LEGIBILITY NOTICE

A major purpose of the Technical Information Center is to provide the broadest dissemination possible of information contained in DOE's Research and Development Reports to business, industry, the academic community, and federal, state and local governments.

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1

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Information Division

NUCLEAR FACILITY DECOMMISSIONING AND SITE REMEDIAL ACTIONS

A SELECTED BIBLIOGRAPHY
Volume 5

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Remedial Action Program Information Center
Information Research and Analysis

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CONTENTS

ABSTRACT

This bibliography of 756 references with abstracts on the subject of nuclear facility decommissioning, uranium mill tailings management, and site remedial actions is the fifth in a series of annual reports prepared for the U.S. Department of Energy, Division of Remedial Action Projects. 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—has 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 (1) Surplus Facilities Management Program, (2) Nuclear Facilities Decommissioning, (3) Formerly Utilized Sites Remedial Action Program, (4) Uranium Mill Tailings Remedial Action Program, (5) Grand Junction Remedial Action Program, (6) Uranium Mill Tailings Management, and (7) Technical Measurements Center. Chapter sections for chapters 1, 2, 4, and 6 include Design, Planning, and Regulations; Environmental Studies and Site Surveys; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. The references within each chapter or section are arranged alphabetically by leading author. References having no individual author are arranged by corporate author or by title. Indexes are provided for the categories of author, corporate affiliation, title, publication description, geographic location, and keywords. The Appendix contains a list of frequently used acronyms.

This report was generated from a computerized database maintained by the Remedial Action Program Information Center (RAPIC), which exists to provide information support to researchers in the remedial action/radioactive waste management field. Comprehensive literature searches of the database and further information concerning this project may be obtained by contacting RAPIC at (615) 576-0568 or FTS 626-0568.

INTRODUCTION

The Remedial Action Program Information Center (RAPIC) is funded by the U.S. Department of Energy (DOE), Division of Remedial Action Projects, to provide technical information support to DOE's Remedial Action Program under the sponsorship of the program's major constituents:

- Surplus Facilities Management Program
  Lead Field Office—DOE Richland Operations Office
  Lead Technical 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 Technical Contractor—Bechtel National, Inc.
- Uranium Mill Tailings Remedial Action Program
  Lead Field Office—DOE Albuquerque Operations Office
  Lead Technical Contractor—Jacobs Engineering Group, Inc.
- Grand Junction Remedial Action Program
  Lead Field Office—DOE Grand Junction Area Office
  Lead Technical Contractor—Colorado Department of Health
- Technical Measurments Center
  Lead Office—DOE Division of Remedial Action Projects
  Lead Technical Contractor—Bendix Field Engineering Corporation

The Nuclear Facility Decommissioning and Site Remedial Actions database was developed and is maintained by RAPIC, which is part of the Information Research and Analysis (IR&A), Information Division, located at Oak Ridge National Laboratory. RAPIC's communications with the U.S. DOE's Remedial Action Program are administratively coordinated through the Office of Surplus Facilities Management, UNC Nuclear Industries, Inc., Richland, Washington.

RAPIC serves as a central clearinghouse for information (derived from both foreign and domestic publications) concerning scientific, regulatory, and socioeconomic aspects of radioactively contaminated facility/site remedial actions. 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 facility disposition.
- Assessing environmental and engineering aspects of proposed remedial action alternatives.
- Drafting detailed remedial action project plans and procedures.
- Performing remedial actions to make facilities/sites available for restricted or unrestricted use.

This bibliography of 756 references is the fifth in a series to be prepared by RAPIC. Volumes 1, 2, 3, and 4, which were published in 1980, 1981, 1982, and 1983, 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 these published bibliographies 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 database.

CONTENTS OF THE BIBLIOGRAPHY

The subject matter of this bibliography is presented in seven 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, Uranium Mill Tailings Management, and Technical Measurements Center.

The Surplus Facilities Management Program (SFMP) chapter contains references pertaining to the SFMP or to sites included in the program, 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.

The Formerly Utilized Sites Remedial Action Program (FUSRAP) chapter contains references pertinent to FUSRAP management 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 UMTRAP management 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. This program is concerned with local structures that have in, under, or adjacent to their walls or foundations uranium mill tailings that originated from the Grand Junction uranium tailings pile.

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.

