and the radionuclide concentrations in dpm/g as a function of particle diameter for respirable and nonrespirable particles. (Auth)(PTO)

501

Swift, J.J., J.M. Hardin, and H.W. Calley, U.S. Environmental Protection Agency, Office of Radiation Programs, Environmental Analysis Division, Washington, DC

Potential Radiological Impact of Airborne Releases and Direct Gamma Radiation to Individuals Living Near Inactive Uranium Mill Tailings Piles

EPA-520/1-76-001; 53 pp. (1976, January)

The estimated potential annual dose from radioactive radon decay products to individuals in dwellings in the vicinity of an average inactive pile is approximately 8 rem to the tracheobronchial region of the lungs at about 50 meters from the pile, 0.3 rem at 1 kilometer, and 0.1 rem at about 2.2 kilometers. The corresponding doses to the pulmonary region of the lungs from airborne uranium, thorium-230, and radium-226 are estimated to be about one-third as large, within 1 kilometer of the pile. Gamma exposure rates on the tailings are up to 1 mR/hr. Estimated exposure rates are in reasonable agreement with the limited data from field measurements. Should an individual be exposed continuously to a dose equivalent of 8 rem/yr to the tracheobronchial region of the

lung, it would require 100 years of exposure to double his risk of bronchial cancer. Also, this level of exposure is considered equivalent to 0.5 Working Level Months per year. Average individuals exposed over a lifetime to a dose equivalent of 0.3 rem/yr and 0.1 rem/yr would increase their risk of bronchial cancer by about 3 percent and 1 percent respectively. (GRA)

502

Thode, E.F., and D.R. Dreesen, Los Alamos National Laboratory, Los Alamos, NM; New Mexico State University, Las Cruces, NM

Technico-Economic Analysis of Uranium Mill-Tailings Conditioning Alternatives

LA-UR-81-2733; CONF-811049; Uranium Mill Tailings Management, Proceedings of a Symposium, Fort Collins, CO, October 26, 1981, (13 pp.) (1981)

An analysis of practicable conditioning technologies for uranium mill tailings and their estimated costs has been conducted for two conditioning alternatives, thermal stabilization and leaching (sulfuric acid). Among the four high priority remedial action sites, Canonsburg, Pennsylvania, and Shiprock, New Mexico appear to be very good candidates for thermal stabilization. At Shiprock, thermal stabilization appears to be less expensive ($16.01/ton) than moving the pile more than five miles and covering with 15 feet of earth. At Canonsburg, costs of other alternatives are not presently available. Given the radiological monitoring and protection expenses attendant upon moving these tailings in a highly populated area, it is likely that thermal, on site stabilization at $41.25/ton would be an attractive remedial action approach. Cost data on the Salt Lake City, Utah site are presented for comparison purposes. Thermal stabilization is not favorable at this site because of high fuel and labor costs, as well as other factors. A conceptual design for a thermal stabilization operation is described. Sufficient information to assess the leaching alternative is available only for the Durango, Colorado site. Because of the large amount of vanadium and uranium in the pile, the income from the sale of these strategic minerals could pay for as much as 58% of the expense of removing, transporting, and covering the pile. (NTIS)(RHB)

503

Thomson, B.M., and R.J. Heggen, University of New Mexico, Department of Civil Engineering, Albuquerque, NM

Water Quality and Hydrologic Impacts of Disposal of Uranium Mill Tailings by Backfilling

IAEA-SM-262/51; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Backfilling of the sand portion of spent uranium mill tailings has been practiced for years in the Grants Mineral Belt of New Mexico. Until recently, it has been limited to abandoned stopes requiring roof support to enable continued ore production, however, more stringent environmental regulations on surface disposal make backfilling an increasingly attractive alternative for a greater fraction of the tails. The research to be discussed has focused on determination of the impacts the backfill process has on ground water resources in the vicinity of the mines. Specific topics to be addressed include the water quality within the mine during backfill operations, water quality within the aquifer after mine abandonment and dewatering has been discontinued and the effects of backfilling on ground water flow. (Auth)

504

Thrall, J.E., J.M. Hans, Jr., and V. Kallemeyn, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Above Ground Gamma Ray Logging of Edgemont, South Dakota and Vicinity - Technical Note

PB-80-205768; 80 pp. (1980, February)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

This report summarizes the results of the 1971-72 and 1978 surveys to locate suspected tailings use areas. It also presents and discusses other gamma measurements made in and around Edgemont. (EDB)

505

Turley, R.E., E.A. Elsayed, and D.F. Petersen, University of Utah, Salt Lake City, UT

Engineering Analysis of the Externalities and Benefit/Cost Opportunities Associated with the Clean-Up of a Dismantled Uranium Production Plant

International Journal of Production Research 16(2):115-126 (1978, March)

This paper presents a benefit/cost analysis for different alternatives considered as remedial actions to reduce potential health hazards associated with radioactive uranium tailings remaining at a dismantled mill in Salt Lake City, Utah. The analysis was carried out in two phases. Phase one considered: the health hazards associated with each of the alternatives over various future time periods; parametric benefit/cost analyses using various monetary values of human life and real estate; and discount and inflation rates. The analysis was undertaken with and without includng opportunity costs. Phase two focused on non-quantifiable constraints that had not been covered in the first phase, and eliminated all but three of the alternatives. (MEX)(PTO)

506

U.S. Congress, Washington, DC

Uranium Mill Tailings Radiation Control Act of 1978

Public Law 95-604; 23 pp. (1978, November 8)

The purpose of this act is to provide a safe and environmentally sound program of assessment and remedial action at inactive mill tailings sites, including the reprocessing of tailings to extract residual uranium and other mineral values where practicable, and to regulate mill tailings during and after uranium or thorium ore processing at active mill operations. The act includes Title I-- Remedial Action Program, Title II- Uranium Mill Tailings Licensing and Regulation Definition, and Title III- Study and Designation of Two Mill Tailings Sites in New Mexico (the former Homestake-New Mexico Partners site near Milan, New Mexico, and the Anaconda carbonate process tailings site near Bluewater, New Mexico). (CAJ)

507

U.S. Department of Energy, Assistant Secretary of Environment, Environmental and Safety Engineering Division, Office of Environmental Compliance and Overview

Office of the Assistant Secretary for Environment Status of Activities on the Inactive Uranium Mill Tailings Sites Remedial Action Program

DOE/EP-0002; 52 pp. (1981, April)

Aerial radiological surveys and detailed ground radiological assessments of properties within the communities in the vicinity of designated processing sites in Canonsburg, Pennsylvania, Salt Lake City, Utah, and Boise, Idaho have been carried out. As a result an initial group of vicinity properties for remedial action, under the provisions of Section 102(e)(2) of the "Uranium Mill Tailings Reduction Control Act of 1978", have been designated. In accordance with the provisions of Section 102(b), the potential health effects of the residual radioactive materials on or near these properties were estimated, and the Assistant Secretary for Environment recommended priorities for performing remedial action to the Department's Assistant Secretary for Nuclear Energy. In designating these properties and establishing recommended priorities for performing remedial action, the Office of Environment consulted with the Environmental Protection Agency, the Nuclear Regulatory Commission, affected state and local governments, and individual property owners. In Fiscal Year 1981, the Office of Environment will be (1) conducting additional radiological surveys to identify and verify other properties in the vicinity of the remaining designated processing sites that may qualify for remedial action, (2) continuing radon monitoring projects in the vicinity of the designated processing sites, and (3) reviewing appropriate National Environmental Policy Act documents and remedial action plans prior to the conduct of specific remedial actions by the Department's Office of Nuclear Energy. Additionally, it is anticipated that the Office of Environment will be initiating its certification program at vicinity properties in the areas of Canonsburg, Pennsylvania and Salt Lake City, Utah. (JMF)

508
U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Remedial Actions at Inactive Mill Tailings Sites

DOE/EV-0015; Division of Environmental Control Technology Program-1977, Decontamination and Decommissioning, (pp. 137-138), 138 pp. (1978, June)

The objective of this program is to reduce the radiological hazards from accumulations of tailings that resulted from milling of uranium to supply the needs of national defense programs. Twenty engineering assessment reports have been completed and provide detailed information on radiation exposures, practicable remedial alternatives, and costs for 22 such mill tailings sites in 8 western states. The findings of these reports indicated that none of the sites has been adequately stabilized for long-term control of wind and water erosion and that many tailings sites are favorably located and in demand for alternate uses. In some cases, consolidation of the tailings pile areas and provision of an adequate stabilizing cover may be effective to correct the situation. In other cases, however, the present sites are unsuitable for long-term stabilization and removal to an alternate location will be necessary. Research and development efforts conducted in FY 1977 in connection with the engineering assessment work provided some encouraging results indicating that further efforts to develop methods to control the release of radon, to improve ground sealants, and to establish cover materials could be successful in reducing environmental impact and the cost of remedial actions. The remedial effort is estimated to require about five years to perform, largely because of the large quantities of tailings and other radioactively contaminated materials involved. On the 22 sites examined in the engineering assessment work, there are about 26,000,000 tons of tailings containing about 14,000 curies of radium, and additional large volumes of slightly contaminated materials. (Auth)(CAJ)

509
U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Remedial Actions at Inactive Uranium Mill Tailings Sites

DOE/EV-0128; Division of Environmental Control Technology Program - 1979, (pp. 171-180) (1980, June)

This section includes a discussion of the program designed to eliminate or control radiological health impacts to the public from accumulations of uranium mill tailings that resulted from the milling of uranium to supply the needs of government programs. Radiological assessments of inactive uranium mill tailings sites in the United States led to the identification of 25 processing sites as candidates for remedial action. The U.S. Department of Energy is assessing the potential health effects to the public from the residual radioactive materials on or near the 25 sites. (EDB)(PTO)

510
U.S. Department of Energy, Environmental and Safety Engineering Division, Washington, DC

Background Report for the Uranium Mill Tailings Sites Remedial Action Program

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DOE/EP-0011; 150 pp. (1981, April)

The purpose of this background report is to identify and assess the radiological conditions at inactive uranium mill sites that produced uranium concentrate for nuclear weapons development. Sites that sold concentrate to agencies other than federal agencies prior to January 1, 1971 are excluded from this report. The report contains site specific summaries for the 25 mill sites covered by the Uranium Mill Tailings Remedial Action Program. Each site summary includes a section on: Site Operation Highlights; Physical Characteristics; Owner History; Radiological History and Status; Remedial Priority; and References. Included in the background section of the document are two subsections; one explaining the need for uranium in the U.S. Government under the Manhattan Engineer District and the Atomic Energy Commission and the other containing a history of responsibilities and legislative actions concerning mill tailings. Appendix A is Public Law 95-604, Uranium Mill Tailings Radiation Control Act of 1978. (PTO)

511
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Remedial Action Standards for Inactive Uranium Processing Sites: 40 CFR 192

EPA-520/4-80-0011; 269 pp. (1980, December)

The U.S. Environmental Protection Agency (EPA) is proposing standards for disposing of uranium mill tailings from inactive processing sites and for cleaning up contaminated open land and buildings. These standards were developed pursuant to the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604). This act requires EPA to promulgate standards to protect the environment and public health and safety from radioactive and nonradioactive hazards posed by uranium mill tailings at designated inactive processing sites. The Draft Environmental Impact Statement examines health, technical, cost, and other factors relevant to determining standards. The proposed standards for disposal of the tailings piles cover radon emissions from the tailings to the air, protection of surface and ground water from radioactive and nonradioactive contaminants, and the length of time the disposal system should provide a reasonable expectation of meeting these standards. The proposed cleanup standards limit indoor radon decay product concentrations and gamma radiation levels and the residual radium concentration of contaminated land after cleanup. (GRA)(RHB)

512
U.S. Environmental Protection Agency, Washington, DC

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

Federal Register 46(6):2256-2563 (1981, January 9)

The U.S. Environmental Protection Agency (EPA) requests comments by May 1981 on proposed standards for disposal of residual radioactive materials (mainly tailings) from inactive uranium processing sites. The proposed standards set limits on radon release to air and water, and provide that these limits will be satisfied for at least 1000 years. The comment period for the cleanup standards proposed earlier is being extended so that it will coincide with the comment period for the disposal standards. (CAJ)

513
U.S. General Accounting Office, Washington, DC

Cleaning Up Commingled Uranium Mill Tailings: Is Federal Assistance Necessary

EMD-79-29; 29 pp. (1979, February)

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The U.S. General Accounting Office (GAO) was asked to determine whether federal assistance should be given to operating mill owners that have processed uranium for sale to both government and industry and, thus, generated residual radioactive wastes. The wastes generated for both government and commercial use are called commingled uranium mill tailings. GAO recommends that the Congress provide assistance to active mill owners to share in the cost of cleaning up that portion of the tailings which were produced under federal contract. Further, GAO believes that the Congress should also consider having the federal government assist those mills who acted in good faith in meeting all legal requirements pertaining to controlling the mill tailings that were generated for commercial purposes and for which the federal government is now requiring retroactive remedial action. At the same time, the Congress should make sure that this action establishes no precedent for the federal government assuming the financial responsibility of cleaning up other non-federal nuclear facilities and wastes, including those mill tailings generated after the date when the federal government notified industry that the tailings should be controlled. (EDB)

514
U.S. General Accounting Office, Washington, DC

Uranium Mill Tailings Cleanup: Federal Leadership at Last

EMD-78-90; 54 pp. (1978, June)

The U.S. Department of Energy has proposed legislation that would allow it to enter into cooperative agreements with various States to clean up residual radioactive materials, commonly called uranium mill tailings, at 22 inactive uranium mills. About 25 million tons of mill tailings have accumulated at these sites since the 1940s. The General Accounting Office (GAO) analyzed the need for, and adequacy of, the proposed legislation and recommends that the cleanup program be endorsed. While the federal government has no apparent legal responsibility for such a cleanup, it does have a moral responsibility since the mills primarily produced uranium for federal programs. Further, it is the only organization able to undertake such a cleanup program on a comprehensive basis. GAO also suggests several areas where the proposed legislation could be strengthened. (EDB)(JMF)

515
U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Final Environmental Statement Related to Operation of White Mesa Uranium Project Energy Fuels Nuclear, Incorporated

NUREG-0556; DOCKET-408681 (1979, May)

A final environmental statement prepared by the staff of the U.S. Nuclear Regulatory Commission is necessary for the issuance of a Source Material License to Energy Fuels Nuclear, Inc., for the construction and operation of the proposed White Mesa Uranium Project. The statement contains information on physical alterations to the surrounding environment, radiation levels, socioeconomic effects, waste volume and disposal, surface water effects, preservation of archeological and historic sites within the proposed project area, and reclamation procedures after operations cease. Also included are recommendations for the conditions under which the license for the White Mesa mill should be granted in order to insure protection of the environment. They are 1) 2000 tons of waste material per day for 15 years to be deposited onsite in subsurface pits; and 2) approximately 5.9 X 10(E+5) cu m of water to be used per year from the Navajo aquifer with about 1.18 cu m per minute discharged to the tailings impoundment area. (JMF)

516
U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Draft Environment Statement Related to Operation of Moab Uranium Mill, Grand County, Utah

NUREG-0341; DOCKET-403453-1 (1977)

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This draft environmental impact statement was prepared by the staff of the U.S. Nuclear Regulatory Commission and issued by the Commission's Office of Nuclear Material Safety and Safeguards. The proposed action is the continuation of Source Material License SUA-917 issued to Atlas Corporation for the operation of the Atlas Uranium Mill in Grand County, Utah, near Moab (Docket No. 40-3453). This authorizes a 600-ton (450-MT) per day acid leach circuit (for recovery of vanadium as well as uranium) and a 600-ton (450-MT) per day alkaline leach circuit (for other ores, including copper-bearing ores). (Auth)(PTO)

517
U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Draft Environmental Statement Related to the Decommissioning of the Edgemont Uranium Mill

NUREG-0846; 179 pp. (1981, September)

The Draft Environmental Statement (DES) related to the proposed decommissioning of the existing uranium milling facilities at Edgemont, South Dakota (Docket 40-1341) including removal or cleanup of contaminated soil from the mill site and local environs. This statement describes and evaluates: (1) purpose of and need for action; (2) alternative methods of tailings disposal; (3) alternative tailings disposal sites; and (4) environmental consequences for the proposed action. The NRC has concluded that the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 is to permit the applicant to proceed with the project as described in this Statement, subject to at least certain conditions as stated in the summary and conclusions of the DES. (Auth)

518
U.S. Nuclear Regulatory Commission, Washington, DC

Generic Environmental Inpact Statement on Uranium Milling

NUREG-0511 (Vol. 1) (1980, April)

The problems of controlling emissions from mills during operations and mill decommissioning are examined. In addition to technical controls, supplementary institutional and financial arrangements for dealing with these problems have been addressed. Health effects on workers and area populations are assessed as well as environmental and socioeconomic impacts of milling operations. A special effort has been made in preparing the Summary to refer the reader to specific sections of the main test pertinent to each issue discussed. Sections and chapters of the main text and appendices which provide details of material covered in the Summary are identified in parentheses, next to the topics, headings and specific material. Specific regulatory changes needed as a result of the analysis performed have been developed, and a range of newer disposal methods have been identified and worked out with mill operators. Guidelines are proposed for establishing financial arrangements which assure that mill decommissioning and tailings disposal is carried out consistent with proposed technical criteria. It is also proposed that mill operators contribute funds to cover the expense of ongoing site surveillance. Finally, because of the highly site-specific nature of environmental impacts that can occur and in view of the importance of the tailings disposal problem, it is recommended that each licensing action should have a thorough environmental assessment. (CAJ)

519
U.S. Nuclear Regulatory Commission, Washington, DC

Availability of Final Generic Environmental Impact Statement on Uranium Milling

Federal Register 45(198):67-77 (1980, October 9)

Notice is given that a Final Generic Environmental Impact Statement (GEIS) on Uranium Milling prepared by the Commission's Office of Nuclear Material Safety and Safeguards is available for public inspection. The report may be purchased through the NRC's sales program or from the National Technical Information Service as NUREG-0706. A wide range of issues are evaluated concerning the problem of controlling emissions from mills during operations and the problem of mill decommissioning. A set of specific conclusions concerning both technical and institutional aspects of uranium mill operation, decommissioning and tailings disposal are drawn in the GEIS. These conclusions have been incorporated into the regulation changes published in the October 3, 1980 Federal Register. (CAJ)

520

University of Colorado, Center for Environmental Studies, Denver, CO

Pollution of Ground Water Due to Inactive Uranium Mill Tailings: Summary of Progress, October 1, 1979 - September 30, 1981

DOE/ET/44206-1; 50 pp. (1980)

An extensive program of characterization of several inactive uranium tailings piles has been carried out in the past year. The geotechnical engineering program conducted a drilling program at the Salt Lake City and Grand Junction sites. The locations of slimes and sands in these sites have been characterized. In general, it was found that slimes exist in the impoundments in lower percentages than normally produced from mill tailings. Permeability tests were conducted yielding values ranging from 10(E-3) cm/s to 10(E-6) cm/s. The geochemical studies made considerable progress in the past year. Extensive sampling of several sites was conducted. Sampling programs have been completed for seven sites and are underway for nine other sites. The work to date has indicated the importance of salts in controlling the direction and rate of movement of contaminants. The work has also indicated that a number of non-radioactive elements such as As are of environmental importance. The work also indicated the importance of the fact that the tailings piles are out of chemical equlibrium with their environment. Computer software was developed and implemented for data storage and retrieval. Automation hardware was installed and tested for the Inductively Coupled Plasma Emission Spectrometer. A number of analytical protocols were developed for routine analyses. A comprehensive quality control program was implemented. More than 18,000 chemical analyses were performed. (GRA)(PTO)

521

Webb, W.D., S.G. Vick, and K.E. Robinson, Dames and Moore, Phoenix, AZ; Dames and Moore, Salt Lake City, UT; Robinson Dames and Moore, North Vancouver, British Columbia, Canada

A Look at Two Unique Uranium Tailings Disposal Systems

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 493-505), 626 pp. (1980)

The U.S. Nuclear Regulatory Commission (NRC) is encouraging the use of below-grade tailings disposal methods to reduce the potential for long-term erosion and dispersion of radioactive wastes. This paper describes two somewhat unique below-grade disposal systems which are presently in various stages of design, licensing, or construction. A history of the regulatory problems associated with each is presented. The paper also discusses the unique design aspects, particularly groundwater studies, for each of the projects. One project involves below-grade cut-and-cover techniques (similar to municipal waste disposal methods) whereby trenches are excavated to shallow bedrock, dewatered tailings are deposited by conveyors, and the excavated material is then used to cover the tailings. The second project involves a partial below-grade system utilizing conventional earth-dam embankments and a synthetic liner to prevent seepage contamination of groundwater. Tailings will fill tne subgrade portion of the impoundment with the diked above-grade portion used for evaporation during the life of the mill. (Auth)(PTO)

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522
Weimer, W.C., R.R. Kinnison, and J.H. Reeves, Pacific Northwest Laboratory, Richland, WA

Survey of Radionuclide Distribution Resulting from the Church Rock, New Mexico, Uranium Mill Tailings Pond Dam Failure

NUREG/CR-2449; PNL-4122; 65 pp. (1981, December)

An intensive site survey and on-site analysis program were conducted to evaluate the distribution of four radionuclides in the general vicinity of Gallup, New Mexico, subsequent to the accidental breach of a uranium mill tailings pond dam and the release of a large quantity of tailings pond materials. The objective of this work was to determine the distribution and concentration levels of Pb-210, Ra-226, Th-230, and U-238 in the arroyo that is immediately adjacent to the uranium tailings pond (pipeline arroyo) and in the Rio Puerco arroyo into which the pipeline arroyo drains. The on-site analysis of radioactive contamination constituted the principal task, the major output being the identification of those portions of the arroyo exceeding the New Mexico Environmental Improvement Division (NMEID) proposed cleanup criteria. Additional tasks included an evaluation of the initial soil sampling scheme and the proposed NMEID verification sampling scheme. Some of the conclusions were that: concentrations of lead-210, radium-226, and uranium-238 in samples throughout the length of the arroyo are not distinguishable from natural background concentrations; and present inability to differentiate between natural background Th-230 and contamination-derived Th-230 prohibits a clear definition of the Th-230 inventory from the tailings pond solution. (Auth)(CAJ)

523
Whicker, F.W., Colorado State University, Fort Collins, CO

Radioecological Investigations of Uranium Mill Tailings Systems: Progress Report, September 1, 1979 - September 30, 1980

DOE/EV/10305-1; 7 pp. (1980, October)

The initial 13 months of this program have been devoted to staffing, development of a radiochemistry capability, development of a mill tailings reclamation study, studies on hydraulic properties of soils, initiation of plant uptake studies, preparation for metabolic studies with deer and antelope, and sample collections. Through the addition of new personnel and equipment, we are rapidly developing analytical capabilitys for uranium-238, thorium-230, radium-226, lead-210, and polonium-210 in matrices such as soil, water, plant material, and animal tissues. A 4-acre study site was developed in cooperation with the Pathfinder Mines Corp. at the Shirley Basin Uranium Mine in Wyoming. The study site is designed for investigations on the influence of various kinds and thicknesses of mill tailings soil covers on the integrity of reclaimed tailings and inherent radionuclides. Studies on the hydraulic properties of various soil materials were conducted and data analysis is in progress. Plots and procedures for conducting plant uptake studies on uranium and progeny were established and long-term investigations have been initiated. A colony of tame mule deer and pronghorn antelope has been developed for studies on the uptake and retention of lead-210 and polonium-210. Numerous collections of soil, vegetation and water from the Shirley Basin Uranium Mine environs were conducted and radiochemical assay is in progress. (EDB)(PTO)

524
Yates, W.G., G.R. Hagee, and P.H. Jenkins, Mound Facility, Miamisburg, OH

Radon Monitoring Program, February-April 1980

MLM-2758; 12 pp. (1980, August 21)

The radon monitoring plan for Canonsburg, PA, was implemented on January 29, 1980. Thirty-eight offsite locations were being monitored by the end of the quarter. Additional locations were planned to fulfill DOE Division of Environmental Control Technology requests. Overall distribution of the radon measurements has not yet been determined. (GRA)(PTO)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

525
Yates, W.G., and P.H. Jenkins, Mound Facility, Miamisburg, OH

Development of a Radon Monitoring Plan for Canonsburg, Pennsylvania

MLM-2703(OP); 4 pp.; CONF-800334; Proceedings of the 2nd U.S. DOE Environmental Control Symposium, Reston, VA, March 18, 1980, (4 pp.) (1980)

The site of the former Vitro Rare Metals Plant, now called the Canonsburg Industrial Park, has been found to be contaminated with large quantities of radioactive wastes generated during former radium and uranium recovery operations. This report describes the development of a comprehensive radon monitoring program in the environment surrounding the site. (GRA)

526
Zahl, E.G., and G.L. Bloomsburg, U.S. Bureau of Mines, Spokane, WA; University of Idaho, Moscow, ID

Seepage Through Partially Saturated Soils Below A Uranium Tailings Pond

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 445-455), 626 pp. (1980)

A finite element computer program, UNSAT2, which simulates unsaturated flow is described and applied to a tailings pond near East Gas Hills, Wyoming. Information necessary to run the program are (1) tables of relative conductivity versus moisture content and capillary pressure versus moisture content; (2) porosity and saturated conductivity; and (3) initial pressures, boundary conditions and spatial coordinates for each FEM nodal point. A 10 year simulation is made of the East Gas Hills tailings pond based on existing field data and assumptions and interpolations where field data is lacking. The final phreatic surfaces through the cross section are similar but higher than measured values, probably due to limitations in assigning boundary conditions. UNSAT2 program results simulate actual conditions much better than saturated flow analysis. Limitations of applying the program to typical tailings ponds are: (1) lack of historical data, (2) cost and difficulty in obtaining representative data to determine relative conductivity - capillary pressure - moisture content relationships, and (3) assigning realistic boundary conditions compatable with the program. Further work on the program could make it an effective method of analyzing flow beneath new, properly instrumented, tailings ponds. (Auth)(JMF)