The Technical Measurements Center chapter contains reports published by the U.S. Department of Energy's Technical Measurements Center (TMC), Grand Junction, Colorado, on the subject of detection and measurement of radioactive/hazardous contaminants, instrument calibration, and field calibration facilities.

Because of the size and diversity of chapters 1, 2, 4, and 6, it has been necessary to subdivide these chapters into the following sections: Design, Planning, and Regulations; Environmental Studies and Site Surveys; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience, and General Studies.

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 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. A number of title words 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.

APPENDIX

The Appendix lists many of the commonly used acronyms in remedial action and radioactive waste management work.

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 for 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}.
4. Cubic or square dimensions of measurements will be shown as, for example, 6 cu cm for 6 cubic centimeters or 3 sq km for 3 square kilometers.
5. Nuclide mass numbers will be shown as Ra-226, U-238, etc.
6. Abbreviations have been used in this publication for certain unit measurements and are listed as follows:

A	ampere	C	Celsius
a	acre	c.d.	current density
Bq	becquerel	Ci	curie

cpm	counts per minute	MeV	mega electron volt
cps	counts per second	min	minute
deg	degree	oz	ounce
dpm	disintegrations per minute	ppm	parts per million
dps	disintegrations per second	R	roentgen
F	Fahrenheit	rad	radiation absorbed dose
ft	feet	rem	roentgen-equivalent-man
g	gram	s	second
gal	gallon	Sv	sievert (dose equivalent)
ha	hectare	V	volt
hr	hour	W	watt
in.	inch	W(e)	watt (electric)
keV	kilo electron volt	W(t)	watt (thermal)
l	liter	WL	working level
lb	pound	yd	yard
m	meter	yr	year

7. The following prefixes have been used to indicate multiples or subdivisions of units of measurement:

a	atto	(10^{-18})	da	deca	(10^{1})
f	femto	(10^{-15})	h	hecto	(10^{2})
p	pico	(10^{-12})	k	kilo	(10^{3})
n	nano	(10^{-9})	M	mega	(10^{6})
u	micro	(10^{-6})	G	giga	(10^{9})
m	milli	(10^{-3})	T	tera	(10^{12})
c	centi	(10^{-2})	P	peta	(10^{15})
d	deci	(10^{-1})	E	exa	(10^{18})

SERVICES

RAPIC provides information support to a large number of researchers who are involved in the remedial action/radioactive waste management field. Such services as performing topical searches of RAPIC databases, performing computerized literature searches of the commercially available databases, 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 and 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 37831.

All inquiries for information services should be addressed to:

Remedial Action Program Information Center
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or
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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 Sherry Daniels of the Information Research and Analysis (IR&A) Computer Services Group for the computer production of this document and to Donna Stokes, Deborah Barnes, Sherry Hawthorne, and Judy Crutcher of the IR&A Publications Office; Eric Lewis, Anne Ehrenshaft, and Julia Cooper of the Center for Energy and Environmental Information; and Ellie Trotter and Carol Johnson of the Hazardous Materials Information Center for assistance in final publication preparations.

We appreciate the time that Tim Myrick, Operations Division, and W. D. Cottrell, Health and Safety Research Division, contributed in reviewing this report.

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. (JMF)[10]

Chapter 1

SURPLUS FACILITIES MANAGEMENT PROGRAM

- Design, Planning, and Regulations
- Environmental Studies and Site Surveys
- Decontamination Studies
- Dismantlement and Demolition
- Site Stabilization and Reclamation
- Remedial Action Experience
- General Studies

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

1

Aguilar, M.A., D.F. Hauman, C.E. Wickland, and D.M. Wilkins, Rockwell International, Energy Systems Group, Rocky Flats Plant, Golden, CO

Criteria and Cost Estimates for Decommissioning and Decontamination of Major Plutonium Buildings at Rocky Flats Plant

CONF-820424; Treatment and Handling of Radioactive Wastes, Proceedings of an American Nuclear Society Topical Meeting, Richland, WA, April 19, 1982. Battelle Press, Columbus, OH; (pp. 87-92) (1982)