527
Zmbrana, B., and R.A. Heath, Ortloff Miner Service Corporation, Golden, CO

Reprocessing of Uranium Tailings by Heap Leaching Ranchers Exploration Naturita Project

Proceedings of the 83rd National Western Mining Conference. Denver, CO, February 6-8, 1980, (pp. 141-149); U.S. Bureau of Mines Mineral Yearbook 1980 (1980)

Ranchers Exploration and Development Corporation recovers uranium and vanadium from old tailings using a modified vat heap leach. Over an 18 month period, 600,000 tons of tailings were processed, recovering 340,000 pounds of U3O8 and 1,600,000 pounds of V2O5. (EIX)(PTO)

Chapter 5

GRAND JUNCTION REMEDIAL ACTION PROGRAM

CHAPTER 5. GRAND JUNCTION REMEDIAL ACTION PROGRAM

528
Bendix Field Engineering Corporation, Grand Junction, CO

U.S. Department of Energy Facilities, Grand Junction, Colorado, and Monticello, Utah: 1980 Environmental Monitoring Report

DOE/GJ/01664-T2; BFEC-1981-3; 38 pp. (1981, April)

The effect the Grand Junction, Colorado, and Monticello, Utah, facilities have on the environment is reflected by the analyses of air, water, and sediment samples. The off-site water and sediment samples were taken to determine what effect the tailings and contaminated equipment buried on the sites may have on the air, water, and adjacent properties. (EDB)

529
Buelt, J.L., Pacific Northwest Laboratory, Richland, WA

Liner Evaluation for Uranium Mill Tailings

PNL-3000-7; Nuclear Waste Management Quarterly Progress Report, July Through September 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 23.1-23.2) (1980, November)

The objective of the liner program is to evaluate prospective materials for preventing moisture transport of radionuclides and hazardous chemicals from uranium mill tailings over a long-term period. The approach embodies conducting a tailings site characterization study to determine the liner exposure conditions and evaluating the effectiveness of the liners through field studies and accelerated laboratory tests. Since initiating the liner program in mid-July, efforts have been directed primarily towards installing two prospective liners at the Grand Junction mill tailings site for field evaluation. The liners, a catalytic, airblown asphalt and a bentonite, gravel, and sand mixture were installed and covered with tailings in a trench 0.75 m deep at the tailings site. Also, tailings samples from sites at Salt Lake City, Durango, and Shiprock have been obtained and partially analyzed for the characterization study. (Auth)

530
Cadwell, L.L., Pacific Northwest Laboratory, Richland, WA

Revegetation of Inactive Uranium Tailings Sites

PNL-3000-7; Nuclear Waste Management Quarterly Progress Report, July Through September 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 26.1-26.3) (1980, November)

The objective of this program is to select and test revegetation strategies, including choice of species and methods for revegetation, that are compatible with sealant/barrier systems and are suited to soils and climates at inactive uranium mill tailings sites. Test plot studies begun at the Grand Junction, Colorado site will be used to evaluate the interaction between remedial action cover technologies and selected revegetation strategies. Under investigation are the relationship between vegetation and each of the methods being evaluated for sealing radon in the tailings, interaction of plants with herbicide barriers for preventing root intrusion, and plant requirements for soil depth. Data on the characteristics of the individual sites were acquired. These included engineering reports on each site and soil data for areas surrounding most of the sites. A data retrieval system was set up to handle organization and recall of the information, and the use of the Plant Information Network (PIN) data base was begun. PIN, developed by Colorado State University for the Fish and Wildlife Service, contains information on vascular plant species in Colorado, Wyoming, South Dakota, and Montana. Through PIN, a preliminary list of plant species with possible revegetation potential in Colorado, South Dakota, and Wyoming was obtained. (Auth)(NPK)

CHAPTER 5. GRAND JUNCTION REMEDIAL ACTION PROGRAM

531
Cadwell, L.L., Pacific Northwest Laboratory, Richland, WA

Revegetation of Inactive Uranium Tailings Sites

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October Through December 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 27.1-27.5) (1981, March)

The objective of this program is to select and test revegetation strategies, including choice of species and methods for revegetation, that are compatible with sealant/barrier systems and are suited to soils and climates at inactive uranium mill tailings sites. Test plot studies under way at the Grand Junction, Colorado, site will evaluate the interaction between remedial action cover technologies and selected revegetation strategies. Contouring, fertilizing, mulching and seeding of the site have been completed. Soil moisture blocks and neutron probe access ports are in place. An irrigation system has been designed and should be operational for the 1981 growing season. Selection of plant species involved compiling site-specific information on climate and suitable species. Climatic data were gathered primarily from NOAA (National Oceanic and Atmospheric Administration). The Plant Information Network (PIN) was used to compile plant species lists pertinent to sites in Colorado, Wyoming, and North Dakota. (Auth)

532
Cadwell, L.L., P.A. Beedlow, J.R. Skalski, R.H. Sauer, M.A. Simonds, M.C. McShane, N.R. Hinds, D.W. Mayer, W. Walters, R.L. Skaggs, and T.J. Bander, Pacific Northwest Laboratory, Richland, WA

Revegetation of Inactive Uranium Tailings Sites

PNL-3000-9; Nuclear Waste Management Quarterly Progress Report, January Through March 1981, T.D. Chikalla and J.A. Powell (Eds.), Ch. 30, (pp. 30.1-30.5) (1981, June)

Current and planned test plot studies will evaluate vegetation establishment as affected by sealant/barrier systems and planting methods. Construction of the Grand Junction test plot was completed. Tentative plans for future test plots were established. Sampling methods for gathering site-specific data were identified and sampling procedures determined. A summary of the type of site-specific data collected to date is presented. Task definition for riprap studies was completed and work began. The goal of this task is to describe the effects of vegetation, rock cover (riprap) and climate on erosion and soil water dynamics via mathematical models. FY 1981 work will concentrate on selecting and evaluating appropriate existing models. (Auth)

533
Cline, J.F., W.E. Skiens, F.G. Burton, D.A. Cataldo, and K.A. Gano, Pacific Northwest Laboratory, Richland, WA

Application of Long-Term Chemical Biobarriers for Uranium Tailings

PNL-3000-9; Nuclear Waste Management Quarterly Progress Report, January Through March 1981, T.D. Chikalla and J.A. Powell (Eds.), Ch. 29, (pp. 29.1-29.4) (1981, June)

The major effort of this quarter was spent in determining the final combination of polymer, pellet size and trifluralin loading to be used in the field trial at Grand Junction this year. The soil concentrations of trifluralin necessary to inhibit root elongation in eight additional plant species were determined to by 7 ppm. Prairie dogs were placed in animal enclosures that were built over a rock barrier at Grand Junction. Observations showed that the prairie dogs excavated considerable quantities of rocks and soil cover. (Auth)

534
Culot, M.V.J., H.G. Olson, and K.J. Schiager, Colorado State University, Fort Collins, CO

CHAPTER 5. GRAND JUNCTION REMEDIAL ACTION PROGRAM

Radon Progeny Control in Buildings

Report; 249 pp. (1973, May)

The use of sealants designed to prevent radon diffusion into habitable structures is investigated for application where the gamma exposure levels do not warrant the costly removal of the tailings but where concentration exceeds the standards. The fractional increase in whole body gamma exposure resulting from the application of radon barriers on interior surfaces of a structure is analyzed. A review of the parameters affecting the diffusion of radon in concrete, and a method to evaluate the effective diffusion coefficient of a concrete slab, are presented. The modifications introduced in the radon concentration profiles by a radon barrier are evaluated by application of a linear diffusion model to a multilayered system of porous media. The prediction of the resulting increase in whole body gamma exposures is obtained for various cases by the introduction of the original and modified concentration profiles in shielding calculations involving infinite slabs with variable radiation volume source strengths. The results of a testing program leading to an effective radon sealant and its effectiveness in reducing the average radon concentration are presented. (Auth)(CAJ)

535

Culot, M.V.J., H.S. Olson, and K.J. Schiager, Westinghouse Electric Corporation, Nuclear Energy Systems, Monroeville, PA

Field Applications of a Radon Barrier to Reduce Indoor Airborne Progeny

Health Physics 34(5):498-501 (1978, May)

The use of uranium mill tailings in the foundations of dwellings has resulted in indoor radon progeny concentrations and gamma exposures in excess of levels presently allowed for the general public. An account is given of the applications of an epoxy coating on the indoor faces of the concrete foundations of three buildings in Grand Junction, Colorado. Epoxy barriers were shown to be effective for preventing radon influx into structures. Gamma exposure rates must be analyzed to ensure that buildup behind the barrier will not introduce an unacceptable gamma exposure level. The use of a sealant is especially economical in situations where structural integrity may be jeopardized by physical removal of uranium mill tailings. (EDB)

536

Duncan, D.L., G.A. Boysen, L. Grossman, and G.A. Franz, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV; Colorado Department of Health, Grand Junction, CO; U.S. Environmental Protection Agency, Office of Air and Waste Management, Washington, DC

Outdoor Radon Study (1975-1975): An Evaluation of Ambient Radon-222 Concentrations in Grand Junction, Colorado

ORP/LV-77-1/1; 68 pp. (1977, April)

This report presents the results of measurements of ambient outdoor radon concentrations around the Grand Junction, Colorado, uranium mill tailings pile during the period of April 27, 1974 to April 2, 1975. A similar study was done by the U.S. Public Health Service in 1967 and 1968 before the pile was stabilized, and this study was done after the pile was stabilized to determine the effects of stabilization. Air samples were collected over a 48-hour period in a Mylar bag which was sent to the laboratory for radon analysis, using alpha scintillation cells. Samples were collected at each of 20 stations every three weeks for one year. The samples collected on the pile had higher radon concentrations following stabilization, and the exact cause for this is not known. Radon concentrations in the predominant daytime wind direction had elevated radon concentrations which are a power function with distance. Samples collected in other directions away from the pile contained background concentrations of radon. (EDB)

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Franz, G.A., Colorado Department of Health, Grand Junction, CO

Instrumentation Use in the Uranium Mill Tailings Program in Colorado

HASL-325; Radon Workshop, Proceedings of the 3rd Seminar, New York, NY, February 1977, (pp. 105-107), 166 pp. (1977, July)

In the Uranium Mill Tailings Program gamma measurements are used to locate radon and radon daughters from contaminating deposits and to determine when they have been removed. Gross gamma and alpha radiation measurements have been made with scintillation type equipment ranging from hand-held rate meters to large truck-mounted instruments. Distance, shielding and masking (shine) are the three major problems that have affected the measuring efforts. Distance was overcome, for the most part, by doing gamma survey work with hand-held rate meters over the surface of each property, using a maximum 10 foot grid search pattern outside and 5 foot or less inside structures. Masking of a deposit by an adjacent deposit has been overcome to some degree by using differential and lead sheet shielded measurements. Shielding, on the other hand, continues to be a problem; only by drilling of coring holes and then gamma logging each hole can some buried deposits be located. Since the process of drilling and logging holes is expensive and time consuming, its use is limited to remedial locations. In 1970 the mobile gamma survey unit provided fast information covering a wide area, but was limited by the distance factor. Hand-held rate meters were then used extensively, and the Rank Nucleonics NE148A was found to be the most rugged field instrument. Aging and difficulty in obtaining NE148A parts from England have prompted a switch to an Eberline PRM-7C, which performs quite well. Precision 111B units were used at the beginning of the program in 1969, but were not rugged enough. Later, Ludlum 12S units were used, but problems developed with the meter and battery power supplies. An Eberline RM15 rate meter, with scintillation probe and recorder, is currently being used for logging of bore holes and for making lead shielded differential measurements. (Auth)(PTO)(RHB)

538

Franz, L.W., W.N. Rom, and V.E. Archer, Colorado Department of Health, Denver, CO

Grand Junction Health Experience from Use of Uranium Tailings in Building Construction

CONF-790447; Health Implications of the New Energy Technologies, Proceedings of a Conference, Park City, UT, April 4, 1979, (pp. 89-98) (1979, April)

This presentation deals with the possible health effects of the Grand Junction, Colorado exposure situation in which uranium mill tailings were used for building purposes from 1952 to 1966. There are no significant differences between the study group and the control groups with reference to length of residence, to health status prior to diagnosis, or the exposure to tailings location. The excess incidence of leukemia in the Grand Junction area is not explained by this study of proximity to tailings structures. These data neither prove nor disprove the safety of long-term exposure to low levels of gamma radiation in the Grand Junction area. (KRM)(PTO)

539

Gee, G.W., Pacific Northwest Laboratory, Richland, WA

Multilayer Barriers for Sealing of Uranium Tailings

PNL-3000-7; Nuclear Waste Management Quarterly Progress Report, July Through September 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 24.1-24.7) (1980, November)

The objective of this project is to investigate the use of multilayer earth materials to retard radon diffusion from uranium mill tailings. Several laboratory and field tests of multilayer soil covers for radon control were started. Soils were tested for properties that could be used in an engineering design to control radon exhalation rates from uranium tailings. The key material properties were determined to be water content, bulk density, and radium content. The literature was surveyed and found lacking in data that fully describes radon transport through cover materials. In the past, key material properties of soil covers have not been measured routinely; this has necessitated tests to better describe the radon diffusion through soils. A new approach to the determination of radon diffusion in soils and earth materials was developed. The bulk diffusion coefficient was determined in such a way that it included the effects of water content on radon diffusion directly. A power function relationship was developed between the effective diffusion coefficient and the air-filled porosity. It was found that radon diffusion is significantly reduced only when the air-filled porosity is less than 0.1. Prototype multilayer systems, including a clay/rock layer and a capillary barrier, were field-tested at Hanford to determine compaction and moisture-holding characteristics and were found to be suitable for more extensive testing. Engineered cover systems were installed at Grand Junction, Colorado, and tested for radon control. Initial measurements of radon flux before and after cover placement generally agreed well with values calculated from our diffusion model. Continued measurements at the field site are planned to compare long-term diffusion effects on flux rates and to verify the effectiveness of thin cover systems that incorporate engineered moisture retention properties. Cover materials from several inactive sites have been collected, and radon diffusion tests are being run to verify model predicitons of optimum cover thickness requirements. (Auth)(PTO)

540

Gee, G.W., R.W. Nelson, C.A. Oster, D.W. Mayer, C.S. Simmons, B.E. Opitz, R.R. Kirkham, and M.E. Dodson, Pacific Northwest Laboratory, Richland, WA; Rogers and Associates Engineering Corporation, Salt Lake City, UT

Multilayer Barriers for Sealing of Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October through December 1980, T.D. Chikalla and J.A. Powell (Eds.), Ch. 25, (pp. 25.1-25.5) (1981, March)

The measurements of water content in the multilayer cover at Grand Junction and Hanford indicate that the designed capillary barrier is effective in isolating the wet clay/gravel layer from the dry overburden cover material, and thus in maintaining a relatively low air-filled porosity-radon control layer. The field results indicate that air-filled porosites of less than 0.1 can be achieved by surface wetting of the compacted clay/gravel layers. Model results suggest that the clay/gravel layer thickness will need to be increased to achieve the 2 pCi/sq m-s limit if the average air-filled porosity of the control layer is much greater than 0.02. Results of field measurements of radon flux show continued increases in radon flux from the test plots. Generally the measured radon flux levels exceed the 2 pCi/sq m-s limit. A computer code has been developed that determines the minimum cost of multilayer covers under user-specified constraints. Multilayer cover diffusion test columns have been assembled in the laboratory for use in verifying the radon diffusion portion of that code. (Auth)(CAJ)

541

Gee, G.W., J.T. Zellmer, C.S. Simmons, D.W. Mayer, R.R. Kirkham, M.E. Dodson, and B.E. Opitz, Pacific Northwest Laboratory, Richland, WA; Rogers and Associates Engineering Corporation, Salt Lake City, UT

Multilayer Barriers for Sealing of Uranium Tailings

PNL-3000-9; Nuclear Waste Management Quarterly Progress Report, January Through March 1981, T.D. Chikalla and J.A. Powell (Eds.), Ch. 28, (pp. 28.1-28.6) (1981, June)

A review of geomorphic processes indicates that stability of multilayer covers will depend largely upon the magnitude and effects of three major geologic factors: erosion, seismic events and subsidence. Proper placement of tailings piles and adequate drainage and compaction of tailings will ensure maximum protection against cover rupture. Simulation of water retention in a multilayer cover during dry years indicates that the clay/gravel layer will retain water indefinitely when considering liquid flow only. When vapor flow was considered, an estimated 20 years would elapse before the clay/gravel layer would dry appreciably. Transient radon flux modeling indicates that as long as 30 days after cover placement is required before radon flux measurements attain maximum, steady-flux values. Monitoring of covers at earlier times will underestimate the radon flux. Field test data show radon flux values are highly variable both in time and space. Flux reductions due to cover placement ranged from 93 to 97% on the multilayer plots. Cost comparisons favor multilayer earth cover systems over single-layer systems. A cost optimization code (RAECO) that determines the minimum cost of multilayer cover systems has been developed and documented. Multilayer cover diffusion test columns have been assembled in the laboratory for use in verifying the radon diffusion part of RAECO. Field measurements of moisture distributions at five mill tailings disposal sites are continuing. (Auth)(CAJ)

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Hartley, J.N., Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Sealing of Uranium Tailings

PNL-3000-7; Nuclear Waste Management Quarterly Progress Report, July Through September 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 22.1-22.4) (1980, November)

The overall objective of this project is to investigate the use of asphalt emulsion sealants to contain radon and other potentially hazardous materials in uranium tailings, including development of the supporting technology and engineering criteria for full-scale sealing of uranium mill tailings piles. Studies of asphalt emulsion sealants during the quarter have shown these sealants to be effective in containing radon and other potentially hazardous material within uranium tailings. Results of laboratory and field studies indicate that radon exhalation from uranium tailings piles can be reduced by less than 99% to less than background levels. Field tests at the tailings pile in Grand Junction, Colorado, demonstrated the effectiveness of an 8-cm admix cationic asphalt emulsion seal containing 22 wt% asphalt applied with a cold mix paver. Other techniques successfully tested included a soil stabilizer and a hot, rubberized asphalt seal applied with a distributor truck. After the seals were applied and compated, overburden was applied over the seal to protect it from ultraviolet degradation. (Auth)(PTO)

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Hartley, J.N., Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Sealing of Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October Through December 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 23.1-23.5) (1981, March)

The overall objective of this project is to investigate the use of asphalt emulsion sealants to contain radon and other potentially hazardous materials in uranium tailings, including development of the supporting technology and engineering criteria for full-scale sealing of uranium mill tailings piles. Results of FY 1980 laboratory and field studies were presented for a project review held December 17 and 18, 1980, at PNL, Richland, Washington. The review committee consisted of J.C. Petersen, Laramie Energy Center; J. Dybalski, Armak Co.; R.E. Kallio, University of Illinois; and J.D. Nelson, Colorado State University. Because the Nuclear Regulatory Commission representative was unable to attend the project review and his input is very important, a visit to NRC in February 1981 to present the results of our work is planned. A draft 1980 annual report was prepared and distributed for comment. Monitoring of the Grand Junction field test site for radon exhalation continued to show the effectiveness of the admix seal. Radon fluxes in November averaged about 0.6 pCi/sq m/s. Laboratory radon diffusion measurements were completed on samples of hot rubberized asphalt. Diffusion coefficients were about 10(E-7) sq cm/s for a specimen 60 mm thick.

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Laboratory seal stability tests were started including temperature cycling tests (freeze-thaw) and aqueous leaching and oxidation studies. After eight cycles of freeze-thaw (-12C to 38C), no degradation or failure occurred to specimens containing 22 wt% residual asphalt and sand. A review of microbial attack on asphalt indicates that this mechanism of degradation should present no problem to the long-term stability of the admix seal. Some microbiological experiments are planned to further verify that this mechanism is not important. (Auth)(NPK)

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Hartley, J.N., M.R. Elmore, R.L. Dunning, H.D. Freeman, D.A. Nelson, and P.L. Koehmstedt, Pacific Northwest Laboratory, Richland, WA; Petroleum Sciences, Inc.

Asphalt Emulsion Sealing of Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October through December 1980, T.D. Chikalla and J.A. Powell (Eds.), Ch. 23, (pp. 23.1-23.5) (1981, March)

Monitoring of the Grand Junction field test site for radon exhalation continued to show the effectiveness of the admix seal. Radon fluxes in November averaged about 0.6 pCi sq m/s. Laboratory radon diffusion measurements were completed on samples of hot rubberized asphalt. Diffusion coefficients were about 10(E-7) sq cm/s for a specimen 60 mm thick. Laboratory seal stability tests were started, including temperature cycling tests (freeze-thaw) and aqueous leaching and oxidation studies. After eight cycles of freeze-thaw (-12 deg C to 38 deg C), no degradation or failure occurred to specimens containing 22 wt% residual asphalt and sand. A review of microbial attack on asphalt indicates that this mechanism of degradation should present no problem to the long-term stability of the admix seal. Experiments are planned to further verify this. (Auth)(CAJ)

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Hartley, J.N., H.D. Freeman, and M.R. Elmore, Battelle Pacific Northwest Laboratories, Richland, WA

Use of Asphalt Emulsion Sealants in Disposal of Uranium Mill Tailings

PNL-SA-9520; CONF-810730; Environmental Engineering, Proceedings of the 1981 National Conference, Atlanta, GA, July 8, 1981, (10 pp.) (1981)

Studies of asphalt emulsion sealants conducted by the Pacific Northwest Laboratory have demonstrated that the sealants are effective in containing radon within uranium tailings. The laboratory and field studies have further demonstrated that radon exhalation from uranium tailings piles can be reduced by greater than 99% to near background levels. Field tests at the tailings pile in Grand Junction, Colorado, confirmed that an 8-cm admix seal containing 22 wt % asphalt could be effectively applied with a cold-mix paver. Other techniques were successfully tested, including a soil stabilizer and a hot, rubberized asphalt seal that was applied with a distributor truck. After the seals were applied and compacted, overburden was applied over the seal to protect the seal from ultraviolet degradation. (EDB)

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Hartley, J.N., P.L. Koehmstedt, D.J. Esterl, H.D. Freeman, J.L. Buelt, D.A. Nelson, and M.R. Elmore, Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Sealing of Uranium Mill Tailings, 1980 Report

DOE/UMT-0201; PNL-3752 (1981, May)

Studies of asphalt emulsion sealants conducted by the Pacific Northwest Laboratory have demonstrated that the sealants are effective in containing radon and other potentially hazardous material within uranium tailings. The laboratory and field studies have further demonstrated that radon exhalation from uranium tailings piles can be reduced by greater than 99% to near background levels. Field tests at the tailings pile in Grand Junction, Colorado, confirmed that an 8-cm admix seal containing 22 wt% asphalt could be effectively applied with a cold-mix paver. Other techniques were successfully tested, including a soil stabilizer and a hot, rubberized asphalt seal that was applied with a distributor truck. After the seals were applied and compacted, overburden was applied over the seal to protect the seal from ultraviolet degradation. (Auth)

547
INCO, Inc., McLean, VA

Aerial Radiometric and Magnetic Survey: Grand Junction National Topographic Map, Colorado, Utah - Final Report

GJBX-112(81); 298 pp. (1981)

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Grand Junction National Topographic Map NJ12-3 are presented. The airbone data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed maps lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included. (SAA)

548
Lyon, B., Oak Ridge National Laboratory, Oak Ridge, TN

Uranium Tailings in the Public Eye

Oak Ridge National Laboratory Review 9(3):18-23 (1976)

The Oak Ridge National Laboratory (ORNL) field team visits to Grand Junction, Colorado, and to other sources of uranium mill tailings, are described. The radioactive hazards of these tailings, which are principally due to Th, Ra, Rn, and radon daughters, are discussed briefly. Government actions which were taken as a result of public concern are listed. The ORNL Health Physics Division mobile laboratory van and its use in assessing the tailings piles at Salt Lake City and elsewhere are described. The highest gamma-ray background found was 155 mrem/yr, with levels being as high as 1750 mrem/yr near points of public access to piles. Some possible solutions to the problem are discussed. (DLC)

549
Peterson, B.H., Colorado Department of Health, Grand Junction, CO

Background Working Levels and the Remedial Action Guidelines

HASL-325; Radon Workshop, Proceedings of the 3rd Seminar, New York, NY, November 1977, (pp. 108-109), 166 pp. (1977, July)

As its guide for structure eligibility, the Grand Junction Remedial Action Program uses radon daughter concentrations of 0.01 Working Level (WL) above background for residences and 0.03 WL above background for other structures. To date, 0.007 WL has been used as "background," based on the mean value determined from 50 control locations. As long as the radon daughter levels in remedial locations are well below the minimum action levels, 0.007 WL is quite adequate. However, it is neither adequate nor appropriate when the observed levels approach the lower guidelines or for post-remedial successfulness evaluation. To more clearly define the term "background," data from the 50 control locations have recently been reviewed to eliminate any which do not meet the sampling criteria of 10 CFR 12. These regulations call for the radon daughter concentration to be the average of six air samples. Each sample must be at least

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100 hours in duration, taken in a habitable portion of the structure, and taken at minimum 4-week intervals throughout the year. Following this review, data from the remaining 29 validly sampled structures fit a log-normal distribution curve with a median of 0.0072 WL. Perhaps even more significant is the plus or minus 1 sigma range of from 0.0042 WL to 0.0124 WL and the plus or minus 2 sigma range of from 0.0025 WL to 0.0212 WL. The state of Colorado has developed the philosophy that any structure with a working level of less than 0.030 (approximately 0.01 WL above the median plus 2 sigma) but still above 0.017 WL will be critically analyzed to try to determine if it is truly in need of corrective action. (Auth)(PTO)