This report is part of the evaluation of two out of three major alternatives considered in the Long-Range Rocky Flats Utilization Study: (1) modify the older plutonium buildings to meet all safety requirements identified by the risk assessment program, (2) relocate the plant elsewhere, and (3) transfer the major plant missions to other existing Department of Energy (DOE) facilities. The latter two alternatives would require decommissioning and decontamination of seven major buildings. They are Buildings 559, 771, 774, 707, 779, 776/777 (considered in this study to be one building), and 371/374 (also considered one building). The authors determined thirteen categories of decommissioning and decontamination activities and the cost estimates required to bring the buildings to the standby condition and either the restricted-use or the unrestricted-use condition. A total expenditure of about $200 million (1980 dollars) would allow two of the buildings to be prepared for restricted use and four of the buildings to be prepared for unrestricted use. (EDB)

2

Bechtel National, Inc., Oak Ridge, TN

Engineering Evaluation of Alternatives for the Disposition of Niagara Falls Storage Site, Its Residues and Wastes

DOE/OR/20722-1; 215 pp. (1984, January)

The Niagara Falls Storage Site (NFSS), located in northwestern New York state, is a surplus facility where an inventory of pitchblende residues and radioactive wastes is stored. Investigations regarding the site have focused on specific residues or wastes. No engineering evaluation has previously been conducted regarding final disposition alternatives for the site or its residues and wastes. The objective of this document is to present the conceptual engineering, occupational radiation exposure, construction schedule, maintenance and surveillance requirements, and cost information relevant to design and implementation of four alternatives: (1) take no action beyond interim remedial measures, other than maintenance surveillance; (2) retain and manage the facility as a long-term waste management facility; (3) decontaminate, certify, and release the NFSS for other use; and (4) partially decontaminate the NFSS by removal and transport offsite of only the more radioactive residues, and upgrade containment of the remaining wastes and residues on site. Conclusions regarding a preferred alternative are not presented. (BDC)

3

Burns and Roe Industrial Services Corporation, Paramus, NJ; Nuclear Energy Services, Inc., Danbury, CT

Shippingport Station Decommissioning Project - Decommissioning Plan

DOE/RL/10153-T1; RL/SFM-83-4 (Rev. 1); 5000 pp. (1983, September)

The Shippingport Atomic Power Station (SAPS), located on the Ohio River 25 miles northeast of Pittsburgh, Pennsylvania, was operated for over 25 years by Duquesne Light Company. The unit operated as a conventional PWR until it was converted to a light water breeder in 1976. The plant was permanently shut down on October 1, 1982, and a two year period of end-of-life testing and defueling began. The primary mission of the Shippingport Station Decommissioning Project (SSDP) is to reduce the radiation levels in the nuclear portion of the station and also to serve as a decommissioning demonstration to the nuclear industry by providing useful information for future decommissioning projects. The project is being executed in four stages: (1) preconceptual planning - assess the decommissioning options for the SAPS and recommend the preferred option - immediate dismantlement; (2) conceptual engineering - set the project cost, schedule, and technical baselines, and identify long-lead activities; (3) detailed engineering - include engineering studies to provide the basis for key technical decisions; and (4) decommissioning operations - perform decommissioning work at minimum cost consistent with safety, security, and environmental requirements. The key schedule milestones are: award of DOC contract - March 1984; complete indoctrination and training and assume responsibility for SAPS - June 1984; start decommissioning operations - January 1985; start plant dismantlement - September 1985; complete dismantlement work - January 1988; complete final survey and final report - July 1988; and complete all records and release the site - September 1988. The general decommissioning approach is to sequentially remove: (1) all asbestos insulation;, (2) radioactive piping systems, components, and structural material; and (3) non-radioactive systems and components. All remaining steel and concrete structures will be surveyed, decontaminated, and released for further dismantlement by standard demolition methods. The site will be restored, approved for release, and returned to the custody of Duquesne Light Company. Building and chambers which form contamination control boundaries will not be dismantled until all internal work that has potential for contamination release, is completed. The work to be performed is defined in 17 activity specifications. The D&D work is characterized by the following features: reactor vessel, reactor internals, and the neutron shield tank will be removed from the plant as one package and shipped for burial by barge; (2) steam generator heat exchanger, presurizer, and other contaminated components will be shipped on the barge as their own container; (3) primary systems will be dismantled without general decontamination; (4) electrical requirements during decommissioning will be provided by a temporary distribution system; (5) existing thin film evaporator, filters, and resin columns will be used to process liquid wastes; (6) evaporator bottoms and filter sludge will be solidified with cement in steel drums; and (7) underground structures will be removed to three feet below grade after decontamination to unrestricted release levels. Decommissioning operations are estimated to cost $73.7 million on an escalated basis, including a 16% contingency. This report consists of 12 volumes. Volume 1 contains the decommissioning operations concept, schedule, and cost estimate. Also included are project organization, safety, and environmental assessment, work breakdown structure, and training requirements. Volumes 2 through 5 contain activity specifications. Volumes 6 through 12 contain various appendices on work breakdown structure; radiation work training programs; engineering requirements; cost/schedule reductions; potential risks; cost benefit criteria; long-lead-time activities; technical baseline; safety and licensing assessments; environmental impact statement; record of decision; safety analyses; permitting plan; engineering studies; and radiation/contamination survey data. (PTO)

4

Fitts, R.B., Oak Ridge National Laboratory, Oak Ridge, TN

Overview of Remedial Action Technology Development Milestone D

CONF-811130; ORNL/NFW-81/34; DOE Participants Information Meeting on Low-Level Waste Management, Proceedings of the Third Annual Meeting, New Orleans, LA, November 4, 1981; (pp. 415-418) (1981, December)

The work on remedial action technology development has the same general basis as that on improved shallow land burial technology development. The major components of work aimed at remedial action technology development involve the following general problem areas: (1) water movement; (2) subsidence; (3) erosion; (4) intrusion; and (5) radionuclide migration. Each of these components is addressed in terms of its content and ongoing research, development and demonstration work. The four principal sites active in the remedial action technology development work of the Low-Level Waste Management Program are: Oak Ridge National Laboratory (ORNL); Los Alamos National Laboratory (LANL); Rockwell Hanford Operations (RHO); and Savannah River Laboratory (SRL). The final remedial action manual is to be prepared by December of 1984. Typical important deliverables for this activity are as follows: (1) Draft State-of-the-Art Remedial Action Manual - ORNL - 6/81; (2) Draft Remedial Action Criteria - ORNL - 9/81; (3) Report on Barriers - LANL - 9/83; (4) Report on Water Management - ORNL - 9/83; (5) Reports on Subsidence Studies - LANL and ORNL - 9/84; (6) Final Remedial Action Manual - ORNL - 12/84. (EDB)

5

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

Role of the Statistician in the Decommissioning of the New Brunswick Laboratory and Other Nuclear Facilities

PNL-SA-9132 (1983, March)

This report examines what the statistician can contribute to decommissioning operations, with particular

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

emphasis on the New Brunswick Laboratory (NBL) currently scheduled for decommissioning beginning in FY81. The author believes that a professional statistician should be a full member of the planning team directing decommissioning operations at the New Brunswick Laboratory. This opinion is based, in part, on the familiarity with the valuable contributions made by statisticians toward the cleanup of transuranics in soil on the Enewetak Atoll. More generally, however, the professional statistician can help plan the decommissioning effort to help ensure that representative data are obtained, analyzed, and interpreted in appropriate ways so that remedial action decisions can be made with the required confidence. The statistician's contributions at the NBL could include providing guidance on the number and location of samples and in situ measurements, analyzing and interpreting these data, designing a data management and documentation system, interfacing with the certification contractor's statistician, and assisting in writing documentation and final reports. In all cases, the statistician should work closely with the professional health physicist and others on the planning team in a closely coordinated effort of planning and data analysis. (EDB)

6

Gould, T.H., Jr., Savannah River Laboratory, Aiken, SC

Restart of Hanford K Reactor as Alternative to Restart of L Reactor at SRP

DPST-83-667; 4 pp. (1983, July 13)

As part of the decision process and environmental review associated with the restart of L-Reactor, possible alternative actions to provide the needed additional capacity for defense nuclear materials are being reviewed and compared with the proposed action - resumption of L-Reactor operation at the Savannah River Plant (SRP) by 1984. One such alternative would be to restart one of the retired K Reactors, KE or KW, at the Hanford Site. This report addresses the viability of this option in relation to the proposed action. Restarting one of the Hanford K-Reactors is not a viable alternative to resuming operation of L-Reactor at SRP. The two K-Reactors have been officially retired, are being dismantled, and are scheduled for decontamination and decommissioning. Upgrading one of the K-Reactors for resumed operation would take at least five years and would cost two to three times more than the renovation of L-Reactor, which is almost completed. (EDB)