550

Rarrick, H.L., D.M. Minnema, and L.W. Brewer, Sandia National Laboratories, Albuquerque, NM

A Counting System for Field Determination of Ra-226 in Soils

IAEA-SM-262/45; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

A nuclear counting system has been developed and placed in service to determine the radium-226 content of soils in core barrel samplers. Samples are counted either on or near uranium mill tailing piles. About 3,000 samples have been counted to determine the radium-226 activity of tailings and of soils beneath the tailings. Minimum detectable activity is about two pCi radium-226/g of soil in a 0.5 mr/hr background with a three minute count. This system operated reliably under field conditions for over nine moths in tempeature from below freeaing to over 40 deg C (104 deg F). About 3000 samples were counted during a nine month period. Approximate cost of the system excluding vehicle is $8000. Problems concerning sampling, calibration, radiation standards, statistical analysis and operational difficulties that were encountered during the program and the solutions to these problems will be discussed. Also, some conclusions of radium-226 contamination beneath the tailings will be presented. (Auth)(JMF)

551

Schiager, K.J., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

The Evaluation of Radon Progeny Exposures in Buildings, A Report on Equipment and Techniques, Designed for the Radiation Hygiene Section, Colorado Department of Health

Report; 95 pp. (1971, March 15)

The design and construction of 75 air samplers for use by the Colorado Department of Health in evaluation of radon progeny exposures in buildings was completed. In addition to noise emissions, other mechanical problems encountered were overheating of the air pumps with subsequent failure of bearings and melting of plastic parts, air flow control under conditions of severe filter clogging with complete stoppage and loss of sample data in some cases, and inconvenience to the personnel responsible for placing and servicing the samplers in the field. Most of the difficulties could have been avoided had adequate time for development and testing of the units been included in the contract period. Also in the contract was the readout and tabulation of the exposure data from the thermoluminescent detectors. (CAJ)

552

Spitz, H.B., N. Cohen, and M.E. Wrenn, New York University Medical Center, Institute of Environmental Medicine, New York, NY

Radon-222 Exposures and Lead-210 Body Burdens in Selected Residents of Grand Junction, Colorado

Health Physics 29(6):901 (1975)

Non-occupational exposures from Rn-222 and its short-lived daughters have been estimated by in vivo and in vitro measurements of Pb-210 in selected families from homes constructed with uranium mill tailings in Grand Junction, Colorado. Radon concentrations inside several homes in Grand Junction were measured with a new continuous readout radon monitor in order to identify those locations where exposure would be maximized. Six individuals were chosen as subjects for this analysis from two homes that had the significant ambient concentrations of Rn-222 of 290 pCi/l and 169 pCi/l. Bioassay for Pb-210 in urine and blood in conjunction with in vivo skull counting procedures using three dual thin NaI(Tl)-CsI(Tl) detectors was performed in order to determine the body burdens of Pb-210. By use of a mathematical model, estimates for the Pb-210 body burden can be employed to calculate the total past exposure to radon and its short-lived daughter products. Since the period and magnitude of exposure of these individuals to elevated Rn-222 levels has been well documented, the relationship between Pb-210 body burden and exposure can be more accurately estimated than was possible in earlier studies with former uranium miners. (Auth)(PTO)

553

Spitz, H.B., N. Cohen, M.E. Wrenn, and M. Eisenbud, New York University Medical Center, Institute of Environmental Medicine, New York, NY

Assay for Pb-210 in the Urine of Selected Residents of Grand Junction, Colorado

COO-3382-16; Radioactivity Studies: Progress Report, July 1, 1976-June 30, 1977, (pp. 8.1-8.12) (1977, June 30)

The concentration of Pb-210 in the urine can be used as a possible indicator of inhalation exposure to elevated airborne concentrations of Rn-222 and radon daughters. The results of measurements of Pb-210 in urine are given for several residents of Grand Junction, Colorado. Two families (samples GJ-1 to GJ-6) were examined for elevated urinary Pb-210 excretion due to the Rn-222 exposure accumulted over ten years from living in homes with uranium mill tailings in the foundation. Urine samples from unexposed control subjects were analyzed to determine the normal Pb-210 urinary output for residents of the town. The daily urinary excretion of Pb-210 for the controls ranges between 0.06 to 0.29 pCi/day, with a mean of 0.12 pCi/day. The excretion rate of Pb-210 for the subjects who lived in houses with elevated Rn-222 in air ranged between 0.25 to 0.69 pCi/day, with a mean of 0.41 pCi/day. (EDB)

554

Spitz, H.B., M.E. Wrenn, and N. Cohen, Battelle Pacific Northwest Laboratories, Richland, WA; New York University Medical Center, Institute of Environmental Medicine, New York, NY

Diurnal Variation of Radon Measured Indoors and Outdoors in Grand Junction, Colorado, and Teaneck, New Jersey, and the Influence that Ventilation Has on the Buildup of Radon Indoors

CONF-780422; Natural Radiation Environment III, Proceedings of a Symposium, T.F. Gesell and W.M. Lowder, (Eds.), Houston, TX, April 23-28, 1978. U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, Vol. 2, (pp. 1308-1330), 881 pp. (1980)

Continuous measurements of Rn-222 were performed indoors and outdoors in two localities that differ primarily in the amount of radon source material within, under, and around building foundations. Grand Junction, CO, represents an area where uranium mill tailings have been incorporated into several residential and commercial structures. There is also a uranium mill tailings pile within the boundary of the city. The radon concentration measured in the basement of a residential structure in Grand Junction known to have no uranium mill tailings within or around the foundation (i.e., a "control" house) was 0.9 plus or minus 0.2 pCi/l [mean plus or minus 1 standard deviation (SD) of the mean]. Results of continuous measurements of radon in other structures in Grand Junction indicate that the presence of uranium mill tailings increased the average indoor radon concentration by at least a factor of 10 compared to the structure without tailings. The outdoor radon concentration averaged 0.7 pCi/l with a range of 0.3 to 1.6 pCi/l. Continuous radon

measurements were made in a two-story, wood-frame residential structure in Teaneck, N.J., which represents a locality where the Ra-226 content of soil and building materials is not artificially enhanced. The daily average radon content of the basement (February 1977) was 0.9 plus or minus 0.2 pCi/l (mean plus or minus 1 SD) of the mean) which is the same as the concentration measured in the control house in Grand Junction. Diurnal fluctuations were observed in the radon concentration in Grand Junction and Teaneck. These fluctuations were primarily a result of ventilation changes made by the occupants of the homes, such as periodically opening windows and doors. In a vacant house the temperature difference between indoor and outdoor air governed the rate at which air was exchanged and also determined the periodicity of the variation. An algebraic equation was developed relating the equilibrium indoor and outdoor radon concentrations, the ventilation rate, and the radon flux from the Ra-226 in the soil beneath the structure and in the fabrication materials of the foundation floor and walls. This relationship was used to calculate the basement ventilation rate of the house in New Jersey. The radon flux measured 3.1 X 10(E-14) pCi/hr, the average indoor and outdoor radon concentrations were 0.83 and 0.13 pCi/l, respectively, so that the calculated ventilation rate for the basement was 0.28/hr. It is also shown that the ratio of the concentration of radon daughters [working level (WL)] to radon (pCi/l) in the air of the basement is less sensitive to changes in ventilation than is the radon concentration. (Auth)(PTO)

555

Tappan, J.T., C-E Maguire, Inc., Grand Junction, CO

Phase II Demonstration of Electrostatic Filtration System as a Uranium Mill Tailings Remedial Action

Report; 27 pp. (1979, February 9)

An electrostatic filter system in a bowling alley facility that was completely underlaid with uranium mill tailings is evaluated. A radon daughter concentration reduction of approximately 82% in the main portions of the building and 90% in the nursery room was initially found. This reduction was well within the design criteria and indicated that the radon daughter concentration (RDC) could be reduced below the remedial action guide of 0.30 WL. Subsequent sampling and evaluation was performed which indicated a highly variable degree of electrostatic filtering system effectiveness (as low as 56% radon daughter concentration reduction with the system operating properly) and the average RDC inside the main portion of the structure was 0.089 gross WL during this period. The primary factors affecting the performance of the electrostatic filtering system were improper operation of the units attributed to tampering with controls and/or improper maintenance, and design problems relating to operation of the normal structure ventilation system (refrigerated air conditioning, heating, and exhaust fans). The maintenance/human error problem would be the most difficult to solve. Electrostatic filtration is a means of lowering the radon daughter concentration substantially; however, there is no means of assuring the radon daughter concentration will be maintained below remedial action criteria indefinitely. Future filtering system installations should be limited to those structures where other remedial techniques (e.g. source removal or sealant) cannot be included in the remedial action program or where interim RDC reduction is desirable pending permanent remedial action. (CAJ)

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U.S. Congress, House of Representatives, Washington, DC

Uranium Radiation Remedial Action Program to Protect Public Health

Public Law 95-649 (Part 1); 8 pp. (1977, September 29)

The Committee on Interstate and Foreign Commerce, to whom was referred the bill (S.266) to amend Public Law 92-314 authorizing appropriations to the Energy Research and Development Administration for financial assistance to limit radiation exposure from uranium mill tailings used for construction, and for other purposes, reported favorably and recommended that the bill pass as amended. The need for the program arose from investigations early in the decade which revealed a potential health hazard caused by the widespread use of sand derived from uranium mill tailings for the construction of buildings in the Grand Junction, Colorado, area. The construction sand has been taken from the site of an abandoned uranium mill which produced uranium for the Federal Government and was used in several hundred private and public buildings. Investigations revealed the potential for the entry into the structures of hazardous radon decay gas, which posed a public health hazard. S.266 extends the time for persons whose buildings were exposed to uranium mill tailings to file applications for remedial action for 4 more years after June 16, 1976; provides that persons who carried out such remedial action directly rather than waiting for it to be performed by the State of Colorado or its contractors may be reimbursed for the cost; provides that persons who in the future want to contract for such work may do so with advance approval of the State and the Secretary of Energy; requires a report on the program within 1 year after enactment of this bill; authorizes $1.5 million in additional appropriations for fiscal year 1979 for the program; and makes a number of technical amendments to Title II of Public Law 92-314. (EDB)(NPK)

557
U.S. Congress, House of Representatives, Washington, DC

Amending Public Law 92-314 Authorizing Appropriations to the Energy Research and Development Administration for Financial Assistance to Limit Radiation Exposure from Uranium Mill Tailings Used for Construction, and for Other Purposes

Public Law 95-649 (Part 2); 10 pp. (1977, October 1)

The Committee on Interior and Insular Affairs, to whom was referred the bill (S. 266), to amend Public Law 92-314 authorizing appropriations to the Energy Research and Development Administration for financial assistance to limit radiation exposure from uranium mill tailings used for construction, and for other purposes, having considered the same, reported favorably and recommended that the bill pass as amended. The need for the program arose from investigations early in the decade which revealed a potential health hazard caused by the widespread use of sand derived from uranium mill tailings for the construction of buildings in the Grand Junction, Colorado area. The Committee on Interior and Insular Affairs recommended the adoption of its substitute amendment which: eliminates the $3 million authorization for fiscal year 1977, since that is no longer deemed necessary in light of the enactment of Public Law 95-3; authorizes the appropriation of a $1.5 million for fiscal year 1979 to complete the remedial work which is now estimated to be required; extends the period during which persons may apply for remedial work on hazardous structures; requires that the modifications of contract authority of the State of Colorado contained in S. 266 be provided only in accord with section 401(a) of the Congressional Budget Act of 1974 so that payments may be made only as provided in appropriation acts; and conforms the original authorizing act with the recent congressional and Executive reorganizations. (EDB)(NPK)

558
U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Grand Junction Remedial Action Program

DOE/EV-0015; Division of Environmental Control Technology Program-1977, Decontamination and Decommissioning, (p. 135), 138 pp. (1978, June)

The Grand Junction Remedial Action Program implements the legislative authority provided by the Congress in Title II of P.L. 92-314. The objective of the program is to remedy conditions of excessive radiation exposure to people as a result of the use of uranium mill tailings in construction of structures at Grand Junction, Colorado. The law specifies that the federal government shall provide 75 percent of the cost of a State-operated remedial program. Approximately one-half of approximately 600 structures estimated to be eligible under the program have been completed. It is estimated that the program can be completed by FY 1981 at an accelerated rate of about 100 structures per year. (Auth)(PTO)

CHAPTER 5. GRAND JUNCTION REMEDIAL ACTION PROGRAM

559
U.S. Department of Energy, Division of Environmental Control Technology, Washington, DC

Grand Junction Remedial Action Program

DOE/EV-0128; Division of Environmental Control Technology Program - 1979, (pp. 181-182) (1980, June)

The objective of the program is to remedy conditions of potentially excessive radiation exposure to people as a result of the use of uranium mill tailings in the construction of structures at Grand Junction, Colorado. The law specifies that the Federal government shall provide 75 percent of the cost of a state-operated remedial program. Remedial action for approximately 44 percent of 800 structures estimated to be eligible under the program has been completed. It is estimated that the program can be completed by FY 1985 at an accelerated rate of about 100 structures per year. (EDB)

560
U.S Department of Energy, Grand Junction, CO

Status Report on Grand Junction Remedial Action Program for the Period May 1, 1981-August 31, 1981

Report; 84 pp. (1981)

This status report on the Grand Junction Remedial Action Program (GJRAP) covering a period of 4 months in 1981 describes results of studies in applications and radiological assessments, engineering and construction, and costs, funding and planning. Each section reviews progress during the reporting period and to date, and provides a forecast of future activity. Information is summarized in tables. (CAJ)

561
U.S. Department of Energy, Washington, DC

Grand Junction Remedial Action Criteria: Redesignation of Part and Nomenclature Change

Federal Register 46(8):2971-2972 (1981, January 13)

The Department of Energy is amending its regulations to reflect nomenclature changes in the regulations. Executive Order 12044 sets forth a program of regulatory reform to be followed by all executive departments. One element of that program is periodic review of existing regulations. The Department of Energy is committed to review all of its existing regulations within five years, on a schedule set forth in the Federal Register for May 8, 1980, Federal Regulation (45) 30448. This program is expected to continueuntil 1987. Two minor changes are necessary to remove certain inaccuracies. Part 712 contained in the May 31, 1979, revision incorrectly defines the "administrator of Energy Research and Development" rather than the "Secretary of Department of Energy." Due to organization changes, DOE is amending 10 CFR Part 712 to require communication procedures to be addressed to the responsible official rather than the "Director, Division of Safety, Standards, and Compliance, U.S. Department of Energy, Washingon, D.C. (CAJ)(Partial Text)

Chapter 6

URANIUM MILL TAILINGS MANAGEMENT

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

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Averill, D.W., P.M. Huck, G.H. Kassakhian, D. Moffett, and R.T. Webber

Data Base Development for the Design of a Radium-226 Removal Process

Journal of the Water Pollution Control Federation 53(7):1233-1242 (1981, June)

A joint government-industry program has been established in Canada to develop a physical-chemical treatment process that reduces the radium content of uranium mining and milling effluents. Target effluent activities of 0.37Bq/l (10 pCi/l) total radium-226 and 0.11 Bq/l (3 pCi/l) dissolved radium-226 were established for this project. Two treatment options are under investigation at bench and pilot scale. Both incorporate barium chloride addition to achieve barium-radium co-precipitation in series-connected stirred tank reactors. In the clarification process, precipitation is followed by rapid mixing of a chemical coagulant, flocculation in series-connected mechanical flocculators, and solid/liquid separation in a clarifier. In the filtration process, precipitation is followed directly by solid/liquid separation using chemically aided granular media filtration. Process development work has been completed, and a preliminary design data base has been established. The two treatment processes will be demonstrated over a period of several months. (EDB)

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Averill, D.W., G.H. Kassakhian, D. Moffett, and R.T. Webber, Environment Canada, Wastewater Technology Centre, Burlington, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada

Development of Radium-226 Removal Processes for Uranium Mill Effluents

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 333-350), 626 pp. (1980)

In Canada, a joint government-industry program has been established to develop a physical-chemical treatment process to reduce the radium content of uranium mining and milling effluents. Target effluent activities of 0.37 Bq/l (10 pCi/l) total radium-226 and 0.11 Bg/l (3 pCi/l) dissolved radium-226 were established for this project. In addition, it was implicit in the terms of reference that the sludge produced by the process should be readily retrievable for further processing and/or disposal. The program was initiated in January 1978, and is scheduled for completion in late 1980. Bench scale process optimization experiments, utilizing both batch and continuous-flow techniques, are being conducted at the Wastewater Technology Centre of Environment Canada in Burlington, Ontario. Pilot scale experiments are in progress at Quirke Mine of Rio Algom Limited in Elliot Lake, Ontario. Two alternative treatment processes are under investigation. Both processes incorporate barium chloride addition to achieve barium-radium coprecipitation in series-connected stirred tank reactors. In the clarification process, coprecipitation is followed by chemical coagulation, flocculation in series-connected mechanical flocculators, and solid-liquid separation in a clarifier. In the filtration process, coprecipitation is followed directly by solid-liquid separation using chemically aided granular media filtration. The process development phase of the program was completed in August 1979. At that time, both processes had produced total radium-226 activities of less than 0.37 Bq/l (10 pCi/l and dissolved raduim-226 activities approaching or equal to 0.11 Bq/l (3 pCi/l) in short-term tests. Both processes were operated at hydraulic loads equal to or greater than conventional values. Long-term demonstration of the two processes was initiated in October 1979. The objectives of the demonstration phase are to confirm the results of the development tests and identify process reliability. This paper summarizes the results of the process development experiments, and discusses the results to date from the demonstration program. (Auth)

564

Averill, D.W., D. Moffett, R.T. Webber, and J.W. Schmidt, Environment Canada, Wastewater Technology Centre, Burlington, Ontario, Canada; Eldorado Nuclear Ltd., Ottawa, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

Development of a Precipitation and Filtration Process for Radium-226 Removal

IAEA-SM-262/10; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

A physical/chemical wastewater treatment process has recently been developed for the removal of radium-226 from the effluents of uranium mining and milling operations. The process consists of barium-radium coprecipitation in stirred-tank reactors and solid/liquid separation in chemically-aided dual-media filters. Over a period of several months, the process was demonstrated at pilot scale to provide an effluent meeting the following program goals: 0.37 Bq/l (10 pCi/l) total radium-226 activity and 0.11 Bq/l (3 pCi/l) dissolved radium-226 activity. (Auth)

565

Banerjee, S., and E.S. Smith, International Engineering Company, Inc., Geotechnical Division, San Francisco, CA

Concepts of a Scheme for Accelerated Consolidation of Tailings Slurries

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 301-313), 626 pp. (1980)

This paper presents a conceptual scheme for stabilization of mill wastes by suitable management of operations and accelerated consolidation of tailings slurries. The main discussion in this paper is aimed at the ability of the proposed scheme to address the major considerations in effective disposal. Comparison in both cost and effectiveness are also made between the proposed scheme and various other currently used disposal concepts. The primary objective of an effective tailings disposal scheme is to provide containment of the contaminants in such a manner that the undesirable impact of the wastes on the three basic elements of our environment-land, air, and water-would be minimal. One may justifiably list the major considerations in the choice of the disposal scheme in terms of its effects on land, air, and water. (Auth)(PTO)

566

Barnes, S.M., J.L. Buelt, and V.Q. Hale, Pacific Northwest Laboratory, Richland, WA

Accelerated Aging Tests of Liners for Uranium Mill Tailings Disposal

DOE/UMT-0205; PNL-4049; 41 pp. (1981, November)

The results of accelerated aging tests to determine the long-term effectiveness of selected impoundment liner materials in a uranium mill tailings environment are described. The study was designed to evaluate several candidate liners for isolating mill tailings leachate in conformance with proposed U.S. Environmental Protection Agency and U.S. Nuclear Regulatory Commission requirements. The liners were subjected to conditions known to accelerate the degradation mechanisms of the various liners. Also, a test environment was maintained that modeled the expected conditions at a mill tailings impoundment, including ground subsidence and the weight loading of tailings on the liners. A comparison of installation costs was also performed for the candidate liners. The laboratory testing and cost information prompted the selection of a catalytic airblown asphalt membrane and a sodium bentonite-amended soil for fiscal year 1981 field testing. (Auth)(CAJ)

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Bearman, P.J., Imperial College of Science and Technology, London, England

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

Review of the Environmental Problems Associated with the Disposal of Uranium Tailings

Minerals and the Environment 1(2):64-74 (1979, July)

The major environmental problems of uranium tailings disposal are that the tailings release radioactive material to the air as radon gas and as airborne particulates, and to waterways as radionuclides leached out by precipitation, surface run-off, and from the waste solutions. A weak gamma irradiation field is created in the immediate vicinity of the tailings. Chemical pollutants including various heavy metals, sulfate and sulfuric acid, may also be leached from the tailings and pollute surface or subsurface waters. If the radionuclides and the radium could be extracted from the tailings by some method which is economically and technically acceptable, the concentrated radioactive waste and the tailings could be disposed of as normal mine tailings. The pollution control technology used to minimize pollution from tailings waste disposal systems is satisfactory, provided that it is properly implemented. The initiation of a full scale monitoring program to assess the efficiency of the tailings retention system should result in a reduction of the environmental problems. On abandoment of the impoundment it is necessary to continue to control and maintain the system and, if feasible, to establish vegetation on the exposed surfaces. (EDB)(JMF)

568

Bengson, S.A., ASARCO, Incorporated, Tucson, AZ

Drip Irrigation to Revegetate Mine Wastes in an Arid Environment

Journal of Range Management 30(2):143-147 (1977, March)

Drip irrigation may be an efficient and effective technique for revegetation of steep slopes in an arid environment. Where supplemental irrigation may be necessary for plant establishment, drip irrigation offers many advantages. There is less hazard of runoff and erosion on steep slopes; excessive salts and phytotoxins can be leached from the root zones; it is adaptable to remote areas without pressurized water systems; it conserves water where water is costly or scarce; and it helps to promote deep root growth and better plant development. Drip irrigation may be a very valuable tool for the reclamation engineer to select as a technique needed to meet his particular revegetation needs. (Auth)

569

Berlin, R.E., and L. Skoski, Dames and Moore, White Plains, NY

The Management of Radioactive Tailings

Dames and Moore Engineering Bulletin 50, Part 2: Uranium - Closing the Nuclear Fuel Cycle, December 1979:5-10 (1979, December)

An overview was presented of the radiological problems associated with the handling and storing of uranium and other radioactive tailings. A brief introduction concerning the nature of the tailings generated, the nuclides involved, and the various environmental pathways that impact man is presented. A discussion of current tailings management practices to minimize potential impacts are discussed as well as the technology used to stabilize and reclaim tailings sites. Equations are presented to calculate the radon flux from earthen covers. An assessment is made concerning current and projected technology for the management of radioactive tailings to minimize environmental impacts. (PTO)

570

Bishop, C.T., and R.J.F. Bishop, McLaren Ltd., Willowdale, Ontario, Canada

Design of Uranium Mine Tailings Impoundments Hydrologic Criteria and Methodology

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

Surface Water Impoundments, Proceedings of a Symposium, Minneapolis, MN, June 2-5. American Society of Chemical Engineers, New York, NY, Vol. 2, (pp. 1155-1164) (1981)

Tailings disposal is usually achieved by discharging the tailings slurry and waste rock to an isolated impoundment area. Process water from the slurry and natural runoff from the tailings basin require treatment in order to meet water quality standards set by regulatory agencies. However, the hydrologic criteria, involving acceptable risks of tailings impoundment failures in Ontario, Canada, have not been clearly defined by the regulatory agencies. This paper discusses the selection and implementation of surface water hydrologic criteria related to uranium tailings impoundments. (EIX)(PTO)

571

Bittel, R., N. Fourcade, and P. Zettwoog, CFA, Centre d'Etudes Nucleaires de Fontenay-e x-Roses, Department de Protection, France

Stabilization of Wastes Unusable from Uranium Industry by Planting of Vegetation

CONF-780740; Management, Stabilization and Environmental Impact of Uranium Mill Tailings, Proceedings of a Nuclear Energy Agency Seminar, Albuquerque, NM, July 24-28, 1978, (pp. 317-324) (1978)

The uranium industry (extraction and treatment of the mineral ores) produces a large volume of waste unusable for recuperating uranium but which nevertheless constitutes an environmental risk and which disfigures the latter. One solution to this problem is the planting of vegetation on the waste rips. The conditions to be fulfilled in this operation are described. It appears that no universal technique exists, but that from among those who are responsible for different scientific disciplines, we ought to gain knowledge of local parameters in such a way as to achieve the integration of an old industrial site in the general landscape. (EDB)

572

Blair, R.D., J.A. Cherry, T.P. Lim, and A.J. Vivyurka, University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada; Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Groundwater Monitoring and Contaminant Occurrence at an Abandoned Tailing Area, Elliot Lake, Ontario

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 411-431), 626 pp. (1980)

The first phase o. an investigation of the chemical composition of subsurface water the the hydrogeochemical processes in and near the abandoned Nordic tailings at Elliot Lake, Ontario, was conducted in 1979. The Nordic area, which covers 280 hectares with an average thickness of 10 m and overlies deposits of permeable glaciofluvial sand, contains 15 million tons of tailings with 3-5% pyrite. Nests of standpipe piezometers installed at three locations o the tailings indicate that seepage through the tailings predominantly downward. The water table in the tailings slopes from the north side of the tailings area, where it is within a meter of surface to the south near the tailings dam, where it is more than 5 m below surface. When they were deposited during the period from 1957 to 1968, the tailings contained pore water at a pH of about 8 resulting from neutralization treatment in the mill. At the three piezometer nests, the pH increases from 3 near the water table to 7 near the bottom of the tailings. The pore water in the tailings is gradually becoming acidic because of oxidation of pyrite in the zone above the water table. The concentrations of Fe, Mn, Ni, Co, Zn and Pb are high in the shallow acidic zone and much lower in the deeper neutral zone. Concentrations of Ra-226 range from 30 to 230 pCi/l. Concentrations of major ion in the permeable sand a short interval beneath the tailings indicate the presence of tailings seepage, but Ra-226 concentrations are only 2 to 8 pCi/l in this zone. Monitoring of a network of multilevel bundle piezometers installed in permeable sand that extends southward from beneath the tailings indicates the occurrence of a plume of tailings-derived water containing high concentrations of Ra, Mg, Fe and SO4 that extend 400 m downgradient from the tailings dam. The total dissolved solids decline from 20,000 at the dam to less than 500 mg/l at the identifiable downgradient periphery of the plume. A much smaller but distinct plume of water with high heavy metal concentraitons and Ra-226 in the range of 10 to 130 pCi/l extends from beneath the dam for a distance of 15 m. The pH of the groundwater in this heavy metal-radium plume is 4 to 5, whereas elsewhere in zone of groundwater with high dissolved solids, the pH is above 6. The results of this investigation suggest that the heavy metals and Ra-226 are relatively immobile in the permeable sandy deposits below and beyond the tailings, except where the mobility is enhanced in zones where the pH of the groundwater has declined below about 5. In the development of predictions of the long-term subsurface movement of contaminants from the tailings, the locations and rates of acidification by pyrite oxidation will be dominant factors. (Auth)(PTO)

573

Borrowman, S.R., and P.T. Brooks

Radium Removal from Uranium Ores

South African Mining and Engineering Journal 88(4119):217, 221, 223 (1976, August)

Mill tailings from conventional uranium extraction processes contain nearly all of the radium originally in the ore. Such tailings require controlled storage in perpetuity to safeguard the surrounding environment from radioactive contamination. Alternatives to controlled storage of the tailings are: (1) removal of the radium from the tailings for separate storage or use; or (2) removal of the radium when processing the uranium ore. (EDB)(PTO)

574

Boyd, F.C., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

A Perspective of the Port Hope Situation

The Environmental Impact of the Disposal of Radioactive Material, Proceedings of a Seminar, Toronto, Ontario, Canada, March 3, 1976, (4 pp.) (1976, March 3)

The refinery at Port Hope, Ontario, Canada was used to produce uranium concentrate for the Manhattan Project. Pitchblende was mined and radium extracted from 1932 until 1942 under private ownership when the Canadian government took control of the operations. In 1958 solvent extraction methods were used and reactor grade uranium oxide and uranium metal were produced. Monkey Mountain site was used between 1945 and 1948 to dump residues from the refining process, the Welcome site was used from 1949 to 1954, and the Port Granby site was used from 1955 on, and remains as the principal disposal site. It has been determined from radiological surveys that no immediate health hazard exists, but the government is taking definite action to clean up the existing contamination. (PTO)

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Boyd, J.M., T.G Carter, R.A. Knapp, and K.B. Culver, Golder Associates, Toronto, Ontario, Canada; Senes Consultants Limited, Toronto, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Hydrogeological Investigations and Evaluation of the Stanleigh Mine Tailings Impoundment Site

IAEA-SM-262/5; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

One of the most critical aspects of site investigation for uranium mill tailings facilities is the potential for contaminated ground water seepage from the impoundment. This paper illustrates the hydrogeological investigation and evaluation process which is currently used to address this question in the Elliot Lake mining area in Ontario, Canada. In particular, the procedures are illustrated by reference to the proposed Crotch Lake Basin which will hold 70 million tons of tailings from the recommissioned Stanleigh Mine. The results of the investigations were used to construct a series of two and quasi-three dimensional computer models of present ground water flows which were adjusted until they satisfactorily simulated known surface water occurrences and ground water conditions monitored in the boreholes. Subsequently, model boundaries were adjusted to reflect changed conditions resulting from tailings deposition in order to enable projections to be made of ground water flows over the life of the facility. This data was in turn used to examine the impact of seepages on water quality in the surrounding lakes and streams. The study provided a basis for license submissions, for discussions with regulatory agencies, and for considerations of future monitoring of the performance of the facility. To date, this overall approach to tailings basin hydrogeological evaluation has been used on four facilities with an ultimate total capacity of approximately 425 million tons. (Auth)(JMF)

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Bragg, K., Atomic Energy Control Board, Waste Management Division, Ottawa, Ontario, Canada

Long Term Aspects of Uranium Tailings Management

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 599-605), 626 pp. (1980)

This paper presents material related to the long term issues of uranium tailings management and attempts to set out proposed criteria as the first stage of a continuing dialogue to establish final criteria. It focuses on the following broad items including: (1) Nature of current problem (i.e., its magnitude and characteristics); (2) a discussion of the relative importance of radiological and non-radiological sources of contamination; (3) philosophy of Management - what are the options available for control and management of tailings in the long term and how these impact our current technical, economic and administrative practices; (4) an attempt to define what long term is and its impact on management; and (5) approach Options - both Canadian and International approaches are discussed in relation to the long term. Criteria will be proposed as a basis for continuing discussions for the close-out phase of tailings management facilities in Canada. (Auth)(NPK)

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Bragg, K., A. James, and C. Potter, Atomic Energy Control Board, Ottawa, Ontario, Canada

Existing Canadian Regulatory Systems - Recent Developments

IAEA-SM-262/1; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The last 2-3 years have produced rapid changes in the way uranium tailings are managed in Canada. This is due both to the development of new technology and to changes in regulatory approach. The thrust of this paper will be to clarify the interrelationship between these two areas with a particular focus on long term management issues. The specific examples to be discussed will include effluent controls for radium-226, AECB's draft interim close-out criteria, deep lake disposal, in-pit disposal and subaerial tailings placement. The interaction between federan and provincial agencies will also be reviewed to illustrate how a cooperative regulatory approach works, even in areas of complex and sometimes confusing jurisdiction. Examples will be given of differing legal/administrative instruments such as regulations, guidelines, criteria and surface leases and their use to achieve the common goals of health and environmental protection. A discussion of long term financial/performance guarantees will serve to illustrate some of the complexities involved. (Auth)(JMF)

decommissioning for long term stability is developed; (f) flexible site specific regulations are developed; (g) a synthesis agency coordinating permits and licenses is developed; and (h) an improved program for education of the public is developed. (Auth)(PTO)

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Brawner, C.O., University of British Columbia, Mineral Engineering Department, Vancouver, British Columbia, Canada

Uranium Mine Waste Disposal

CONF-8005177; Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY; 626 pp. (1980)

The purpose of the conference was to update the state of the art of uranium mine waste disposal, to provide an educational forum to expand our knowledge and to assist in reducing the fear syndrome associated with low level radionuclide disposal. The conference dealt with the following topics: (a) health effects of low level radiation; (b) properties of uranium mine waste; (c) geotechnical and site investigations; (d) design and construction options for waste disposal (surface, near surface, underground and in situ leaching); (e) radionuclide movement in seepage water and its control; (f) radon gas migration, diffusion and control; (g) the potential treatment of ores to reduce or remove radionuclides during milling; (h) regulations; (i) research; and (j) case examples. The general concensus among the engineering and scientific environmental communities is that uranium mine waste disposal can be made safe within a degree of acceptable risk and economics provided a number of conditions are fulfilled. These include: (a) the investigation and design is a team effort; (b) the site monitoring is comprehensive to provide good original background data, data for all operational aspects and for decommissioning; (c) a sound long term decommissioning monitoring program is developed; (d) adequate site radionuclide control is incorporated to minimize seepage contamination and radon diffusion to acceptable levels; (e) reclamation and

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Brook, A., Carleton University, Ottawa, Ontario, Canada

Uranium Mine Tailings and Obligations to Future Generations

Moral and Ethical Issues Relating to Nuclear Energy Generation, Proceedings of a Seminar, Toronto, Ontario, Canada, March 12-13, 1980, (pp. 49-73), 212 pp. (1980, March)

This paper examines the moral questions posed by the development of nuclear power and the possible effect on future generations from waste generation. Consideration is given to all aspects of the fuel cycle, particularly the 'front end' processes. The methodology for determining what our obligations to future generations involves: moral principles, which determine basic principles of distribution of costs and benefits over populations and times; conceptual analysis lay out criteria for setting costs against costs, benefits against benefits, and each against the other; and then with criteria settled for ordering costs and benefits, the job of collecting the facts to which to apply these criteria can be undertaken. (PTO)

580

Brown, J.R., W.S. Fyfe, F. Murray, and B.I. Kronberg, University of Western Ontario, London, Ontario, Canada

Immobilization of Uranium-Thorium-Radium in Mine Wastes

Canadian Mining Journal 102(3):71-75 (1981, March)

Eliminating the environmental problems associated with uranium mine wastes is examined. Much work to reduce mine wastes contamination has centered on containing uranium and thorium via reduced alkaline conditions. The Elliot Lake uranium deposits in Ontario are examined in a case study. Uranium deposits, mining activities, and tailings production are described. Impacts from this uranium mining operation are reviewed. Hypothetical tailings pile leaching actions are assessed. Possible treatment of the tailings using sulfate vs. phosphate is compared. (EDB)

581

Bryant, D.N., D.B. Cohen, and R.W. Durham, Canada Environmental Protection Service, Ottawa, Ontario, Canada

Leachability of Radioactive Constituents from Uranium Mine Tailings - Status Report (June 1974 - January 1977)

EPS4-WP-79-4; 32 pp. (1979, April)

A project using lysimeters to determine the leaching of radioactive constituents from abandoned uranium mine tailings, and BaRaSO4 sediments from these tailings that was initiated at the Wastewater Technology Center, Burlington, Ontario is described. Lime addition to the surface of acidic abandoned tailings did not reduce the level of radioactive constituents in the leachate. The project was revised by increasing the high water application rate from 82 mm/month to a continuous flow of about 460 mm/month. Another experiment compared the quality of effluent flowing over chemically-fixed (solidified) BaRaSO4 sediments with that of non-fixed sediments (control) in simulated sedimentation ponds. (EIX)(JMF)

582

Burgess, P.J., P.F. Pullen, and R.L. Volpe

Application of Engineering Design Objectives for the Long-Term Stabilization of Uranium Tailings

IAEA-SM-262/52; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The International Atomic Energy Agency (IAEA) and Nuclear Energy Agency (NEA) have identified a principal engineering objective for the design of uranium tailings disposal as the capacity and integrity of the disposal site to provide for long-term containment of the tailings. In this paper, the authors, all members of the Engineering Working Group of the NEA Program on the Long-Term Aspects of Uranium Mill Tailings Management and Disposal, describe and discuss those engineering design features required to meet the long-term disposal objectives. Case histories of actual designs from Australia, Canada and the United States are also included to document the application of these engineering design objectives. (Auth)

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Burton, F.G., D.A. Cataldo, J.F. Cline, and W.E. Skiens, Battelle Pacific Northwest Laboratories, Richland, WA

Application of Controlled Release Technology to Uranium Mill Tailings Stabilization

PNL-SA-8872; CONF-810217; Waste Management '81: State of Waste Isolation in the U.S. and Elsewhere, Advocacy Programs and Public Community, Proceedings of an American Nuclear Society Conference, Tucson, AZ, February 23-26, 1981, Vol. 2, (18 pp.) (1981, February)

A trifluralin (herbicide) releasing device was developed with a theoretical effective lifetime in excess of 100 years. When placed in a layer in soil, the PCD system will prevent root penetration through that layer without harming the overlying vegetation. Equilibrium concentrations of trifluralin in soil can be adjusted (along with the theoretical life of the device) to suit specific to protect the asphalt layer or clay/aggregate barriers on

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uranium mill tailings piles; PCD devices composed of pellets could also be implanted over burial sites for radioactive and/or toxic materials, preventing translocation of those materials to plant shoots, and eventually into the biosphere. (EDB)(PTO)

584
Campbell, D.B., and C.O. Brawner

Tailings Dam: An Engineered Structure

Western Miner 44(4):161-168 (1971, April)

The ever increasing, worldwide demand for metals is being met by mining low-grade ore bodies, producing during their treatment huge masses of tailings. Those tailings are disposed of in huge ponds that have to be protected by dams. The paper analyzes the construction materials and methods, slope stability, seepage and drainage control which factors have to be considered in engineering of safe dams. (EIX)(PTO)

585
Chakravatti, J.L., E. LaRocque, D.W. Reades, and E.I. Robinsky, Denison Mines Limited, Elliot Lake, Ontario, Canada; Golder Associates, Toronto, Ontario, Canada; E.I. Robinsky Associates Ltd., Toronto, Ontario, Canada

Thickened Tailings Experiment for Close-Out of Uranium Mill Tailings at Denison Mines Limited

IAEA-SM-262/3; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

"Environmental Assessment into the Expansion of the Elliot Lake Uranium Mines" identified two concerns associated with the long-term effects of Elliot Lake tailings following their close-out, which are potential acid generation from the oxidation of pyrites contained in the tailings and possible release and migration of heavy metals and radionuclides from these tailings to the water and the air environment. As a necessary pre-requisite for the development of an "Acceptable Close-Out Scenario", a suitable rehabilitation program is required which will minimize the potential adverse effects on the surrounding environment and hasten the restoration of the area. A program of research with two 10,000 tons "mini" piles of thickened tailings to investigate feasibility of in-situ coning, and the effects on run-off, seepage flow, pyrite oxidation and evapotranspiration has been initiated. A large scale demonstration is currently planned for inactive Williams Lake Tailings Management area in the near future, by applying the knowledge and skills acquired with the "mini" piles. This paper discussed the results of both the geotechnical and radiological monitoring of the first "mini" pile. (Auth)(JMF)

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Chambers, C.C., Technology Management, Inc., Grand Junction, CO

Seepage Control Using SBR/Asphalt Hot Sprayed, Elastomeric Membranes

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 271-288), 626 pp. (1980)

Manufacturer sponsored research over the past three years has proven the suitability of styrene-butadiene/asphalt membranes in many waste disposal seepage control applications for the mining industry in general and uranium mining and milling in particular. The class of membranes that have been tested are SBR/asphalt blends containing up to 68 weight percent asphalt, the balance being elastomeric polymers, fillers and phase compatibility promoters. These membranes are classified as thermoplastic, elastomeric materials and can be hot spray applied to any moderately dry substrate at 177 deg C (350 deg F), and placed in service within one hour of application. The properties of this membrane that make it suitable for use as an engineering material in these applications are discussed. These properties include chemical resistance, bacterial resistance, UV light resistance, permeability, stream/strain characteristics and bonding data. Considering the useful properties and relatively low cost of SBR/asphalt membrane, it could very well become the material of choice for a wide variety of seepage control applications. The successful use of this material in other applications for up to 15 years and the fact that engineering solutions already exist for "site specific" problems concerning the new applications adds credibility to these goals. (Auth)(PTO)

587

Charlie, W.A., and J.P. Martin, Colorado State University, Department of Civil Engineering, Fort Collins, CO

Dewatering Uranium Mill Tailings Impoundments

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 289-299), 626 pp. (1980)

Uranium mill tailings are often slurried and hydraulically deposited behind containment embankments. The existence of large deposits of loose, saturated, and uniformly graded tailings poses potential hazards to the environment. These hazards include potential for short and long term seepage from the impoundments and the potential for large scale release and movement of liquified tailings should be embankment fail. To minimize the environmental impact, Plateau Resources Limited proposes to use an interior drainage system at its Shootering Canyon Urnaium Project in Utah. The interior drainage system will consist of a drainage blanket installed on top of the clay liner. Collector pipes, protected by filters, will be used to collect the seepage. The objectives are to decrease the effective head to minimize seepage through the clay liner, to dewater and stabilize the tailings, and to increase the amount of water recycled to the mill. Since concern has been raised for potential clogging of the drainage system by the fine portion of the tailings, filter material has been included to protect the collection system. The paper will review the concept, criteria, design, and proposed monitoring of the interior drainage system. In addition, filter criteria to prevent clogging of the drains and its application to tailings will be discussed. (Auth)

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Cline, J.F., Pacific Northwest Laboratory, Richland, WA

Application of Long-Term Chemical Biobarriers for Uranium Tailings

PNL-3000-7; Nuclear Waste Management Quarterly Progress Report, July Through September 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 25.1-25.2) (1980, November)

The objective of this project is to develop and evaluate the effectiveness of physical and chemical barriers designed to prevent the breaching of uranium tailings containment systems by plants and animals for extended periods of time. Eight different polymers were combined with trifluralin in PCD systems. Trifluralin release rates were determined for each PCD system. The first pelletized PCD system was developed, the release rate determined, and the system placed into greenhouse experiment as the first step in field testing. Trifluralin as a liquid (short term) was placed over the asphalt emulsion and multilayer clay seals at the Grand Junction uranium tailings site. A stone layer also was installed over the same seals to test its effectiveness as a barrier to animal intrusions. (Auth)

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Cline, J.F., Pacific Northwest Laboratory, Richland, WA

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Application of Long-Term Chemical Biobarriers for Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October Through December 1980, T.D. Chikalla and J.A. Powell (Eds.), (pp. 26.1-26.3) (1981, March)

The objective of this project is to develop and evaluate the effectiveness of physical and chemical barriers designed to prevent the breaching of uranium tailing containment systems by plants and animals for extended periods of time. Three new polymers in sheet forms were combined with 10% trifluralin, and two pelletized PCD systems were formed and combined with 10 and 25% trifluralin. Release rates of trifluralin from these systems were measured. The effective life of the pellets loaded with 25% trifluralin was estimated to be 100 years or more. The minimal concentrations of trifluralin in soil required to prevent root penetration of a barrier ranged from 0.3 to 12 ppm in nine plant species tested. Trifluralin reached equilibrium concentration in soils in 30 days and remained in a steady state during the rest of a 60-day study. Preliminary studies show that longitudinal movement of trifluralin from placement is less than 6 cm. A pelletized PCD system was placed at various spacings in growth containers that were then planted to Russian thistle, barley, and tansy mustard. These plants will be harvested, and plant root relationship with the barrier and seals will be determined in February. (Auth)

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Cline, J.F., W.E. Skiens, F.G. Burton, D.A. Cataldo, and K.A. Gano, Pacific Northwest Laboratory, Richland, WA

Application of Long-Term Chemical Biobarriers for Uranium Tailings

PNL-3000-6; Nuclear Waste Management Quarterly Progress Report, April Through June 1980, A.M. Platt and J.A. Powell, (pp. 22.1-22.4), 142 pp. (1980, September)

Six polymeric carrier/delivery (PCD) systems were produced to test for their potential use as barriers to plant root intrusion of uranium tailings sealants. Treflan release rates were determined for three of the above PCD systems. The rates varied between 6.6 and 91.7 ug of Treflan per sq cm of polymer per day. Phytotoxic screening studies showed that approximately 0.2 ug of Treflan/g of dry soil was an effective concentration to inhibit root growth. (Auth)(PTO)

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Cline, J.F., W.E. Skiens, F.G. Burton, D.A. Cataldo, K.A. Gano, and J.F. Cline, Pacific Northwest Laboratory, Richland, WA

Application of Long-Term Chemical Biobarriers for Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October through December 1980, T.D. Chikalla and J.A. Powell (Eds.), Ch. 26, (pp. 26.1-26.3) (1981, March)

Three new polymers in sheet form were combined with 10% trifluralin, and two peletized PCD systems were formed and combined with 10 and 25% trifluralin. Release rates of trifluralin from these systems were measured. The effective life of the pellets loaded with 25% trifluralin was estimated to be 100 years or more. The minimal concentrations of trifluralin in soil required to prevent root penetration of a barrier ranged from 0.3 to 12 ppm for nine plant species tested. Trifluralin reached equilibrium concentrations in soil in 30 days and remained in a steady state during the rest of a 60-day study. Preliminary studies show that longitudinal movement of trifluralin from placement is less than 6 cm. A pelletized PCD system was placed at various spacings in growth containers that were then planted with Russian thistle, barley, and tansy mustard. These plants will be harvested, and plant root relationship with the barrier and seals will be determined. (Auth)(CAJ)

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Collings, R.K., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

CHAPTER 5. URANIUM MILL TAILINGS MANAGEMENT

Mineral Waste Resources of Canada Report No. 3 - Mining Wastes in British Columbia

CANMET-79-22; 40 pp. (1978, November)

This paper provides background information on waste rock and mill tailings in British Columbia, where more than 300 million tons of such wastes are produced annually. Data on the occurrence, mineralogy, petrography, physical and chemical characteristics of wastes from twenty-seven operating mines are provided in tabular form for three principal types of mines - metal, non-metallic or industrial mineral, and coal. Placer gold mines are not included. Potential uses for certain wastes are noted along with relevant reserach. (EDB)(PTO)

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Crawford, D.J., Oak Ridge National Laboratory, Oak Ridge, TN

Graphical Determination of the Radionuclide Inventory in the Concentrate and Tailings from Processing Facilities - Thorium-232, Uranium-238 and Uranium-235 Decay Series Members

ORNL/TM-6488; 42 pp. (1979, October)

During radiological surveys of radionuclide processing facilities, one must make a determination of the expected inventory of all members of the three naturally occurring radionuclide decay chains. A set of graphs has been developed that display the decay and ingrowth of all members of the Th-232, Th-238, and Th-235 decay series. These graphs may be used in the field to predict present inventories from a knowledge of previous inventories. Equations used to generate several of the graphs are given in tables. (EDB)(PTO)

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Culot, M.V.J., K.J. Schiager, and H.G. Olson, Westinghouse Electric Corporation, Nuclear Energy Systems, Monroeville, PA

Development of a Radon Barrier

Health Physics 35(2):375-380 (1978, August)

High radon progeny exposures exist in structures where uranium mill tailings have been improperly used as a concrete aggregate constituent and as a leveling or backfill material. The application of a radon barrier on the indoor face of these structures' foundations is considered a potential means to reduce the radon progeny exposure to the occupants. The methods used and the results obtained in the search for a material capable of inhibiting or entirely blocking diffusion of a noble radioactive gas such as radon are presented; a material which would simultaneously offer good durability and be practical. Demonstration of the method's applicability is shown by successful reduction of radon concentrations to subbackground levels in an experimental building built atop uranium mill tailings. (EDB)

595

Culver, K.B., J.L. Chakravatti, D.M. Gorber, and J.B. Davis, Rio Algom Limited, Elliot Lake, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada; Senes Consultants Limited, Toronto, Ontario, Canada; Golder Associates, Toronto, Ontario, Canada

Close-Out Concepts for the Elliot Lake Uranium Mining Operations

IAEA-SM-262/7; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Since the mid-1950's when uranium mining first started in the Elliot Lake area, approximately 100 million tons of tailings have been generated. These tailings have been deposited in ten separate management areas covering a total of 460 hectares. Processing of currently committed reserves will account for additional 234 million tons of

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tailings while processing of additional reserves could increase the future tailings production to as much as 500 million tons. With continued placement of tailings into land based management areas, the ultimate combined area covered with tailings would be in the order of 1500 to 2000 hectares. The principal environmental concerns associated with the land based management areas in the long term (after mining has ceased), are the potential of acid generation from pyrite oxidation, release and migration of radionuclides and emissions of airborne particulates. The development of close-out criteria and concepts, therefore, must be aimed at minimizing these concerns. This paper outlines some of the more promising of these concepts and discusses their inherent advantages and disadvantages to the environment in both the short and long term. The paper stresses engineering, scientific and environmental health aspects of close-out and how they must be related to site specific conditions. Commentary is also provided on the generic guidelines and criteria that have been proposed by regulatory bodies. (Auth)

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Dave, N.K., T.P. Lim, D.R. Murray, A.J. Vivyurka, K. Morin, N. Dubrovsky, and J.A. Cherry, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada; University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada

Hydrogeochemical Evolution of an Inactive Pyritic Uranium Tailings Basin and Retardation of Contaminant Migration in a Surrounding Aquifer

IAEA-SM-262/14; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Hydrogeochemical investigations of an inactive pyritic uranium tailings basin have been ongoing for the past four years at the Nordic Mine tailings site in Elliot Lake, Ontario, Canada. The major elements of study are: 1) tailings area hydrogeology; 2) hydrochemical interactions and developments of solid and liquid phase chemical and radioisotope profiles in the tailings; 3) migration of contaminant as a subsurface seepage in the surrounding aquifer and its retardation by geochemical interactions in the formation; 4) interaction of vegetative cover with the tailings and its impact on the development of soil profiles and vegetables uptake of radionuclides and major chemical constituents and their correlation. (Auth)

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Davis, J.B., P.F. Pullen, and K.B. Culver, Golder Associates, Toronto, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Uranium Tailings Management Practices at Elliot Lake, Ontario

IAEA-SM-262/6; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

This paper describes the tailings management practices adopted by the mining companies in the Elliot Lake area as part of the expansion in terms of the physiography of the area (topography, climate and surface water hydrology), and the geology of the area (bedrock geology, Pleistocene geology, hydrogeology and seismicity). In summary, the topography of the Elliot Lake area is typical of the Canadian Shield and may be described as rugged but of relatively low relief. The topography is largely bedrock controlled; the bedrock consisting of synclinally folded, metamorphosed sedimentary rock of Proterozoic age. The climate is generally humid with severe winters and warm summers. Surface water is abundant in the region with some 20 to 25 per cent of the surface area being covered by swamps, lakes and streams. Because of the regional topography, geology and climatology and considering the orebody characteristics (size

and grade), tailings in the Elliot Lake area are deposited on surface within existing lake basins. Such basins are chosen to maximize the natural containment of the tailings by the bedrock knolls and ridges forming the basin sides and to minimize the need for man-made containment dams to close topographic lows on the basin perimeter. Where required, such dams are typically zoned earthfill embankment structures and are typically less than about 20 m high. As an example of the current tailings management practice at Elliot Lake, the paper describes the Panel Mine Tailings Impoundment which was reactivated in late 1979. Included is a description of the basin and tailings management scheme, the geotechnical and geological investigations undertaken to evaluate the potential for groundwater seepage from the basin, and typical details of the containment dams. (Auth)(JMF)

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Down, C.G., and J. Stocks

Methods of Tailings Disposal

Mining Magazine 136(5):345-359 (1977, May)

Mill tailings, because of their characteristics and the quantities created, pose disposal problems at least as severe as any other waste material of modern society. In this article, the source and characteristics of tailings and current disposal practices are reviewed. Impoundment methods, site selection for tailings impoundments and dam wall designs are discussed. Underground disposal, as well as marine, river and lake disposal are also dealt with. (EIX)

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Dreesen, D.R., Los Alamos National Laboratory, Los Alamos, NM

Biogeochemistry of Uranium Mill Wastes - Program Overview and Conclusions

LA-8861-UMT; 8 pp. (1981, May)

The major findings and conclusions are summarized for research on uranium mill tailings sponsored by the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission. An overview of results and interpretations is presented for investigations of radon-222 emissions, revegetation of tailings and mine spoils, and trace element enrichment, mobility, and bioavailability. A brief discussion addresses the implications of these findings to tailings disposal technology and proposed uranium recovery processes.

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Dreesen, D.R., E.J. Cokal, P.D. O'Brien, E.F. Thode, L.E. Wangen, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM; Sandia National Laboratories, Albuquerque, NM; New Mexico State University, Department of Management, Las Cruces, NM

Uranium Mill Tailings Conditioning Technology

IAEA-SM-262/56; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Conditioning of uranium mill tailings involves the physico-chemical alteration of tailings to remove or immobilize mobile radionuclides and toxic trace elements before disposal in a repository. The reduction in contaminant mobility caused by conditioning is assessed by determining the reduction in the radon emanation power and aqueous leachable components. The principal immobilization approach under investigation is sintering tailings at high temperatures (1100-1200 deg C). This thermal stabilization reduced radon emanation power for tailings sands by factors of 20 to 200 and for tailings fines by factors of 300 to 1100. A conceptual thermal stabilization process has been developed that utilizes coal-fired rotary cement kilns to perform the sintering. An economic analysis of this conceptual process has shown that thermal stabilization can be competitive at certain tailings sites with other remedial actions requiring burial in a repository. An analysis of the long-term radiological

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hazard posed by tailings has illustrated the necessity of extracting both Ra-226 and Th-230 to achieve long-term hazard reductions. Sufuric acid extraction of residual minerals and radionuclides has been investigated and an economic analysis of the sulfuric acid leach process was made. (Auth)(RHB)

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Eureniui J., A. Osihn, and E. Strandell, VBB/SWECO Consultants, Stockholm, Sweden; LKAB, Stockholm, Sweden; ASA, Stockholm, Sweden

Uranium Mill Tailings Management - A Swedish Approach

IAEA-SM-262/22; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Uranium mineralizations occuring in alum shales and ryolite type rocks have been found in Sweden. Mining is being considered at Ranstad (alum shale) in the southern part of the country and at Pleutajokk (ryolite) in the northern part. Two tailings disposal methods proposed for the Pleutajokk and Ranstad sites are described in this paper. The tailings are handled in a "dry" condition during disposal. When the operation of the mine is terminated the tailings are to lie above water at Pleutajokk, and below water at Ranstad. In the Ranstad case below water disposal is chosen to minimize pyrite oxidation and release of heavy metals. Both at Pleutajokk and Ranstad the tailings areas are selected with regard to topography, groundwater conditions and obtainability of moraine used for cover. The tailings are in both cases covered with more than 3 m moraine. The cover is designed to limit the release of radon to the atmosphere. The radon flux as well as the gamma radiation will be negligible. The emissions are within the range of natural soils. The cost of the tailings handling including rehabilitation is calculated to about 5% of capital and operating costs. (Auth)(JMF)

602

Fisher, J.W., and A.M. Robertson, Steffen, Robertson and Kirsten, Inc., West Vancouver, British Columbia, Canada

Overview of Saskatchewan Uranium Tailings Disposal

IAEA-SM-262/11; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The paper reviews the trends and developments that have taken place during the past five years in uranium tailings disposal in Saskatchewan. It begins with a brief mention of the essentially conventional wet disposal techniques used for the lower grade uranium mines at Beaver Lodge and Rabbit Lake. It outlines the increased concerns associated with the more hazardous nature of the tailings from the very high grade recent mines and prospects. The continued evolution of technology and regulatory process is illustrated by the development of storage concepts at Cluff Lake, semi-dry tailings disposal for Key Lake and Midwest Lake, and consideration of dry tailings for Collins Bay. The most significant changes both in the process and treatment of the tailings and in the impoundment engineering and management are mentioned, and their advantages and cost implications discussed. (Auth)(JMF)

603

Franklin, J.C., R.C. Bates, and J.L. Habberstad, U.S. Bureau of Mines, Spokane Mining Research Center, Spokane, WA

Polymeric Sealants May Provide Effective Barriers to Radon Gas in Uranium Mines

Engineering Mining Journal 176(9):116-118 (1975, September)

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The application of polymeric coatings to uranium mine openings can prevent radon gas from entering the mine atmosphere, thereby reducing miners' exposure to radon daughter products, according to laboratory tests conducted by the U.S. Bureau of Mines' Spokane Mining Research Center. Of the 46 coating materials tested on uranium ore samples, three were found to be 100% efficient as radon barriers and 22 materials were judged at least 50% efficient. Toxicity, flammability, adhesion to wet and dry rock, and cure rate in a minelike environment were evaluated to screen out unacceptable materials. (EIX)

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Franklin, J.C., L.T. Nuzum, and A.L. Hill, U.S. Bureau of Mines, Spokane Mining Research Center, Spokane, WA

Polymeric Materials for Sealing Radon Gas Into the Walls of Uranium Mines

Bureau of Mines Report of Investigation RI-8036; 32 pp. (1975)

Polymeric materials (polyesters, epoxies, furan resins, and inorganic materials), laboratory tested for their effectiveness in reducing the emanation rate of radon gas from uranium ore, showed a stoppage up to 100 percent. Two field tests in the Dakota mine at Grants, New Mexico, using open and closed chamber methods, showed that the emanation rate could be significantly reduced in an actual mine. A new instrument for determining gas concentration, working levels, and decay products RaA, RaB, and RaC was compared to the radon counter flask and Tsivoglou method for measuring radon gas, working level, and daughters A, B, and C. The instrument is satisfactory for measuring both radon gas and working level. (GRA)

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Fry, R.M., Office of the Supervising Scientist, Sydney, Australia

Criteria for the Long Term Management of Uranium Mill Tailings

IAEA-SM-262/40; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The lifetime uranium requirement for the roughly 1,000 GWe of nuclear energy estimated to be installed in the world by the year 2000 is about 4 million tons. If this were produced from 0.1% uranium ore, some 4,000 million tons of uranium mill tailings would be left behind for disposal plus large quantities of below ore grade material and other waste rock. There wastes contain non-radioactive pollutants, in particular heavy metals, which can be damaging to the environment but which, with some notable exceptions, are unlikely to be a hazard t man; and virtually all the radioactive daughter products of the original uranium which, while of little direct environmental consequence, pose a potential radiological public health risk. Proper management of uranium mill tailings will aim to minimize environmental and radiological detriment due to both these components. The Nuclear Energy Agency of OECD is sponsoring an international collaborative study which is attempting to develop radiological and environmental performance objectives and criteria, based on the ICRP system of dose limitation, for the long term management of uranium mill tailings. The Nuclear Regulatory Commission of the USA has also carried out such a study (Final Generic Environmental Impact Statement on Uranium Milling NUREG-0706) and found that for the most part formal application of the ICRP optimisation procedure did not lead to useful results. The criteria that are emerging in a number of countries for acceptable management of uranium mill tailings in the long term will be reviewed. (Auth)(JMF)

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Fry, R.M., and I.W. Morison, Office of the Supervising Scientist, Sydney, Australia; Department of National Development and Energy, Canberra, Australia

Regulation of the Management of Waste from Uranium Mining and Milling in Australia

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IAEA-SM-262/62; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Development of new uranium deposits in Australia is being undertaken following extensive inquiry into the issues involved. Under the Australian federal system in which states are responsible for mining activities, public health and environmental protection, national controls are being achieved primarily through development of national codes of practice. A special situation exists in the Northern Territory where the commonwealth government maintains a role complementary to that of the state authorities. The paper outlines commonwealth/state arrangements and current waste management regimes applying to uranium mining operations in the various states, with particular reference to the effectiveness of the two-level system in meeting operational and public safety requirements. (Auth)(JMF)

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Gee, G.W., Pacific Northwest Laboratory, Richland, WA

Multilayer Barriers for Sealing of Uranium Tailings

PNL-3000-8; Nuclear Waste Management Quarterly Progress Report, October Through December 1980 T.D. Chikalla and J.A. Powell (Eds.), (pp. 25.1-25.5) (1981, March)

The objective of this project is to investigate the use of multilayer earth materials to contain radon diffusion from uranium mill tailings. Diffusion model results based on considerations about air-filled porosity indicate the need for multilayer covers in order to achieve the required radon flux control. Based on measured parameters for cover and tailings, greater than 7 m of a single-cover material would be required to attenuate the highest bare surface flux (1900 pCi/sq m/s) to less than 2 pCi/sq m/s at our test site. This compares with less than 2 m total cover thickness when a properly designed multilayer system is used. The measurements of water content in our multilayer cover at Grand Junction and at Hanford indicate that the designed capillary barrier is effective in isolating the wet clay/gravel layer from the dry overburden cover material, and thus in maintaining a relatively low air-filled porosity-radon control layer. The field results indicate that air-filled porosities of less than 0.1 can be achieved by surface wetting of the compacted clay/gravel layers. Model results suggest that the clay/gravel layer thickness will need to be increased to achieve the 2 pCi/sq m/s limit if the average air-filled porosity of the control layer is much greater than 0.02. Field measurements of radon flux at the Grand Junction, Colorado, test site were continued through December. Results to date show continued increases in radon flux from the test plots. With few exceptions, the measured radon flux levels exceed the 2 pCi/sq m/s limit set by the U.S. Nuclear Regulatory Commission. Additional water was added to the clay/gravel layer on three subplots in December. The effect of the added water on these subplots will be monitored during subsequent months. A computer code has been developed that determines the minimum cost of multilayer covers under user-specified constraints. Thus economic analysis can be made for a variety of single or multilayer cover designs. Multilayer cover diffusion test columns have been assembled in the laboratory for use in verifying the radon diffusion portion of that code. Field measurements of moisture distribution in non-mined areas adjacent to five western U.S. mill tailings sites are continuing. (Auth)(PTO)

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Gingrich, J.E., R.A. Oswald, and H.W. Alter, Terradex Corporation, Walnut Creek, CA

Monitoring Radon Around Uranium Mine and Mill Sites with Passive Integrating Detectors

IAEA-SM-262/25; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

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A large number of integrated radon measurements have been made around uranium mine and mill sites with the passive Track Etch radon detection system. Measurements have been made for pre-operational base-line studies, for operational mines and mills and for personnel. Track Etch detectors are well sutied for such measurements, particularly in remote mining areas since they are completely passive, have no batteries or electronic components and can integrate exposure for times ranging from a few days to a year or more if desired. Several different types of Track Etch detectors have been developed to meet the various application requirements. They have been calibraded at exposures ranging from 17.35 (pCi/l)-days to 13,019 (pCi/l)-days. The calibration data are discussed and the lower limit of detection is presented for each detector configuration. In a year-long radon monitoring program around one operating mine/mill complex, twelve sampling stations were established and the radon detectors were left in place for a month at a time. Results show large monthly variations depending on activities at the facility and changing weather patterns. Maximum variations were typically two to three times the average concentrations, and they varied by factors of 5 to 10 from the highest months to the lowest months at the same locations. On-site measurements for the year averaged 2.65 pCi/l while the site boundary averaged 1.18 pCi/l and the off-site averaged 0.89 pCi/l. The year-long average radon concentrations showed typical fall-off with distance from the center of the mine/mill complex. A small, compact Track Etch detector has recently been developed which is suitable as a personnel monitor. Field tests with this detector indicate that it should be satisfactory as an indicator of radon progeny exposure. The field tests were conducted for times up to 170 hours under typical mine conditions with changing Working Levels and Working Level Ratios. A large number of Track Etch detectors have been used for monitoring radon in ordinary homes and buildings. The results show some surprisingly high radon concentrations. Data indicate that a significant number of homes may have radon concentrations higher than those observed around uranium mines and mills. (Auth)(PTO)

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Halbert, B.E., J.M. Scharer, J.L. Chakravatti, and E. Barnes, Senes Consultants Limited, Toronto, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Modelling of the Underwater Disposal of Uranium Mine Tailings in Elliot Lake

IAEA-SM-262/4; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Uranium mining at Elliot Lake, Ontario, is noted as being the largest such development in existence. On completion of current expansion programs at the mining properties of Denison Mines Limited and Rio Algom Limited, the principal mining companies operating in the Elliot Lake area, the combined milling capacity will be increased from an existing level of 15,790 MTPD to 27,485 MTPD by 1985. Development of appropriate tailings management plans has formed an integral part of the expansion program. Underwater tailings disposal is viewed as being suited to the Elliot Lake area due to the close proximity of the mining operations to Quirke Lake, a large deep lake in the Serpent River Basin. Consequently, the governing regulatory body, the Atomic Energy Control Board of Canada, directed the mining companies to undertake a study to assess the feasibility of underwater tailings disposal in Quirke Lake. Two key elements of the investigations carried out to date have included: a field program and laboratory studies to evaluate the significance of acid generating sources, the development and application of a mathematical water quality model for the Serpent River Basin to investigate changes in water quality for various alternative management scenarios. (Auth)(JMF)

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A Summary of the Canadian Uranium Mill Tailings Situation

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IAEA-SM-262/61; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

As a leading uranium producer, Canada has a strong interest in developing strategies for the long-term management of uranium tailings. The major thrust of the Canadian research program is to determine the extent of any long-term problems that may arise and to develop optimum closeout methods. In Canada, the existing uranium tailings do not present unacceptable environmental and health risks, as long as they are maintained and supervised to control hazardous effluents and to prevent human intervention. The two main objectives of the Canadian efforts are as follows: to ensure that the existing or improved levels of supervision and control are maintained for as long as required, and to determine what will happen in the long-term after these institutional controls are no longer effective. It is noted that there may be a limit to the time that passive disposal methods must last in Canada because of the very high probability of renewed glaciation within the next 15,000 years. (RHB)

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Hanney, K.E., E.I. Jurgens, D.C. Comrie, and R.H. Fletcher, Kilborn Engineering, Toronto, Ontario, Canada

Reclamation Concepts and Practice for Uranium Tailings Impoundments

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 521-554), 626 pp. (1980)

The reclamation of mine/mill tailings areas is undertaken for a variety of objectives including safety, appearance, economical use of lands and forests and long term storage of a future resource. The establishing of criteria for these objectives at any site is a shared task of the government and mining company. Our attention in this paper is directed to uranium mine/mill tailings as they are handled in the Canadian industry and in the unique Canadian climate. The main objective of tailings impoundment is the stability both physically and chemically of the mobile materials. Since the requirements for the operation and construction of tailings areas in Canada have changed considerably over the past decade, there exists a great many mine/mill tailings areas which while considered adequate in their day, would not meet modern criteria. However, most of these installations pose no concern or hazard to the public. The proximity of mine/mill development to inhabited land areas has necessitated more stringent modes of tailings operations and provisions for tailings site reclamation. The more important of these have been: 1) the prevention of dyke failure, with large liquid-solid outflows onto adjoinging lands; and 2) the prevention of seepage from the tails of pollutants such as chlorides, sulphides, heavy metals and radionuclides. (Auth)(PTO)

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Hartley, J.N., M.R. Elmore, P.L. Koehmstedt, H.D. Freeman, R.L. Clark, D.J. Esterl, and J.L. Buelt, Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Sealing of Uranium Tailings

PNL-3000-6; Nuclear Waste Management Quarterly Progress Report, April Through June 1980, A.M. Platt and J.A. Powell, (pp. 21.1-21.8), 142 pp. (1980, September)

Progress during the third quarter of FY-1980 included carrying out laboratory and field studies. Uranium mill tailings samples were obtained from the Grand Junction tailings pile and chemically and physically characterized. Radon seals were formulated from a variety of asphalt emulsions and concrete sand. Radon diffusion measurements for admix seals were continued. The radon collection efficiency of activated carbon was determined at various temperatures and gas flow rates. The stability of asphalt as a long-term sealing material was reviewd, and initial weathering tests were started. Application technology for applying a radon-tight seal was reviewed. Several equipment screening tests were successfully carried out and included the use of a cold mix paver, slurry sealer, continuous portable pugmill and a concrete mixer truck. A field radon flux measurement system was designed, and fabrication was started. A field test was scheduled for August and September at the Grand Junction tailings site. Application of a radon-tight seal will be investigated using four application techniques. (Auth)

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Hartley, J.N., H.D. Freeman, E.G. Baker, M.R. Elmore, D.A. Nelson, C.F. Voss, and P.L. Koehmstedt, Pacific Northwest Laboratory, Richland, WA

Field Testing of Asphalt Emulsion Radon Barrier System

PNL-SA-9815; 25 pp. (1981, September)

Three years of laboratory and field testing by the Pacific Northwest laboratory has demonstrated that asphalt emulsion seals are effective radon diffusion barriers. Both laboratory and field tests in 1979, 1980 and 1981 have shown that an asphalt emulsion seal can reduce radon fluxes by greater than 99.9%. The effective diffusion coefficient for the various asphalt emulsion admix seals averages about 10(E-6)/sq cm/s. The 1981 joint field test is a culmination of all the technology developed to date for asphalt emulsion radon barrier systems. Preliminary results of this field test and the results of the 1980 field test are presented. (Auth)

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Hartley, J.N., P.L. Koehmstedt, and D.J. Esterl, Battelle Pacific Northwest Laboratories, Richland, WA

Asphalt Emulsion Sealing of Uranium Mill Tailings

Scientific Basis for Nuclear Waste Management, Proceedings of the International Symposium, Boston, MA, November 27-30, 1979, Vol. 2, (pp. 681-688) (1979, November)

The use of asphalt emulsion to contain radon and radium in uranium tailings was investigated at the Pacific Northwest Laboratory. A hydrostatic stabilizer was used to apply the admix. This was followed by compaction to form the radon seal. Overburden was applied to provide a protective soil layer over the seal. Included in part of the overburden was a herbicide to prevent root penetration. (EIX)(PTO)

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Hartley, J.N., P.L. Koehmstedt, D.J. Esterl, and H.D. Freeman, Battelle Pacific Northwest Laboratories, Richland, WA

Asphalt Emulsion Sealing of Uranium Mill Tailings - 1979 Annual Report

PNL-3290; 86 pp. (1980, June)

Uranium mill tailings are a source of low-level radiation and radioactive materials that may be released into the environment. Stabilization or disposal of these tailings in a safe and environmentally sound way is necessary to minimize radon exhalation and other radioactive releases. One of the most promising concepts for stabilizing uranium tailings is being investigated at the Pacific Northwest Laboratory: the use of asphalt emulsion to contain radon and other potentially hazardous materials in uranium tailings. Results of these studies indicate that radon flux from uranium tailings can be reduced by greater than 99% by covering the tailings with an asphalt emulsion that is poured on or sprayed on (3.0 to 7.0 mm thick), or mixed with some of the tailings and compacted to form an admixture seal (2.5 to 15.2 cm) containing 18 wt % residual asphalt. (EDB)

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A Canadian Research Program into the Long-Term Management of Uranium Mine Tailings

IAEA-SM-262/13; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Canada has embarked upon a three-year intense research program intended to develop technology that will lead to the safe long-term disposal of uranium mine and mill tailings. Currently there are well in excess of one hundred million tons of uranium tailings on the surface in Canada, an amount that is expected to triple by the end of the century. A group of experts, who have studied the problem, concluded that there was insufficient knowledge at present of the long-term consequences to the environment and man to walk away from uranium tailings after the termination of operations without thought for the future. Recommendations were made to government authorities for a three-pronged research program that would contribute to a sounder basis for future decisions on requirements for the long-term safe abandonment of uranium tailings. (Auth)

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Holoway, C.F., W.A. Goldsmith, and V.M. Eldridge, Oak Ridge National Laboratory, Oak Ridge, TN

Uranium Tailings Bibliography

ORNL-5109; 97 pp. (1975, December)

A bibliography containing 1,212 references is presented with its focus on the general problem of reducing human exposure to the radionuclides contained in the tailings from the milling of uranium ore. The references are divided into seven broad categories: uranium tailings pile (problems and perspectives), standards and philosophy, etiology of radiation effects, internal dosimetry and metabolism, environmental transport, background sources of tailings radionuclides, and large-area decontamination. (GRA)

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Holtzman, R.B., P.W. Urnezis, A. Padova, and C.M. Bobula, Argonne National Laboratory, Argonne, IL

Progress Report on a Study of Contamination of the Human Food Chain by Uranium Mill Tailings Piles

ANL-78-65 (Part 2); Radiological and Environmental Research Division Annual Report, July 1977 - June 1978, (pp. 176-194) (1978)

A study is in progress to estimate the contamination of the human food chain by uranium, thorium-230, radium-226, lead-210, and polonium-210 originating from tailing piles associated with uranium ore processing mills. Rabbits, cattle, vegetables, and grass were collected on or near two uranium mill sites. For controls, similar samples were obtained from areas 20 km or more from the mining and milling operations. For the on-site rabbits the mean radium-226 concentrations in muscle, lung, and kidney of 5.5, 14, and 15 pCi/kg wet, respectively, were substantially higher than those in the respective tissues of control animals (0.4, 1.5, and 0.2 pCi/kg). The levels in liver did not differ significantly between the groups. The concentrations in bone (femur and vertebra) were about 9000 and 350 pCi/kg ash for the on- and off-site animals, respectively. The levels of lead-210 and polonium-210 did not differ significantly for a given tissue between the two groups. For cattle the existing data indicate that the concentrations of radionuclides do not differ greatly between those grazed near the pile and the controls, except that the lead-210 concentration in the liver of an exposed animal is greater than that of the control. Vegetables from a residential area on a mill site contained substantially greater concentrations of radium-226 and lead-210 than those reported for standard New York City diets. (EDB)(PTO)

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International Atomic Energy Agency, Vienna, Austria

Current Practices and Options for Confinement of Uranium Mill Tailings

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IAEA Technical Reports Series No. 209; 102 pp. (1981)

This report presents an overview of the current practices for impoundment of mill tailings and appropriate site selection which can be considered with the objective of minimizing the potential radiological risks of such an operation now and in the future. Although non-radiological hazards are not considered in any detail, it is felt that good control of the radioactive materials will generally contribute to good control of non-radiological hazards. The report: (a) identifies the nature and source of radioactive pollutants in uranium mill tailings; (b) describes briefly the pathways by which the pollutants may reach man and his environment; (c) identifies the important mechanisms by which pollutants can be released from the tailings impoundment; (d) identifies the important parameters that control the release mechanisms; (e) describes some of the site-specific selection and design options that may be implemented to limit the extent of any release, primarily during mill plant operations; and (f) provides a brief review of options and considerations for final stabilization and rehabilitation of tailings impoundments. Both operating and post-operating conditions are considered. After shutdown of the mill plant and stabilization of the tailings, continuing surveillance and maintenance cannot be assured over the long term, and the future stability of the confinement elements are therefore given considerable emphasis. The report does not discuss scenarios which in the long-term period may result in partial or even substantial damage to the impoundment system, nor does it discuss the radiological consequences resulting from tailings dispersal through such events. Methodologies for further examination of these questions are undergoing development elsewhere. The report does not deal with management of those tailings resulting from the removal of overburden on other excavations, which are not treated in the mill process. Although the basic principles will also apply to thorium tailings, the sources, pathways and processes related to these tailings are not discussed. (Auth)(PTO)

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Research on Uranium Mine/Mill Tailings Management at the Canada Centre for Mineral and Energy Technology

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 619-622), 626 pp. (1980)

Urnanium mining and milling over the past 25 years has generated approximately 100 million tons (MT) of radioactive wastes tailings mainly in Ontario and Saskatchewan. If the total present Canadian resources of uranium ore are developed, an additional 800 MT will be produced in Ontario, Saskatchewan, British Columbia and Labrador. The Canada Centre for Mineral and Energy Technology (CANMET) have for the past five years carried out research on methods of radionuclide containment from existing tailings piles and in the development of alternative milling processes to alleviate potential radionuclide contamination of the environment. On existing uranium tailings piles, surface containment such as revegetation and studies on the rates of radionuclide generation and migration within and outside of the tailings piles are being carried out in an attempt to quantify the potential magnitude of radionuclide contamination of the environment over the long term. In process development of existing milling processes, preconcentration of acid-generating sulphide and radionuclides has been tested by flotation, gravity and high intensity magnetic concentrations together with radionuclide removal and recovery by hydrometallurgical processing. A general outline is presented for a national program for radioactive waste management from mill tailings detailing the general type studies required so that safe long term containment is assured. (Auth)

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Properties of Uranium Mine Waste

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 43-49), 626 pp. (1980)

Uranium mine waste is defined as the overburden soil and rock removed during site preparation, similar material removed during development of a mine, uranium tailing generated by the mill, and water used by the mill. Overburden soils are usually stockpiled for reuse during reclamation or are used as earth materials for construction of fills, roads, dams, and soil linings. Overburden rock and mine rock can be stockpiled, used as mine backfill or can be used for earth construction in fills, roads, and dams. The tailing is usually placed in a tailing storage area and water is usually recycled to the mill or disposed of in large evaporation ponds. The properties of waste that are discussed in the paper include gradation, plasticity, permeability, strength, compressibility, mineralogy, chemistry, compactibility, hardness, abrasiveness, excavatibility, ability to sustain growth, bulking factors, characteristics when wet (such as ability to dewater), reaction to an acidic environment, swell potential, shale content, and natural angle of repose. These properties are usually determined through evaluation of the geology of a project, studies of past histories of other projects, test hole drilling and sampling, test pit excavation and sampling, indirect measurement means such as refraction and cross hole seismic work, laboratory testing, field testing (such as test fills and test excavations and observations made during construction and operation. Properties of uranium mine waste are important in all phases of a project including design, construction, operation and reclamation. Examples of the ranges of the properties and illustrations of methods to determine these properties are discussed. The need for determining these properties and their applicability in design, consturction, operation and reclamation are also discussed. (Auth)

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An Ecological Approach to the Assessment of Vegetation Cover on Inactive Uranium Mill Tailings Sites

IAEA-SM-262/2; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Vascular plants have been collected from abandoned or inactive uranium mill tailings in three mining areas in Canada. The collection was evaluated to determine some characteristics of vegetation development and to identify the plants which will persist on the sites. A total of 170 species were identified. Many of the species are widely distributed in North America, none have been reported as rare in any of the locations from which they were collected. Species richness was highest on Bancroft sites and lowest on Uranium City sites, though values were variable between sites. Fourty-four percent of the total number of species were found on only a single site. Only seven species occurred on more than half of the tailings sites and in all three mining areas. There was no difference between amended and unamended sites in terms of either species richness or species composition. There was no apparent relationship between species richness and either site size, site age or amendment history. The results of this survey suggest that the uranium mill tailings sites are at an early stage of colonization where the seed input from surrounding areas and the heterogeneity of the sites are factors determining species composition and species richness. The fate of an individual once it has reached the site will be determined by its ability to establish on the sites. A perennial growth habit and the ability to expand clonally are important characteristics of the species on the tailings. The species on the tailings are commonly found in a variety of habitats. Consistent with the observation that the tailings sites are at a stage of early colonization, we find that the few species widely distributed across sites are all characteristic pioneering species with wide environmental tolerances. These species included POPULUS TREMULOIDES, P. BALSAMIFERA, SCIRPUS CYPERINUS, EQUISETUM ARVENSE, BETULA PAPYRIFERA, ACHILLEA MILLEFOLIUM and TYPHA spp. The vegetation on the tailings is likely to be characterized by these species for a long period of time. (Auth)

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Radium-226 and Lead-210 in TYPHA LATIFOLIA Growing on Old Abandoned Uranium Mill Tailings in Canada

IAEA-SM-257; Migration in the Terrestrial Environment of Long-Lived Radionuclides from the Nuclear Fuel Cycle, Proceedings of an International Symposium, Knoxville, TN, July 27-31, 1981, (22 pp.) (1981, July)

The Province of Ontario (Canada) has two uranium mining districts, Bancroft and Elliot Lake. Uranium mill tailings are an extremely harsh environment for plants due to low pH, high conductivity and low nutrient content. TYPHA LATIFOLIA is one of the few indigenous species which is able to grow on the 20 year old tailings sites. A study has been carried out to determine the uptake of Ra-226 and Pb-210 from the tailings by this wetland species. Radium-226 and lead-210 uptake by T. LATIFOLIA from tailings is shown to differ from the uptake of the elements by those grown in the soil. Concentration factors calculated on solids concentrations (tailings or soils) lead to different conclusions with respect to uptake, than calculated concentration factors based on water extractable concentrations of the radionuclides. In soils regular patterns can be observed for both radionuclides. On the tailings sites there is no regularity of the concentrations of Pb-210 and Ra-226 between the roots and the substrates. (Auth)(PTO)

624

Kalin, M., and P.M. Stokes, University of Toronto, Institute for Environmental Studies, Toronto, Ontario, Canada

Macrofungi on Uranium Mill Tailings - Associations and Metal Content

The Science of the Total Environment 19:83-94 (1981)

Sporocarps of three species of Ascomycota and ten species of Basidiomycota were collected from abandoned uranium mill tailings. On these sites some natural colonization by vegetation had occurred in the last 20 years. The existing vegetation provides some circumstantial evidence for mycorrhizal associations with PINUS STROBUS, POPULUS BALSAMIFERA, P. TREMULIODES, and SALIX sp. A new record for MELVELLA CORIUM in Ontario requires confirmation. For twelve fungal collections, representing three different tailings sites, analysis of elemental composition by neutron activation was carried out for Al, Ba, Ca, Mg, Mn and Na. Fungal concentrations of these elements were for the most part much higher than previously published values; however, the respective substrate values were also higher than values for most soils. Concentration factors rarely exceeded unity. When collections were compared, concentration factors (c.f.) for Mn were consistently higher than c.f.'s for Ba, Al or Mg, with the single exception of Ba in the ascomycete SEPULTARIA on Madawaska site which had a concentration factor of 1.3. The possible significance of the findings for revegetation of uranium tailings, and for fungal tolerance of high mineral substrates is considered. (Auth)(CA-I,

625

Kealy, C.D., and R. Busch, U.S. Bureau of Mines, Spokane Mining Research Center, Spokane, WA

Evaluation of Mine Tailings Disposal

Current Geotechnical Practice in Mine Waste Disposal. American Society of Civil Engineers, New York, NY, (pp. 181-201) (1979)

A review of mine-mill-waste disposal practices is presented. Emphasis is placed on problems of seepage control and structural stability. Slope stability methods and finite-element programs for water-flow are discussed. Recommendations for monitoring waste embankments and improving geotechnical control are included. (EDB)

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Kharbanda, J.L., P.K. Panicker, and K. Balu, Bhabha Atomic Research Centre, Waste Management Division, Bombay, India

A Study on Development of a Process for Treatment of Uranium Mill Effluents

IAEA-SM-262/29; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Processes for recovery of uranium from its ores produce large quantities of radioactive and chemically toxic solid and liquid effluents. In India, at Jaduguda mines, uranium is recovered by the use of acid-leach ion exchange process. The acidic barren liquors produced as ion exchange process effluents contain the bulk of chemical and radioactive pollutants. Radium is the main radioactive contaminant of concern and soluble manganese Mn(2+) accounts principally for chemical toxicity. Approximately three thousand cubic meters of liquid tailings are produced for each thousand tons of ore processed. In order to reduce the environmental impact of the discharges to public streams, investigations were undertaken to evolve methods for more efficient decontamination, primarily of the barren liquors and also of the overflow streams. Further, efforts were directed towards insolubilization/stabilization of the contaminants prior to transfer of the tailings to the pond. The process developed involves chemically fixing or binding the contaminants, radium and manganese, in a stable and insoluble form. These investigations indicated that it would be desirable to continue the use of tailings pond as a permanant reservoir for the slurries and the pollutants. (Auth)(JMF)

627

Klohn, E.J., Klohn Leonoff Consultants Ltd., Vancouver, British Columbia, Canada

Geotechnical Investigations for Siting Uranium Tailings Dams

CONF-8005177; Uranium Mine Waste Disposal. C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia. Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY. (pp. 51-73), 626 pp. (1980)

Selection of the waste impoundment facility for a uranium project is a decision that must be based on a comprehensive evaluation of a wide range of engineering, environmental, and social factors. The location and design of the waste impoundment facility should be integrated with the preliminary mine and mill planning and considered as a whole from the outset of the feasibility studies. Environmental requirements have become so important with regard to tailings disposal, that location of a suitable waste impoundment facility could have a major impact on mine and mill planning. Design of the waste impoundment facilities is a site specific operation. A design considered suitable for one site might be completely unacceptable at another. Regulatory guidelines in both Canada and the U.S.A. recommend that alternative waste disposal areas be identified and the preferred site selected on the basis of preliminary site investigations. Once the preferred waste disposal site is selected, detailed site investigation, leading to ultimate design of the facility, should be carried out. The paper outlines the geotechnical site investigations required to provide the designers sufficient data in the preliminary stage to select the preferred site, and in the final stage to develop safe and economical designs that satisfy all regulatory requirements. To achieve these ends the geotechnical site investigations must cover such items as: topography, climate, hydrology, geology, hydrogeology, seismicity, site stratigraphy (soil and bedrock), soil properties (permeability, strength, compressibility, etc.), availability of suitable borrow materials for dam construction, and clay minerology and physiochemical properties of potential soil liners. Not all of these items normally would be classified as geotechnical. However, as they are all interrelated and as they all should be carried out as part of the engineering site investigations, they are treated collectively as "geotechnical site studies" for purposes of this presentation. The team required to carry out these site investigations should be interdisciplinary in nature, and preferably should be led by a geotechnical engineer having broad experience and/or training in some of the related disciplines (hydrogeology, hydrology, seismicity, etc.). (Auth)

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Klohn, E.J., Klohn Leonoff Consultants Ltd., Vancouver, British Columbia, Canada

Current Tailings Dam Design and Construction Methods

Mining Engineering 33(7):798-808 (1981, July)

The article describes in detail design criteria for tailings dams and provides illustrations from several case studies. (EIX)(PTO)

629

Klute, A., and D.F. Heermann, Science and Education Administration, Agricultural Research, Fort Collins, CO; U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Water Movement in Uranium Mill Tailings Profiles

ORP/LV-78/8; 98 pp. (1978, September)

The objective of this study was to characterize the behavior of water in profiles of uranium mill tailings. The approach taken consisted of (1) measurement of the water retention and transmission properties of selected tailings materials, (2) numerical simulation of water flow in selected profiles of tailings subjected to specific boundary conditions, and (3) analysis and interpretation of the simulation results within the framework of unsaturated soil water flow theory. The sequence of flow events in a tailings profile without vegetation and with a water table at a given depth is: (1) an initial drainage from saturation, with evaporation at the surface, (2) infiltration of varying amounts of rain at irregular intervals, (3) and periods of evaporation and drainage from the profile, with redistribution within the profile, between infiltration events. The water flow regime in the upper 90 cm, particularly the upper 10-20 cm is transient and dynamic. The lower part of the profile, below about 70-90 cm, tends to behave in a quasi-steady downward flow condition. (GRA)

630

Landa, E., U.S. Geological Survey, Washington, DC

Isolation of Uranium Mill Tailings and Their Component Radionuclides from the Biosphere Some Earth Science Perspectives

U.S. Geological Survey Circular 814; 35 pp. (1980)

Sources of potential human radiation exposure from uranium mill tailings include the emanation of radon gas, the transport of particles by wind and water, and the transport of soluble radionuclides, seeping from disposal areas, by ground water. Due to the 77,000 year half-life of thorium-230, the parent of radium-226, the environmental effects associated with radionuclides contained in these tailings must be conceived of within the framework of geol[illegible] processes operating over geologic time. The magni[illegible]e of erosion of cover materials and tailings and the extent of geochemical mobilization of the contained radionuclides to the atmosphere and hydrosphere should be considered in the evaluation of the potential, long-term consequences of all proposed uranium mill tailings management plans. (EIX)

631

Landa, E.R., U.S. Geological Survey, Washington, DC

Uranium Mill Tailings and the Radiological Quality of the Environment

U.S. Geological Survey Circular; 53 pp. (1979)

Uranium mining and milling is an expanding activity in the western United States. The milling process yields a uranium concentrate and a large volume of tailings containing most of the radioactivity associated with the ore. By virtue of the physical and chemical processing of the ore and the re-distribution of the contained radionuclides at the earth's surface, these tailings, presently

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comprising a volume in excess of 60 million cubic meters, constitute a technologically enhanced source of natural radiation exposure. Sources of potential human radiation exposure from uranium mill tailings include the emanation of radon gas, the transport of solid tailings by wind and water, and the ground-water transport of soluble radionuclides (cheifly radium-226) seeping from a tailings retention area. Due to the 80,000 year half-life of thorium-230 (the parent of radium-226), the diminution of environmental effects associated with radionuclides contained in these tailings must be conceived of within the framework of geologic processes operating over geologic time. Current practices of covering the tailings with a few feet of soil will, in the short-term, reduce the transport of radon gas and tailings solids, but the long-term stability of such covers, in light of present erosion rates, is doubtful. In making risk assessments for future generations, the erosion of cover materials and tailings, and the geochemical mobilization of a portion of the contained radionuclides to the atmosphere and hydrosphere should be recognized as the likely, eventual consequence of presently-conceived uranium mill tailings management plans. (Auth)

632

Levins, D.M., and R.K. Ryan, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Leaching of Radium-226 from Uranium Tailings

Environmental Studies, Ch. 6, (pp. 47-48)

A systematic study of the factors affecting the leachability of radium-226 from tailings (derived from an ore containing 0.22% uranium) was undertaken to propose a mechanism for the leaching. Major findings were that: initial release of radium from tailings is very rapid, occurring within one minute; equilibrium is established between solution and tailings in about one hour; significant quantities of radium can be leached by contact of tailings with large volumes of water; and high sulphate concentrations in solution tend to retard the release of radium, the pH having a marked affect on leachability in the absence of high sulphate concentrations and other dissolved salts. High chloride and nitrate concentrations also promote rapid leaching. (Auth)(CAJ)

633

Lloyd, P.J.D., Chamber of Mines of South Africa, Metallurgy Laboratory, Republic of South Africa

Ninety Years Experience in the Preservation of Uranium Ore Dumps

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 33-42), 626 pp. (1980)

The practice of dumping potential uranium ores in a finely milled state on surface for nearly 100 years has shown that it can be done without significant hazard to the population. The major route for transport of radionuclides into the environment has been the loss of integrity of the dam structure, but modern methods of construction have overcome this. Loss of material by wind and water erosion has almost entirely been overcome by vegetation. It has recently been shown that vegetation established 20 years ago is capable of maintaining itself, and that natural plants are replacing the exotic plant life originally established. (Auth)

634

Loomis, T.H.W., U.S. Department of the Interior, Office of Environmental Project Review, Washington, DC

Environmental Aspects of Site Selection for Uranium Mill Tailings

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st Inter-

national Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 87-92), 626 pp. (1980)

An increasing awareness and concern for environmental factors during the past decade has brought about an evolution in both siting and design of uranium mill tailings ponds. Site selection criteria used to be simple - a tract of land as near to the ore supply as possible with adequate area and suitable topography to contain the expected volume of wastes. Site selections in the past have left a legacy of problems to be corrected - radioactive wastes on stream banks and in floodplains, mill wastes in and near established communities, and unprotected wastes subject to constant erosion. This is no longer acceptable. In the United States the environmental concerns are articulated in a series of laws, regulations, and Executive Orders. These include the National Environmental Policy Act, the Uranium Mill Tailings Radiation Control Act of 1978, the Resource Conservation and Recovery Act of 1976, the Endangered Species Act, a series of cultural resource requirements, and restrictions on floodplains and wetlands. The site selection process must focus on these concerns to identify the best available disposal location from both technical and environmental considerations. This requires extensive interagency participation at early stages of the siting study. The Department of the Interior has a major role in the site review and selection process because of jurisdictional responsibilities on public and Indian lands or under the endangered species and cultural resource laws. In addition, Interior houses a broad range of expertise that may be utilized in the consultation and coordinaiton stages even where these is no jurisdictional involvement. Field offices of the various bureaus are prepared to work closely with the applicants, States, and other Federal agencies to ensure full consideration of both technical and environmental factors in selecting disposal sites. (Auth)

635

Lowe, L.M., and D.B. Chambers, James F. MacLaren Limited, Toronto, Ontario, Canada

Radiological Evaluation of a Uranium Mines Expansion: A Case Study

Transactions of the American Nuclear Society 33:170 (1979, November)

Due to the resurgence in the worldwide demand for uranium in the past few years, Denison Mines Limited and Rio Algom Limited began preparations to expand their uranium production capabilities at their Elliot Lake, Ontario, properties. In 1976, the Ontario Government directed that the expansion be subjected to environmental review and public hearings. The radiological evaluation of the proposed expansion, to a processing rate of about 30,000 tons of ore per day, was one component of the subsequent environmental study. The Elliot Lake study reported a total surface area of 3.5 million sq m for seven inactive and active tailings areas. Unlike many areas in the United States, there is a net water surplus resulting in continuous waste water discharge from tailings areas. The evaluation of potential radiological effects was made more complex when elevated radon gas concentrations and gamma exposure levels were found in homes in Elliot Lake. This resulted in an interim hearing to establish safe levels for radiation protection in new homes. A variety of mining, milling, and waste management alternatives which potentially could affect environmental discharges over the long term were evaluated, including radionuclide removal, underground backfill of tailings, deep lake disposal of tailings, and tailings stabilization. It was concluded that the expansion would not result in unacceptable short- or long-term radiological impacts. (Auth)(PTO)

636

Lush, D.L., P. McKee, and W.J. Snodgrass, Beak Consultants Limited, Toronto, Ontario, Canada

Variables Affecting the Estimation of Dose Commitment from Uranium Mill Tailings

IAEA-SM-262/9; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The determination of an optimal management strategy for uranium mill tailings requires a knowledge of both the costs of improved management and the resultant savings in long term collective dose commitment. This paper is concerned with dose commitment and in particular with the doses derived from aquatic pathways. The principal environmental pahtways by which radionuclides of the uranium-238 and thorium-232 decay series affect surrounding populations are examined for six different management options at a composite site in Ontario. A simple geochemical model was developed to predict how the sources of radionuclides would vary through time. This was combined with a hydrological model and a food-chain model which together incorporate variables such as hydraulic dilution, solute-solid phase partitioning, sedimentation rates, sediment-water column interactions, radioactive decay and bioconcentration. Pathways involving critical groups and regional populations and based on water use, aquatic food consumption and aquatic resource uses were used to estimate effective doses. Dose conversion factors were derived for each radionuclide and exposure pathway and then critical group and regional collective dose rates and cumulative doses were calculated. In combination with the costs involved, the results are being used as part of a larger study on the role of cost-benefit procedures in the comparison of alternative methods of tailings management. (Auth)

637

Mahon, D.C., P.G. Sagert, and M.R. Legeyt, Envirocon Limited, Vancouver, British Columbia, Canada; Chemex Laboratories Limited, Vancouver, British Columbia, Canada

An Analysis of Environmental Baseline Data Programs for Uranium Tailings Storage

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 75-87), 626 pp. (1980)

The Environmental Baseline Data Programs are used to define the probable movement of release radionuclides in the environment, and to describe the potential for accumulation of these radionuclides in the environment. The data will form the basis for dose commitment studies, reclamation design and impact assessment. By their very nature, Environmental Baseline Data Programs are site specific, and must be flexible in design to incorporate new methodologies and requirements. The generic approach, as outlined by regulatory agencies, while permitting flexibility in one sense, does not define accurately enough either the quality or quantity of information needed for an assessment. As we have described, strict adherence to guidelines and regulations provide an incomplete, and at times misleading data base on which this and future assessments will be judged. A site and species specific data base is therefore essential for a successful evaluation. With advances in health physics, geochemistry and engineering the need to modify the Environmental baseline Data Program and to improve the data base becomes more apparent each year. At present these programs appear to raise more questions than they provide answers. (Auth)(PTO)

638

Marcus, D., and W.A. Sangrey, Gulf Research and Development Company, Pittsburgh, PA; Carnegie-Mellon University, Pittsburgh, PA

Uranium Mill Tailings Stabilization with Additives

IAEA-SM-262/49; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Subsurface trench disposal of uranium mill tailings is one of several new techniques developed to meet safety and environmental constraints. The stabilized tailings in the trench have to develop sufficient strength to support a layer of fill placed as cover over the trenches. The use of chemical additives to achieve the stabilization of mill tailings is discussed in this paper. Special emphasis was placed on using stabilization additives which were waste products from other industries. (Auth)

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Markos, G., and K.J. Bush, Geochemistry and Environmental Chemistry Research, Inc., Rapid City, SD

Physico-Chemical Processes in Uranium Mill Tailings and Their Relationship to Contamination

IAEA-SM-262/23; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Investigations over the last three years, of the physico-chemical properties of abandoned uranium mill tailings, in a range of climatic and geologic environments of the U.S.A., shows that tailings are in chemical disequilibrium and reactive. Disequilibrium occurs when the ore is removed from its original physico-chemical habitat and subjected to a vigorous chemical process to remove the ore value. Chemical reactivity and physical activity of the tailings result mainly from the high concentrations of salt in the interstitial solutions (concentrations up to 2 molal have been determined), the heterogeneity of physical and chemical properties, and the hydrodynamic conditions. The chemical reactions are significant in the processes across the tailings/soil interface and in the production of physical forces. In designing tailings management techniques it must be remembered that each situation represents different hydraulic forces which are significant in determining the physical manifestation of the physico-chemical conditions of the tailings. (Auth)(JMF)

640

Markose, P.M., S. Venkataraman, K.P. Eappen, G.K. Srivastava, and M. Raghavayya, Bhabha Atomic Research Centre, Health Physics Division, Bombay, India

Environmental Surveillance in the Vicinity of Uranium Complex, Jaduguda

IAEA-SM-262/27; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

Waste effluents from the uranium mine-mill complex at Jaduguda originate from two points, the mine and the tailings pond. Both are released into a carrier strem which ultimately joins the local aquatic system. The important toxins in these streams are radium-226, uranium manganese, chlorides and sulfates. A continuous surveillance programme has been in operation at Juduguda to assess the pollution status of the aquatic system. The levels of toxins in the streams-mine water, tailing effluences and the public streams - have remained fairly steady and well below the appropriate permissible limits. The radioactive impact on the aquatic system due to discharge of effluents from the uranium complex has been found to be negligible and smaller than due to discharge of uranium-bearing tailings from a copper plant located nearby. Occasionally, transport of solids from the tailings pond have occurred due to temporary malfunction of the decantation system, thereby increasing the specific activity of the sediments. Bioaccumulation of radium by aquatic organisms like spirogyra (CF = 1870) and common pond snail (CF = 30(flesh); 60(bone)) has been established, but there is no evidence to indicate any accumulation of radium or uranium by terrestrial plants. The migration of radium or uranium by terrestrial plants. The migration of radium through subsoil has been studied and found to be insignificant; these results are confirmed by analysis of nearby well waters. Another pathway for movement of radium, namely, soil-grass-milk-man, has also been investigated. The grass species studied is the common variety, CYNADON DECTYLON. Concentration factors (CF) range from 4 X 10(E-3) to 30 X 10(E-3), with a mean of 14.8 X 10(E-3). This wide variation suggests that the concentration factor depends upon several factors which need identification and further study. The release of Mn from the tailings pond is found to depend on pH of the effluent. Overall, the surveillance to date indicates that the uranium processing operation at Jaduguda has not had any adverse effect on the environment of the uranium complex. (Auth)(JMF)

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Marks, S., and W.J. Bair, Pacific Northwest Laboratory, Richland, WA

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Estimation of Health Effects at Inactive Uranium Mill Tailings Sites

IAEA-SM-262/66; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

The potential for health effects in workers or residents due to exposure to radioactivity from residual material at or derived from inactive uranium mill tailings is a primary factor in decisions regarding remedial actions. A methodology is described here for estimating potential health effects due to such exposure. The extent of the area of exposure and the levels of radioactivity at various sites in the area are defined by a careful radiological survey. The exposed population, both occupational and residential, is characterized with due regard for such parameters as weekly hours of exposure and physiological levels of activity of exposed persons. Models for potential environmental transport of radionuclides are selected on a site-specific basis. Appropriate risk coefficients for health effects due to gamma exposure and radon and its daughters or other relevant nuclides are then employed to estimate health effects for specific population groups, characterized according to level of exposure, type of personal activity, and other factors. (Auth)

642
Marple, M.L., W.E. Clements, D.F. Petersen, and E.M. Sullivan, Los Alamos Scientific Laboratory, Los Alamos, NM

Contribution of Radon-222 to the Atmosphere from Inactive Uranium Mill Tailings Piles and Its Attenuation by Cover Materials

LA-7254-PR; Biomedical and Environmental Research Program of the LASL Health Division, Progress Report, January-December 1977, M.L. Marple, et al., (Comp.), (pp. 90-92) (1978, October)

The radon-222 flux from tailings piles fluctuates widely during a year, but the average flux is at least two orders of magnitude greater than background. Thus, a typical inactive tailings pile with an area of 50 ha and an average flux of 700 atoms/sq/cm/s would contribute 6000 Ci of radon to the atmosphere each year. To attenuate the flux by 98%, a cover of 3.9 m of soil would be required. Thus, tailings piles are a significant local source of radon-222 to the atmosphere unless covered by deep overburdens. (EDB)(PTO)

643
Mayer, D.W., C.A. Oster, R.W. Nelson, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Radon Diffusion Through Multilayer Earthen Covers: Models and Simulations

PNL-3989; 67 pp. (1981, September)

A capability to model and analyze the fundamental interactions that influence the diffusion of radon gas through uranium mill tailings and cover systems has been investigated. The purpose of this study is to develop the theoretical basis for modeling radon diffusion and to develop an understanding of the fundamental interactions that influence radon diffusion. This study develops the theoretical basis for modeling radon diffusion in one, two and three dimensions. The theory has been incorporated into three computer models that are used to analyze several tailings and cover configurations. This report contains a discussion of the theoretical basis for modeling radon diffusion, a discussion of the computer models used to analyze uranium mill tailings and multilayered cover systems, and presents the results that have been obtained. (EDB)

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Mayer, D.W., and D.A. Zimmerman, Pacific Northwest Laboratory, Richland, WA

Radon Diffusion Through Uranium Mill Tailings and Cover Defects

PNL-4063; 33 pp. (1981, December)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

Research was conducted at Pacific Northwest Laboratory to define the effects of cover defects on the emission of radon gas from covered uranium mill tailings piles. This report describes the results from the analysis of four geometrically simplified cover defects. (GRA)

645

McWhorter, D.B., and J.D. Nelson, Colorado State University, Fort Collins, CO

Unsaturated Flow Beneath Tailings Impoundments

ASCE Geotechnical Engineering Division 105(11):1317-1334 (1979, November 11)

Using technology developed for flow through porous media for applications in other disciplines, equations were developed to permit computation of seepage rates from tailings impoundments. Seepage is shown to take place in three distinct stages. The first stage comprises a period during which a wetting front progresses downward from the impoundment. The second stage commences when the wetting front contacts either a phreatic surface or an impermeable boundary. The third stage begins when the groundwater mound contacts the bottom of the impoundment. During the third stage flow occurs laterally away from the area beneath the impoundment. Example computations are presented for an impoundment with and without a liner. Particular conclusions regarding the variation of seepage rates depend on the boundary conditions of the situation being analyzed. Seepage rates increase almost linearly during the first two stages and decrease after the third stage has been reached. (EIX)

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McWhorter, D.B., and J.D. Nelson, Colorado State University, Fort Collins, CO

Seepage in the Partially Saturated Zone Beneath Tailings Impoundments

Mining Engineering 32(4):432-439 (1980, April 4)

Conventional analyses of seepage through saturated media do not apply when tailings impoundments are located above a partially saturated zone. Three stages of seepage are identified and methods for estimating the seepage rates and duration of each stage, based upon flow in partially saturated and saturated porous media, are demonstrated. The effectiveness of earthen is discussed and procedures for estimated the required properties of the porous media are provided. (EIX)

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Moffett, D., E. Barnes, and J.N. Hilton, Rio Algom Limited, Elliot Lake, Ontario, Canada

Radium-226 Removal by Precipitation and Sedimentation in Settling Ponds

Canadian Institute of Mining and Metallurgy Bulletin 74(832):128-134 (1981)

In pilot-plant studies, tailings wastewater was treated with barium chloride to precipitate radium-226 and was allowed to settle in plastic-lined settling ponds. Adjustment of the pH with sulfuric acid from 9.5 to approximately 7.5 gave an approximate five-fold improvement in total radium-226 removal. In a five month demonstration test, the treated effluent had a mean total radium-226 activity of 44 pCi/l after a settling time of two and a half days and 29 pCi/l after five days. (EDB)(RHB)

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Murray, D.R., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

The Influence of Uranium Mine Tailings on Tree Growth at Elliot Lake, Ontario

MRP/MRL 77-80; 12 pp.; Transactions of the Canadian Institute of Mine Metallurgy 81:185-187 (1977, July)

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A four year study has been carried out to determine the ability of coniferous trees to aid in the reclamation of uranium tailings at Elliot Lake. Five species were planted: white cedar, white spruce, jack pine, scotch pine and red pine. Over 570 bare root, two year old seedlings were planted on bare tailings and in areas of established grasses. A further division was made between areas of coarse and fine tailings. Overall survival and growth of the trees has been far below expectations from previous experience with several varieties of grasses. The criteria for assessment have been percent survival and yearly growth increases as estimated by plant height. Pine species were superior with survival percentages of 68% for bare coarse tailings, 45% for vegetated coarse tailings, and 34% for vegetated fine tailings. Cedar was the worst with survival percentages of 49%, 14% and 7% respectively. No species survived on bare fine tailings. The survival and growth of the coniferous trees have been related to the species, environmental conditions and the tailings properties. (Auth)

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Murray, D.R., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Influence of Uranium Mill Tailings on Tree Growth at Elliot Lake

Canadian Institute of Mining and Metallurgy Bulletin 71(800):79-81 (1978, December)

A four-year study was carried out to determine the ability of coniferous trees to aid in the reclamation of uranium tailings at Elliot Lake. Five species were planted: white cedar, white spruce, jack pine, scotch pine and red pine. More than 570 bare-root, two-year-old seedlings were planted on bare tailings and in areas of established grasses. A further division was made between areas of coarse and fine tailings. Over-all survival and growth of the trees has been far below expectations based on previous experience with several varieties of grasses. The criteria for assessment have been per cent survival and yearly growth as determined by plant height. Pine was superior, with 68% survival when planted in bare coarse tailings, 45% for vegetated coarse tailings and 34% for vegetated fine tailings. Cedar had the worst survival rates at 49%, 14% and 7% respectively. No species survived on bare fine tailings. The survival and growth of the coniferous trees have been related to species, environmental conditions and tailings properties. (EDB)

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Murray, D.R., and D. Okuhara, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Effect of Surface Treatment of Tailings on Effluent Quality

Reclamation Review 3(3):169-177 (1980)

Successful reclamation treatment, in preparation for long range abandonment of mining wastes, involves both surface treatment and water quality control containment of waste solids and liquid contaminants. This paper describes use of lysimeters containing 125 tons of tailings to determine the impact of gravel, sawdust and vegetation as surface treatments on the quality and quantity of effluent produced from sulphide containing uranium mill tailings. Over a five-year period these treatments were observed and compared with bare tailings where no surface addition was made. The treatments did not alter the effluent quality to a level acceptable to regulatory requirements. Surface treatments did not appear to affect the leaching of Ra-226, NH4 and NO3. The concentration of Fe, SO4, Cu, Pb, Al increased with the rise of acidity as the pH changed from pH 9.5 to pH 2 in four and one-half years. However the rate and extent of changes of some of these parameters vary with the treatment. The experimental results for the observed trends are presented with limited explanation. Original design problems and unexpected delays in tailing reactions have made firm conclusions impossible at this stage. This data, however, provides a base for further investigation and development of explanations and firm conclusions, as to the role of surface treatment in long-term waste abandonment. (Auth)(PTO)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT

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Murray, D.R., R.T. Webber, and E. LaRocque, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Reclamation of the Lower Williams Lake Tailings Area of Denison Mines Limited

Canadian Institute of Mining and Metallurgy Bulletin 72(803):135-137 (1979, March)

A 2-hectare uranium tailings area has been reclaimed. The exposed tailings of 1.4 hectares were capped with glacial till and vegetated with grasses and legumes. The water running through the tailings was diverted around the tailings in a line ditch and treated with sodium hydroxide and barium chloride. Difficulties occurred in placing the till capping because of the low bearing strength and the uneven surface of the tailings. This report provides a record of work for use in assessing the long-term suitability of these treatments. (EDB)

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Nathwani, J.S., and C.R. Phillips, University of Toronto, Department of Chemical Engineering and Applied Chemistry, Toronto, Ontario, Canada

Rates of Leaching of Radium from Contaminated Soils: An Experimental Investigation of Radium Bearing Soils from Port Hope, Ontario

Water, Air, and Soil Pollution 9(4):453-465 (1978, May)

The leachability of Ra-226 from soil at Port Hope, Ontario contaminated by waste from a long established U refinery is described. A small-scale static leach test was devised to provide information to permit an assessment of hazard due to leaching in the environment. Two different leaching solutions were prepared to simulate a range of infiltrating water quality in disposable environments: one by bubbling CO2 into distilled water to pH 5.5, and another by bubbling SO2 into water to pH 3.5. Narrow-range fractions of the soils (i.e. 0.250 to 0.105 mm) were leached for 30 to 45 days (equivalent rainfall of 2 to 3 yr). (EDB)(PTO)

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Nathwani, J.S., and C.R. Phillips, University of Toronto, Department of Chemical Engineering and Applied Chemistry, Toronto, Ontario, Canada

Rate Controlling Processes in the Release of Radium-226 from Uranium Mill Tailings - 1 - Leaching Study

Water, Air, and Soil Pollution 11(3):301-308 (1979, April)

Uranium mill tailings (a pyritic quartz conglomerate ore) obtained from a Canadian operation were leached according to a modification of the method recommended by I.A.E.A. for the leaching of radioactive ions from solidified wastes. A static leach test procedure was chosen to provide information to permit an assessment of hazard due to release of Ra-226 to the environment. Narrow range size fractions (53 to 75 um) of both fresh material obtained directly from a tailings line and material weathered for approximately 10 to 15 yr in a tailings basin were leached for up to 70 days. Distilled water and an acidic synthetic effluent (pH 2.5) were chosen as leachants. Two sequential desorption processes were observed, one before and the other after a leaching period of approximately 10 to 15 days. In the later and more significant stage of desorption, the leaching behaviour could be described in terms of a diffusion mechanism. Significantly greater quantities of Ra-226 were leached over relatively short leaching periods by the acidic effluent; thus the quality of the effluent and percolating water in a tailings disposal area would markedly affect the leachability of Ra from tailings. It was also found that the quantities of Ra-226 leached were significantly influenced by the solid:liquid ratio at low leaching volumes. (EDB)(PTO)

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Nathwani, J.S., and C.R. Phillips, University of Toronto, Department of Chemical Engineering and Applied Chemistry, Toronto, Ontario, Canada

Rate Controlling Processes in the Release of Radium-226 from Uranium Mill Tailings - 2 - Kinetic Study

Water, Air, and Soil Pollution 11(3):309-317 (1979, April)

A kinetic study to examine the leaching mechanisms and the rate controlling steps in the release of Ra from loose granular U mill tailings was undertaken. A batch procedure was chosen in which the kinetics of desorption of Ra-226 from tailings were determined by observing the increase in radioactivity in the solution with time. Intra-particle diffusion was found to be the rate controlling step for desorption periods greater than 84 h; for leaching periods less than this, the desorption rate was described by a semi-logarithmic relationship involving either film diffusion or a chemical exchange mechanism as the rate controlling step. It is postulated that the intraparticle diffusion constant, B, correlates and defines the internal structure and hence the binding properties of Ra-226 within the tailings aggregate. Values of the intraparticle diffusion coefficient, D sub p, have been calculated and the effect of pH on D sub p was studied. It was found that the diffusion coefficient at a specific pH does not significantly differ from 'fresh' or 'weathered' samples. However, a minimum value of D sub p was obtained at a pH of about 7.6. Values of D sub p were found to range from 2.5 X 10(E-13) to 20.0 X 10(E-13) sq cm/hr. (EDB)(PTO)

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Nathwani, J.S., and C.R. Phillips, University of Toronto, Department of Chemical Engineering and Applied Chemistry, Toronto, Ontario, Canada

Leachability of Radium-226 from Uranium Mill Tailings Consolidated with Naturally Occurring Materials and/or Cement - 1 - Empirical Analysis

Water, Air, and Soil Pollution 14:379-387 (1980)

Reduction of the fraction of Ra-226 leached from uranium mill tailings by one or two orders of magnitude was found possible by solidifying the mill tailings with cement and cement plus peat or clay. For the period of the leaching experiments (approximately 100 days) the leaching behavior of the solidified mill tailings could be described by the empirical equation Q = A t sup B, where Q = fraction of activity leached, normalized with respect to the surface:volume ratio of the tailings, t = time, and A and B are constants. The most effective consolidation mixture investigated was a 70:30 tailings to consolidating mixture comprised of cement, peat and clay in the ratio of 50:30:20. (EDB)(PTO)

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Nathwani, J.S., and C.R. Phillips, University of Toronto, Department of Chemical Engineering and Applied Chemistry, Toronto, Ontario, Canada

Leachability of Radium-226 from Uranium Mill Tailings Consolidated with Naturally Occurring Materials and/or Cement - 2 - Analysis Based on Mass Transport Equations

Water, Air, and Soil Pollution 14:389-402 (1980)

The leaching of Ra-226 from uranium mill tailings consolidated with cement and cement plus clay and/or peat may be described by a plane source diffusion model or a simultaneous first order reaction and diffusion model. A useful quantitative measure of the effectiveness of the consolidation process is the magnitude of the effective diffusion coefficient relative to that of the unconsolidated tailings material. The lowest effective diffusion coefficient upon consolidation was for consolidation with cement and peat. (EDB)(PTO)

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Nelson, R.W., A.E. Reisenauer, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

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Model Assessment of Contaminant Seepage from Buried Uranium Mill Tailings

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 245-269), 626 pp. (1980)

A model assessment was made to evaluate contaminant transport to ground water from clay-lined and unlined tailings pits. The input hydrologic soil characteristics were measured on materials typical of those found at the Morton Ranch uranium mill site in central Wyoming. The assessment involved combined saturated and partially saturated flow and contaminant transport models for two-dimensional cross-sections typical of the proposed Morton Ranch burial pits. Specifically obtained from the models were contaminant flow paths, the advancing contaminant flow fronts for sorbed and non-sorbed constituents, and travel times of contaminants along flow paths. Such results enable evaluation of the environmental consequences for the alternative control methods. The assessment considered four alternatives for minimizing seepage of contaminants from the buried mine tailings. They include: (1) Clay-lined pits (bottom only) with implacement of saturated tailings; (2) Clay-lined pits (both bommom and sides) with implacement of saturatd tailings; (3) Clay-lined pits (bottom only) with implacement of dewatered tailings; and (4) Clay-lined pits (bottom only) with implacement of saturated tailings but with underdrains and pumping of tailings solution from sumps placed above the bottom clay liner. The first two alternatives rely exclusively upon isolating and containing the drainage solution from the mill tailings. By contrast, the third and fourth alternatives use a combined approach. Major emphasis is upon reducing the volume of drainage solution available to seep from the tailings followed by using containment linings in those areas in the pit of greatest potential for seepage. The model assessment indicated the advantage of the combined approach in alternative 3 and 4 over the first two involving only clay liners. Alternative 4, using underdrains, provides slightly better control than dewatered tailings. Accordingly, alternative 4 using underdrains is the method recommended for use at Morton Ranch. (Auth)(NPK)

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Nielson, K.K., V.C. Rogers, D.C. Rich, F.A. Nederhand, G.M. Sandquist, and C.M. Jensen, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Laboratory Measurements of Radon Diffusion Through Multilayered Cover Systems for Uranium Tailings

DOE/UMT-0206; PNL-4107; 125 pp. (1981, December)

Laboratory measurements of radon fluxes and radon concentration profiles were conducted to characterize the effectiveness of multilayer cover systems for uranium tailings. The cover systems utilized soil and clay materials from proposed disposal sites for the Vitro, Durango, Shiprock, Grand Junction and Riverton tailings piles. Measured radon fluxes were in reasonable agreement with values predicted by multilayer diffusion theory. Results obtained by using air-filled porosities in the diffusion calculations were similar to those obtained by using total porosities. Measured diffusion coefficients were a better basis for predicting radon fluxes than were correlations of diffusion coefficient with moisture or with air porosity. Radon concentration profiles were also fitted by equations for multilayer diffusion in the air-filled space. Layer-order effects in the multilayer cover systems were examined and estimated to amount to 10 to 20 percent for the systems tested. Quality control measurements in support of the multilayer diffusion tests indicated that moisture absorption was not a significant problem in radon flux sampling with charcoal canisters, but that the geometry of the sampler was critical. The geometric design of flux-can samplers was also shown to be important. Enhanced radon diffusion along the walls of the test columns was examined and was found to be insignificant except when the columns had been physically disturbed. Additional moisture injected into two test columns decreased the radon flux, as expected, but appeared to migrate into surrounding materials or to be lost by evaporation. Control of moisture content and compaction in the test columns appeared to be the critical item affecting the accuracies of the experiments. (Auth)

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Osborne, R.V., Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada

Optimizing Radiation Protection in the Management of Uranium Mill Tailings

IAEA-SM-262/30; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

One of the main tasks is the study of uranium mine and mill tailings by the groups working under the auspices of the Nuclear Energy Agency of OECD is to determine how and to what extent the system of dose limitation recommended by the ICRP can be applied. The objectives for radiation protection in this system are now well-known by the names justification, optimization and dose limitation, with the second also being commonly referred to by the acronym ALARA. The Nuclear Energy Agency of OECD has already considered how gaseous effluents from some nuclear facilities might be managed to meet the optimization and dose limitation objectives. The study described here takes a similar approach. The first step in the analysis has been to determine (a) the costs of the various options that provide protection, and (b) the protection of individuals and the general population that is so attained. The next step has been to estimate the values of incremental cost-effectiveness for the various options; i.e., the quotients of the differences in costs (delta X) by the differences in protection. The quantity taken to represent the change in protection is the change in collective dose commitment (delta S), defined as in the previous study. The optimum set of measures can then, in principle, be identified as the set with the largest value of (delta X/delta S) that is less than some designated value. Such designation might be by a regulatory body or other national authority and would be the judged worth of saving a unit of collective dose commitment. The study group is not making that judgement itself. For determining the acceptability of the level of protection for individuals, the maximum dose rates to the most highly exposed individuals have been estimated. (Auth)(JMF)

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Osborne, R.V., and R.A. Judd, Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada

Management of Uranium-Mill Tailings

AECL-7163; Progress Report, Health Sciences Division, July 1-September 30, 1980, (p. 15), 93 pp. (1980, November)

The applicability of existing environmental pathway models to uranium tailings dispersal and the practicality of applying various criteria are being reviewed. (CAJ)

661

Overmyer, R.F., V.C. Rogers, and C.M. Jensen, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Reduction of Radon Flux from Uranium Tailings

Mining Congress Journal 65(9):21-25 (1979, September)

The article pertains to experiments designed to measure the effectiveness of various tailings cover materials in reducing radon flux, the theoretical analysis of radon diffusion, and the experimental results. Because the inhalation of radon daughters from uranium tailings causes an increased risk of lung cancer, NRC has issued performance objectives for uranium mill tailings treatment. The performance objectives mandate a reduction of the radon flux from the tailings to twice the background flux in the surrounding environs. A cost optimization study on a site-specific basis is required to select the overall most cost-effective method of flux reduction. (EIX)(EDB)(RHB)

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Patton, F.D., F.D. Patton Consultants Ltd., West Vancouver, British Columbia, Canada

Baseline Ground Water Studies for Uranium Mine Waste Disposal Sites: Instrumentation

Province of British Columbia Royal Commission of Inquiry into Uranium Mining Commissioner's File Number T-500; 86 pp. (1979, December)

This report covers the general framework within which one should operate in order to develop by means of instruments baseline groundwater data for uranium mine waste disposal sites. The purpose of this report is to help define good instrumentation techniques for gathering these data. The primary topics of discussion in this report are: the need for groundwater measurements, the types of supplementary data on geology and hydrology required; the special problems encountered in groundwater sampling; the locations where measurements are required; the management of groundwater studies; the techniques for taking pressure measurements and water samples; and the need for and development of multiple measurement port installations. (Auth)(PTO)

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Pidgeon, R.T., Western Australian Institute of Technology, Bentley, Western Australia, Australia

Review of the Non-Radiological Contaminants in the Long-Term Management of Uranium Mine and Mill Wastes

IAEA-SM-262/58; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

In the management of uranium mine and mill wastes public attention has focussed on hazards associatd with radioactivity. However in many such wastes non-radiological contaminants such as heavy metals, acids, organic complexes, and colloids also form potentially significant long-term health and environmental hazards. The purpose of the present review is to examine in general terms geochemical processes occurring in these wastes and to draw attention to the need for further research to provide a basis for management strategies aimed at minimizing the long-term impact of radiological and non-radiological contaminants. (Auth)

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Raicevic, D., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Removal of Radionuclides from Uranium Ores and Tailings to Yield Environmentally Acceptable Waste

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 351-360), 626 pp. (1980)

The presence of residual uranium and other radionuclides in the uranium mill tailings are posing a continuous health concern to the surrounding environment. The slow generation of sulphuric acid from residual sulphide minerals is the cause of persistant dissolution and discharge of many metallic components of the tailings. The most effective long term solution to these problems would seem to be to produce chemically stable tailings. This paper describes two possible answers to the problem: (1) Removal of radionuclides and pyrite from tailings by mineral dressing techniques; some 60-68% of the residual uranium, 70-75% of the radium, 60-65% of the thorium and 95-98% of the pyrite have been rejected from the Elliot Lake tailings. The decontaminated tailings contained 0.003% uranium, 50-60 pCi/g radium-226, 0.01% thorium and less than

0.1% sulphur as pyrite. (2) Preconcentration of radionuclides and pyrite by beneficiation from Elliot Lake ores prior to leaching; applying this approach about 97% of the uranium, 95% of the radium, 92% of the thorium and 98.5% of the sulphides were concentrated in a radionuclide and pyrite concentrates comprising 25% and 8% of the ore, respectively. The preconcentration tailings (waste) produced contained 0.004% uranium, 20-25 pCi/g radium-226, 0.005% thorium and less than 0.1% sulphur as pyrite. Economic and environmental advantages of both approaches and the leaching of the concentrates are also discussed. (Auth)(PTO)

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Raicevic, D., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Decontamination of Elliot Lake Uranium Tailings

Canadian Institute of Mining and Metallurgy Bulletin 72(808):109-115 (1979, August)

After more than 93 percent of the uranium is extracted from Elliot Lake ores by a sulphuric acid leaching process, the leach residue (tailings) contains small amounts of uranium and radioactive isotopes, particularly radium-226, which is the most serious health hazard. Heavy metal components and pyrite are also present, along with the gangue minerals. Currently, over 1000 acres of the Elliot Lake area are covered with these tailings, which contain over five million tons of pyrite. Because of constant oxidation of the pyrite by bacteria (thiobacillus) and the presence of moisture, pyrite slowly generates sulphuric acid, which steadily leaches the metal-bearing constituents from the tailings. The seepage flows of the dissolved contaminants, although often quite low in volume, have an environmental impact on the Elliot Lake area. Although these seepages are treated and most of the contaminants removed and impounded, a small amount of the radioactive contaminants reaches Lake Huron via the Serpent River. A flotation approach for treatment of the Elliot Lake uranium tailings was investigated. It produced decontaminated tailings which were practically free of pyrite, with radium, thorium, and uranium contents considerably reduced. The tailings produced comprise about 75 percent by weight of the current tailings and appears to be suitable for mine backfill. Surface storage of about half of the uranium tailings would be eliminated by this process. Mine backfilling would also increase the mine production and thus enlarge the overall uranium resources due to recovery of the ore from pillars. The pyrite concentrate produced from the current uranium tailings would be suitable for sulphuric acid production. (EDB)

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Ramsay, W., U.S. Nuclear Regulatory Commission, Washington, DC

Radon from Uranium Mill Tailings: A Source of Significant Radiation Hazard

Environmental Management 1(2):139-145 (1976)

Calculations regarding the long-term hazards to health from the radioactive gas radon which emanates from the tailings of milled uranium ores are presented. The absolute and relative risks to the population from mill tailings, as well as technical solutions to the problem of disposal methods which would eliminate or minimize lung cancer risk, are discussed. Since the emission of radon from tailings will occur thousands of years after the projected benefits from nuclear fission power have been obtained, the problem of present and future hazard from mill tailings calls for increased regulatory consideration. (EIX)

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Ramsey, R.W., Jr., U.S. Department of Energy, Washington, DC

Tailings Technology - Decommissioning and Rehabilitation Remedial Action Technology Development

IAEA-SM-262/65; Management of Wastes from Uranium Mining and Milling, Proceedings of an

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International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

This paper provides an overview of technology requirements for long-term uranium mill tailings disposal and remedial actions for existing tailings to ensure their adequate disposal. The paper examines the scientific disciplines that are the basis for the technology of uranium mill tailings stabilization and the design of barriers to control radiological exposure or environmental degradation at the location of tailings disposal. The discussion is presented as a hypothetical course of instruction at a fictitious university. Features of six mechanisms of dispersal or intrusion are examined with brief discussions of the applicable technology development of each. The full spectrum of technology is examined whether it exists or not, allowing gaps in technology to be assessed and defined. (Auth)(RHB)

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Re, G., L. Skoski, and K.E. Robinson, Dames and Moore, White Plains, NY; Robinson Dames and Moore, North Vancouver, British Columbia, Canada

Determining Radon Attenuation of Cover Materials Using Field Experimentation

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers. Inc., Society of Mining Engineers, New York, NY, (pp. 325-331), 626 pp. (1980)

This paper presents the results of a field study to select and test cover material to determine its suitability for eventual reclamation of a currently active uranium mill tailings pile. The major criteria guiding the study were the necessity of reducing the radon flux to a level meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC), and the desire to employ locally availabe material as the cover. The methodology chosen to test the radon attenuation property of the material (i.e., the radon diffusion coefficient) involved placement of various thicknesses of cover over a given thickness of dried out tailings. The tailings were placed in a six foot trench lined with plastic to simulate a tailings pond. Cover material of varying thicknesses was packed into open-ended 55-gallon drums placed directly on top of the tailings. After sufficient time had elapsed to allow radon diffusion to approach the steady-state condition, radon flux measurements were taken at the surface of each thickness of cover and from the surface of the bare tailings. This allowed determination of the flux attenuation by the cover material. Once the attenuation characteristic of the cover and the radiological characteristics of the tailings pond and background sites were determined, the thickness of material required to cover the tailings pond, based on NRC criteria, was calculated. The above steps in the process of cover thicknesses determination are presented in detail in the following paper. Conclusions based on the results obtained in the study are discussed, along with recommendations on the further testing of cover materials. (Auth)

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Robertonson, A.

Uranium Tailings: A Hot Issue in North America, But What of South Africa

South African Mining and Engineering Journal 90(4147):41-43 (1979, February)

The hazards presented by the radioactivity in tailings from uranium bearing ores has become a sensitive issue in North America. South Africa has the advantage of following in the footsteps of North America, and with foresight may be able to avoid some costly mistakes. The author discusses the issues as they have developed in America and how they relate to the South Africa situation. (EDB)(PTO)

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Robertson, A.M., and D.J.A. van Zyl, Steffen, Robertson and Kirsten, Inc., West Vancouver, British Columbia, Canada

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Design and Construction Options for Surface Uranium Tailings Impoundments

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 101-119), 626 pp. (1980)

The single most significant option available to the designer of a tailings impoundment is the site selection. Wise selection and cost effective site development is dependent on a full appreciation of the range of design and construction options that exist to satisfy the site-specific requirements. Outlined in the paper are the principal elements of a uranium tailings impoundment. These include: (1) the physical containment basin and structures; (2) liner and seepage control mechanisms; (3) tailings management systems; (4) stabilization and reclamation measures; (5) effluent treatment systems; and (6) monitoring and maintenance measures. For each of these design elements, a number of design philosophies and options exist. Their effectiveness and the cost of their implimentation varies from site to site and on the combination of other options that are selected. The main options are listed and the factors influencing their effectiveness and cost are discussed. An evaluation and comparison of the dollar costs for different sites and design options is relatively easily achieved. No comparable quantitative method exists for the evaluation of the risk and the consequential cost of environmental impact resulting from inadequate performance or failure. A semi-quantitative risk assessment method is outlined to assist in this environmental risk evaluation and consequently in site and design option selection. (Auth)(NPK)

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Robinette, M.S., Boise State University, Boise, ID

Geophysical Techniques for Selection, Analysis and Monitoring of Waste Disposal Sites

CONF-800412; Engineering Geology and Soils Engineering, Proceedings of the 18th Annual Symposium, Boise, ID, April 2, 1980, (pp. 245-254) (1980, April 2)

Groundwater contamination from waste disposal sites could be avoided with proper site analysis techniques. One of the major criterions for site selection should be the relative permeabilities at the site. In the case of hazardous waste disposal such as in uranium tailings operations, a waste disposal site should have extremely low permeability with no permeable hydrostratigraphic units included within the sequence which would carry contaminates away from the site. If it is not possible to find a site with these properties, then engineering safeguards must be designed into the waste disposal facility. In many cases, core recovery is not complete. In such cases, geophysical logs can provide a continuous in situ reading of subsurfaced parameters which affect seepage potential. Geophysical logs can be used as a very effective technology to eliminate the necessity of having to line an impoundment which is a very expensive operation. At other sites, the geophysical logs may indicate that lining is necessary because of the pressure of highly permeable units. Groundwater contamination from waste disposal operations could be avoided with proper site analysis techniques. Contamination from disposal sites is carried down-gradient within permeable hydrostratigrahic units which can be located and delineated with a combination of drill holes, borehole geophysical logs, and surface geophysics. These same techniques are useful in the assessment and delineation of existing contaminate plumes and provide cost-effective data for the design of withdrawal wells in the affected area. (EDB)

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Robinette, M.S., University of Idaho, Moscow, ID

Applications of Surface and Borehole Geophysics to Uranium Waste Disposal Practices

Proceedings of Annual Meeting of the AIME, Littleton, CO, February 24-28, 1980 (1980, February)

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Groundwater contamination from uranium operations can be avoided with proper site analysis techniques. Contamination from tailings disposal sites is carried downgradient within premeable hydrostratigraphic units which can be located and delineated with a combination of drill holes, borehole geophysical logs and surface geophysics. Several case studies are presented. (EIX)(PTO)

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Geophysical Techniques foı Selection, Analysis and Monitoring Uranium Waste Disposal Sites

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 93-99), 626 pp. (1980)

Ground-water contamination from uranium operations could be avoided with proper site analysis techniques. Contamination from tailings disposal sites is carried downgradient within permeable hydrostratigraphic units which can be located and delineated with a combination of drill holes and borehole geophysical logs. Engineering safeguards can be designed into a disposal site by determining if permeable hydrostratigrpahic units exist which will dominate the flow system and provide seepage paths for contaminates. It is more cost-effective to accurately assess seepage potential with geophysical logs before contamination becomes a problem than to be faced with a major clean-up effort after contamination has occurred. If a uranium waste impoundment already has a ground-water contamination problem, then borehole geophysical logs may be used to delineate the contaminated zones which need to be cleaned up. It is less expensive to withdraw the contaminated plume from only within the affected zones rather than attempt to dewater the entire area. Consequently, the geophysical logs are invaluable in assessing which zones should be pumped and where packers should be set for construction of piezometers to allow monitoring of water-quality changes. A surface geophysical technique is being tested and developed for monitoring of seepage from uranium tailings impoundments. Geoelectric soundings and profiles from direct current resistivity surveys can locate ancmalous areas for the placement of drill holes to better assess seepage. This reconnaissance technique should eliminate radom hit-or-miss drilling at sites where monitoring is required. Tests and experiments are being done on developing the capabilities of this technique to incorporate complex resistivity data to assess cultural impedence noise which complicates simple resistivity data. (Auth)

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Rogers, V.C., and K.K. Nielson, Pacific Northwest Laboratory, Richland, WA

A Handbook for the Determination of Radon Attenuation Through Cover Materials

PNL-4084; 80 pp. (1981, December)

Radon emissions from bare and covered uranium mill tailings can be estimated by diffusion theory if appropriate diffusion coefficients are known. The mathematical basis for the diffusion theory expressions are herein presented, as is a general survey of previous and present research, as well as technological developments associated with radon transport through tailing cover systems. Research is presently being conducted to define more clearly the influences of moisture, porosity, pore size distribution and other factors, on the attenuative properties of cover materials. The results of these present investigations will be incorporated in a subsequent addendum to this handbook. The radon fluxes of cover thicknesses can be calculated by hand or by available computer programs. The equations and procedure for the hand calculations is in direct support of the methodology contained in Appendix P of the Generic Environmental Impact Statement on Uranium Milling. Several examples are given to demonstrate the methodology. (GRA)

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Ryan, R.K., and D.M. Levins, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Extraction of Radium from Uranium Tailings

CIM Bulletin 73(822):126-133 (1980, October)

Removal of radium from uranium tailings would substantially lessen their environmental impact because it would eliminate, or greatly reduce, the hazards arising from radon emanation, leaching of radium, dust dispersal and gamma radiation. A process is described to extract radium from tailings by leaching in 3M NaCl solution. The radium can be rapidly leached at ambient temperatures by either multi-stage contact in agitated vessels or washing on a tailings filter cake. Extraction efficiencies ranging from 80 to 92 % have been measured for tailings derived from a number of Australian ores. Methods for radium recovery from the leach solution by precipitation, ion exchange and adsorption have been examined. Precipitation as barium/radium sulphate appears to be the most suitable approach. A possible flow diagram for the process is proposed which involves recycle of the saline leach liquor. (Auth)(CAJ)

676

Schumm, S.A., J.E. Costa, J.C. Knox, T.J. Toy, and R.F. Warner, Colorado State University, Fort Collins, CO; University of Denver, Denver, CO; University of Wisconsin, Madison, WI; University of Sydney, Sydney, New South Wales, Australia

Geomorphic Hazards and Uranium-Tailings Disposal

IAEA-SM-262/50; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

In order to assess the long-term stability of a uranium-tailings disposal site the potential for climate change, tectonic activity, baselevel change, and vegetation and landform modification by man must be considered. All of these processes affect landforms, and a change in any or all may create geomorphic hazards, as a result of their influence on runoff, sediment yields, river behavior, and slope erosion. In addition, during the passage of time landforms may be so modified by the operation of natural erosional and depositional processes that a site may become unstable. Predictions of site stability improve as the amount of information available on landform evolution at that site increases. In addition to climatic and hydrologic data, geomorphic information on channel, hillslope and drainage-basin characteristics is needed in order to predict probable future landform changes and the extent to which the change may be deemed hazardous. (Auth)

677

Seeley, F.G., Oak Ridge National Laboratory, Oak Ridge, TN

Problems in the Separation of Radium from Uranium Ore Tailings

Hydrometallurgy 2(3):249-263 (1977, May)

The radium content of a representative sandstone type of uranium ore was found to be distributed uniformly according to particle size before leaching, but in sulfuric acid-leached tailings was found predominantly in the -325 mesh fraction. The radium leaching characteristics from both ore and sulfate-leached tailings were investigated. Several 1 M salt solutions showed poor to moderate $RaSO_4$ dissolution from slimes solids tailings, while 3 M HNO_3 or HCl solutions dissolved approximately 95% of the radium content of either ore or tailings. Tests are reported in which -325 mesh sand particles were coated with alkaline-earth sulfates by a special technique to simulate slime solids tailings. The dissolution of $RaSO_4$ from these coated sands was decreased by the presence of $BaSO_4$, but increased by the presence of $CaSO_4$. The interrelationship in the dissolution of mixtures of $CaSO_4$, $SrSO_4$, $BaSO_4$ and $RaSO_4$ are shown, and a generalized equation for the estimation of the dissolution of a minor component is presented. (PTO)(EDB)

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Silker, W.B., and P.G. Heasler, Pacific Northwest Laboratory, Richland, WA

Diffusion and Exhalation of Radon from Uranium Tailings

PNL-3207; 136 pp. (1980, March)

The objectives of this program were to develop and apply an absolute method for determining radon emissions from uranium tailings. Briefly, Ra-226 and Rn-222 (Pb-214) concentration gradients as a function of depth were measured in situ by gamma-ray spectrometry, which was accomplished by lowering a calibrated intrinsic germanium detector to discrete levels within a sealed and cased test well hole and accumulating the gamma-ray spectrum with a multichannel analyzer. Differences between the vertical distributions of radium and radon were used to calculate a radon diffusion coefficient, the fraction of emanating radon and the flux of radon across the tailings-air interface. A diffusional model was devleoped that accounted for the non-uniform radium concentrations that occur with depth in tailings piles. (GRA)(PTO)

679

Sill, C.W., Health Services Laboratory, Idaho Falls, ID

Determination of Thorium and Uranium Isotopes in Ores and Mill Tailings by Alpha Spectrometry

Analytical Chemistry 49(4):618-621 (1977, April)

Procedures are presented for the determination of thorium-230 and isotopes of uranium in uranium ores and mill tailings, and of isotopes of thorium in thorium ores, all by alpha spectrometry. All samples are decomposed completely by fusion with potassium fluoride in platinum dishes. The cakes are then transposed with sulfuric acid and sodium sulfate to pyrosulfate fusions with simultaneous volatilization of hydrogen fluoride and silicon tetrafluoride. After dissolving the pyrosulfate cakes in dilute hydrochloric acid, thorium and uranium are extracted into Aliquat-336 from an aliquot of their respective samples in strong, acidic aluminum nitrate. Each element is then stripped from its respective extract, electrodeposited, and analyzed by alpha spectrometry. Thorium-230 is preconcentrated from relatively larger samples by precipitation on barium sulfate. Chemical yields are determined using thorium-234 and uranium-232 tracers and are generally at least 90 percent or higher. (EDB)

680

Silver, M., and J.E. Andersen, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Removal of Radium from Elliot Lake Uranium Tailings by Salt Washing

Water Pollution Research Journal of Canada 15(3):217-231 (1980)

The paper reports on the investigation carried out to define the optimun conditions for radium removal from an Elliot Lake uranium mine mill waste by salt washing in order to aid in suggestions for the modification of existing plant practice. Maximum removal from unwashed tailings is achieved by use of potassium chloride concentrations greater than 1 m and from water washed tailings by potassium chloride concentrations greater than 2 m. Radium is removed uniformly from all particle size fractions. (EIX)

681

Skeaff, J.M., G.M. Ritcey, D. Raicevic, and A. Jonegejan, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

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Research on Uranium Tailings Disposal Technology at CANMET, Ottawa

IAEA-SM-262/12; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium. Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

In this paper, results from four continuing investigations at CANMET on uranium tailings management are presented. These investigations are: cleaning of tailings by flotation and high-intensity magnetic separation (HIMS), conversion of municipal wastes into compost for use as topsoil on uranium tailings, methods for the chemical fixation of uranium tailings and a laboratory determination of the rate of release of environmental contaminants from uranium tailings. (Auth)

682

Smith, W.J., and F.W. Whicker, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

An In-Situ Gross Alpha Monitoring Technique for Delineating Fugitive Mill Tailings

IAEA-SM-262/35; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

A good correlation was found by Dreesen and Wienke (1978) between gross alpha counting (zinc sulfide) and gamma spectorscopy (Ge(Li)) for estimating the radium-226 content of soil and tailings samples. Both detection systems were used in the laboratory for rapid screening or precise assessment of samples, respectively. The benefit of the gross alpha system was significantly shorter counting times for sample screening. Although the precision of the alpha system cannot equal that of the gamma spectroscopy data yielded good correlations for three sets of samples. The investigation described here evaluates the zinc sulfide gross alpha system for rapid surveys and sample screening in the field. Gross alpha measurements were made and soil samples were collected at five stations along a transect extending from the base of a uranium mill tailings, impoundment dam to a point six km downwind. Measurements and samples were for surface soils and for soils at various depths. The soil profiles were studied to a depth of 25 cm. Each sample has been re-counted in the laboratory with the zinc sulfide gross alpha system. The sample preparation procedure outlined by Dreesen and Wienke (1978) was used. Presently, each sample will be sealed in a metal container, the radon daughters allowed to equilibrate, and be analyzed by gamma spectroscopy. A set of data similar to that of Dreesen and Wienke (1978) is thereby obtained, and the supplementary measurements made in the field are available for evaluation of the gross alpha technique for field use. At the time this synopsis is being prepared all data are not available, but some preliminary results and observations may be presented. (Auth)(JMF)

683

Snodgrass, W.J., D. Lush, and J. Capobianco, Johns Hopkins University, Department of Geography and Environmental Engineering, Baltimore, MD; Beak Consultants Limited, Toronto, Ontario, Canada

Implications of Alternative Geochemical Controls on the Temporal Behaviour of Elliot Lake Tailings

IAEA-SM-262/54; Management of Wastes from Uranium Mining and Milling, Proceedings of an International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna. (1982, May)

An assessment of the major minerals and probable radioisotope associations for tailings which are typical of the Elliot Lake, Canada, mining district have been made using mill operating data, laboratory and field observations, and equilibrium chemistry calculations. The majority of the uranium-238 series and one half of the thorium-232 series are postulated to have been chemically leached and reprecipitated with gypsum, jarosite and hydroxides and carbonates of calcium and iron during the milling and tailing neutralization processes. It is hypothesized that gypsum dissolution controls the mobilization of radioisotopes within the tailings except for jarosite associated radium mobilization and acidification control on thorium. Treating a typical tailings area as homogeneous and with a typical drainage area, it is estimated that the time to leach all buffer from the tails is 100-150 years, the time to oxidize all pyrite is 200 years and the time to dissolve all gypsum is 400 years. For alternative management schemes of tailings hydrology, with or without pyrite removal, the errors in estimates of radionuclide concentration and pH in the tailings pore water and a downstream lake are modeled and assessed. The major errors are the proportion of radium in jarosite and gypsum, the adsorption coefficient in the tailings and the time history of the solubility product of the mill-formed and in-situ-formed minerals. The calibration of this model is explored. (Auth)

684

Swift, J.J., U.S. Environmental Protection Agency, Office of Radiation Programs, Division of Criteria and Standards, Washington, DC

Health Risks to Distant Populations from Uranium Mill Tailings Radon

ORP/TAD-80-1; 40 pp. (1981, May)

Uranium mill tailing piles can expose the population to radiation by several pathways. The author believes the air pathway to be the most important and radon-222 to be the principal nuclide. The report illustrates the effects of tailings piles on a variety of local and regional populations, assesses the effects of the tailings on distant populations, and compares EPA methods and results with assessments by others. (GRA)

685

Thomas, K.T., International Atomic Energy Agency, Waste Management Section, Vienna, Austria

Management of Wastes from Uranium Mines and Mills

International Atomic Energy Agency Bulletin 23(2):33-35 (1981, June)

The disposal of large quantities of waste produced in mining and milling does have an environmental impact, owing to the long half-lives and the ready availability of the toxic radionuclides Ra-226 and Rn-222. The special precautions taken to deal with radioactive wastes from mining and milling, including waste rock, mine-water, mine-exhaust ventilation, barren solutions, airborne contaminants, dusts and fumes, and uranium mill tailings are discussed. After the mill has been decommissioned, control, surveillance, and maintenance of waste-retention systems present problems which will last into the future. When assessing the adverse effects on health, the radioisotopes Ra-226, Rn-222, and Pb-210 in the tailings and U-238 and U-234 from yellow-cake operations are important. On the basis of detailed analysis, the contribution from the radioactivity remaining in mill tailings to the collective dose-commitment is small compared to that from natural background. The IAEA has been active for many years in studying the radiological and technological bases for the management of uranium-processing wastes. An overview of current practices for the impoundment of mill tailings and of site selection will be published in 1981, and a review and update of the code and guide on management of wastes from the mining and milling of uranium and thorium ores is planned beginning in 1981. (CAJ)

686

Torma, A.E., New Mexico Energy and Minerals Department, Santa Fe, NM

Extraction of Radionuclides from Low-Grade Ores and Mill Tailings - Final Report - February 15, 1980 - February 15, 1981

NP-1903909; EMD-2-68-3320 (1981)

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The purpose of this research project is to develop efficient leaching processes for the extraction of uranium from low-grade ores and for the removal of long half-life radionuclides (radium and thorium) from the leach residue in order to produce innocuous tailings. The present investigation is the first part of a three-year project. It provides kinetic information not previously available for uranium leaching by hydrochloric and sulfuric acid solutions and preliminary data for the removal of radionuclides from the leach residues by KCl-solutions. This study has demonstrated that uranium extractions as high as almost 100% can be realized with either HCl or leach solutions. Initial radium concentration of 245 pCi/g originally in the ore was reduced to 70 and 23 pCi/g in the final tailings of hydrochloric and sulfuric acid leachings. (EDB)(PTO)

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Van As, D.

Uranium Mill Tailings Management

INIS-MF-5983; Summer School on Uranium Health Physics, Pretoria, South Africa, April 14-15, 1980 (1980)

The tailings produced as a result of uranium mining and milling operations contain large quantities of radioactive material albeit at concentrations only slightly above that occurring naturally. Due to the fact that the material has been brought to the surface and has been physically and chemically changed, radioactive and other constituents are now more mobile and available for uptake in food chains etc. The large volumes of material and the long half-lives of the radionuclides present make it impossible to completely isolate the material from the environment. Releases to the environment must however be controlled to limit exposures of the public to acceptable levels. This lecture discusses the sources of radioactivity in tailings material and the most important release mechanisms i.e. seepage, erosion, gaseous emanation and particulate suspension by which the radioactivity can escape to the environment. The possible critical pathways by which man can be exposed and its dependence on climatic factors are described and management options for controlling these releases are mentioned. Finally, the existing legislation in South Africa for the control of these releases are discussed and the release rate limits applied in various countries are given. (EDB)

688
Vivyurka, A.J.

Rehabilitation of Uranium Mines Tailings Areas

Canadian Mining Journal 96(6):44-45 (1975, June)

This paper is about the experiences that Rio Algom Mines has had in the Elliot Lake uranium area trying to make the tailings more compatible with the surrounding environment. In 1970, Rio Algom commenced a rehabilitation program. Feasibility studies were done on the Lacnor-Nordic tailings area and the Pronto tailings area. Subsequent studies were done in 1972 in the Crotch Lake area, the Milliken-Stanleigh area and at Panel. In co-operation with the Ministry of the Environment, Industrial Wastes Branch, a program was developed for each area to reduce the impact of the idle tailings areas on the environment. (EIX)(PTO)

689
Watford, G.A., and J.A. Wethington, Jr., University of Florida, Department of Nuclear Engineering, Gainesville, FL

Radiological Hazards of Uranium Mill Tailings Piles

Nuclear Technology 53(3):295-301 (1979, December 17)

This paper examines reasons for the radiological health problems associated with the front end of the nuclear fuel cycle. The increases of radioactivity in the general environment attributable to uranium mill tailings are small but never ending. Sources of radiations, mainly particulate matter and radon gas, are discussed. Management of the piles seems to provide the only viable solution to the problem. The objectives here are to: (1) describe uranium mill tailings piles as a radiological hazard; (2) identify the characteristics of tailings piles that are important in understanding and evaluating the hazards; (3) discuss the potential radiological importance of tailings piles to the public and to individuals; and (4) describe methods of waste management aimed at controlling the problem. (Auth)(JMF)

690

Williams, A.R., Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Biological Uptake and Transfer of Radium-226: A Review

IAEA-SM-257/92; Migration in the Terrestrial Environment of Long-Lived Radionuclides from the Nuclear Fuel Cycle, Proceedings of an International Symposium, Knoxville, TN, July 27-31, 1981, (18 pp.) (1981, July)

The theoretical basis of the biological uptake of radium is poorly developed. The simple linear concentration factor model has been used almost exclusively and often without any appreciation of its limitations. An analysis of the available data reveals that this model can be adequately validated only for freshwater algae. Deviations from this model are due to non-linearity of uptake response to increased radium concentration in the medium, to the lack of equilibrium being established within the time scale of the food-chain transfer, and to the existence of multiple sources (e.g. food and water) in some of the food-chain compartments. These theoretical weaknesses and the large errors of prediction indicate a need for more rigorous experimental work; however this need must be viewed in the light of the revised dose limits for the long-lived daughter products of uranium, recently recommended by the International Commission on Radiological Protection (ICRP). These revised limits suggest that Radium-226 may no longer be a singularly critical nuclide, and thus more research on Thorium-230, Lead-210 and Polonium-210 may take precedence over a qualitative improvement in our knowledge of the environmental behavior of Radium-226. (Auth)(CAJ)

691

Wulff, J.G., F.W. Gifford, and D. Buranek, Wahler Associates, Consulting Geotechnical Engineers, Palo Alto, CA

Current Parameters in the Cost-Effective Design of Uranium Mill Waste Disposal Systems

CONF-8005177; Uranium Mine Waste Disposal, C.O. Brawner, (Ed.), Proceedings of the 1st International Conference, Vancouver, British Columbia, Canada, May 19-21, 1980. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Society of Mining Engineers, New York, NY, (pp. 377-409), 626 pp. (1980)

The rapid advancement of modern engineering technology and recent regulatory requirements have together created challenging new conditions for the cost-effective design of uranium mill waste disposal systems. In the design process, the recognition of site-specific conditions has become even more critical than formerly; and equally critical are the regulatory agencies' interpretation and administration of the regulations. Under these conditions, a solution that is environmentally acceptable and cost-effective for one milling operation may be environmentally unacceptable or even technically and/or financially infeasible for another. This paper presents three case histories where alternative disposal studies for three different operations with different site conditions led to three distinct types of proposed solutions. Each of the solutions would be economically justified for the specific operation it is to serve, but none is the most cost-effective solution for that particular site. In a discussion of what constitutes cost-effectiveness, the concepts of economic justification and financial feasibility are examined, in the light of the effects that regulatory requirements may have on

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them. Examples illustrate how realistic the optimizing of cost-effectiveness is restrained in the interests of satisfying environmental and regulatory restrictions. A concluding discussion deals with the philosophy of achieving a proper balance between regulatory restrictions and maximum cost-effectiveness. (Auth)(PTO)

692

Yagnik, S.K., M.H.I. Baird, and S. Banerjee, McMaster University, Hamilton, Ontario, Canada

Investigation of Radium Extraction from Uranium Mill Tailings

Hydrometallurgy 7(1):61-75 (1981, June)

The possibility of extracting a substantial portion of the most toxic radionuclide radium-226 from sulfuric acid-leach process tailings from the Elliot Lake area was investigated by contacting with several leachants such as HNO_3 and solutions of DTPA, EDTA and $CaCl_2$. (EIX)(PTO)

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Zellmer, J.T., Battelle Pacific Northwest Laboratories, Richland, WA

Stability of Multilayer Earthen Barriers Used to Isolate Mill Tailings: Geologic and Geotechnological Considerations

PNL-3902; 49 pp. (1981, August)

This report briefly discusses how seismic activity, erosion, climatic change, slope stability, differential settlement, and cover design could affect the long-term integrity of multilayer earthen cover systems. In addition, the report suggests ways to design and construct covers so that adverse impacts can be avoided or minimized. The stability of multilayer earthen barriers used to isolate uranium milltailings depends on the morphology of the barrier, the condition of the tailings, and the possible impacts of earthquakes, erosion, and climatic changes. When designing a cover for or siting a tailings pile, one must take into account both geologic and geotechnological variables. To alleviate the adverse effects of possible seismic activity, tailings piles should never be located on or near active or capable faults. Existing piles near faults should be removed to safer sites or engineered to withstand possible displacement and shaking. Liquefaction generally can be prevented if the tailings and their underlying material are compacted to a relative density of 60% or greater, or if they are kept dry. If the tailings are saturated, dewatering schemes may have to be used. Erosion may be caused by streams, glaciers, or wind, depending on the geomorphic and atmospheric conditions at the site. Fluvial erosion can be prevented by using dikes (and avoided by initially siting the pile a safe distance away from stream courses). In some cases, fluvial waters or rainfall may have to be rerouted over the pile via armored ditches. Eolian erosion can be minimized by vegetating the disopsal site or covering it with gravel. Because of the wide geomorphic and geotechnological variations at most sites, a single cover design cannot be cost-effectively and efficiently used at all sites. (EDB)(JMF)

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APPENDIX

(This appendix contains references to recently acquired literature relevant to the remedial action program that could not be included due to time constraints.)

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