7

Heine, W.F., and C.A. Barrington, Rockwell Hanford Operations, Richland, WA

Rockwell Hanford Operations Surplus Facilities Surveillance and Maintenance Plan

RHO-RE-PL-10-P; 223 pp. (1983, June)

The Surplus Facilities Management Program Office (SFMPO) has established a requirement for formal documentation of the surveillance and maintenance of retired, radioactively contaminated U.S. Department of Energy facilities. This report provides the documentation for those contaminated retired facilities under the management and control of Rockwell Hanford Operations at the Hanford Site. The plan provides: individual facility condition, history, and radiological characteristics; descriptions of access controls; routine surveillance procedures, frequencies, and documentation requirements; routine maintenance items and frequencies; and surveillance and maintenance costs applicable to each facility. Program costs of surveillance and maintenance activities, excluding major repairs, program management, and engineering support, were estimated to be $1, 074,000 for fiscal year 1983. (Auth)(BDC)

8

Kanehiro, B.Y., and V. Guvanasen, Lawrence Berkeley Laboratory, Berkeley, CA

Assessment and Evaluation of Engineering Options at a Low-Level Radioactive Waste Storage Site

LBL-13600; Earth Sciences Division Annual Report for 1981; (pp. 35-38) (1982, September)

This report summarizes work done at the Weldon Spring radioactive waste storage site. The primary purpose of this work has been to seek solutions to hydrologic and geotechnical problems associated with existing disposal sites and to evaluate the efficiency of engineering options that have been proposed to improve the integrity of such sites. The Weldon Spring site is generally like other low-level nuclear waste sites, except that the wastes are primarily in the form of residues and contaminated rubble from the processing of uranium and thorium ores rather than industrial isotopes or mill tailings. (EDB)

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

9

Kennedy, W.E., and B.A. Napier, Pacific Northwest Laboratory, Richland, WA

Allowable Residual Contamination Levels for Decommissioning the 115-F and 117-F Facilities at the Hanford Site

PNL-4704; 78 pp. (1983, July)

This report contains the results of a study sponsored by UNC Nuclear Industries to determine Allowable Residual Contamination Levels (ARCL) for the 115-F and 117-F facilities at the Hanford Site. The purpose of this study is to provide data useful to UNC engineers in conducting safety and cost comparisons for decommissioning alternatives. The ARCL results are based on a scenario/exposure-pathway analysis and compliance with an annual dose limit for three specific modes of future use of the land and facilities. These modes of use are restricted, controlled, and unrestricted. Information on restricted and controlled use is provided to permit a full consideration of decommissioning alternatives. Procedures are presented for modifying the ARCL values to accommodate changes in the radionuclide mixture or concentrations and to determine instrument responses for various mixtures of radionuclides. Finally, a comparison is made between existing decommissioning guidance and the ARCL values calculated for unrestricted release of the 115-F and 117-F facilities. The comparison shows a good agreement. (EDB)

10

Kennedy, W.E., and B.A. Napier, Pacific Northwest Laboratory, Richland, WA

Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site

PNL-4722; 133 pp. (1983, July)

This report contains the results of a study sponsored by UNC Nuclear Industries to determine Allowable Residual Contamination Levels (ARCL) for five generic categories of facilities in the 100 Areas of the Hanford Site. The purpose of this study is to provide ARCL data useful to UNC engineers in conducting safety and cost comparisons for decommissioning alternatives. The ARCL results are based on a scenario/exposure-pathway analysis and compliance with an annual dose limit for three specific modes of future use of the land and facilities. These modes of use are restricted, controlled, and unrestricted. The information on ARCL values for restricted and controlled use provided by this report is intended to permit a full consideration of decommissioning alternatives. ARCL results are presented both for surface contamination remaining in facilities (in dpm/100 sq cm), and for unconfined surface and confined subsurface soil conditions (in pCi/g). Two confined soil conditions are considered: contamination at depths between 1 and 4 m, and contamination at depths greater than or equal to 5 m. A set of worksheets is presented in an appendix for modifying the ARCL values to accommodate changes in the radionuclide mixture or concentrations, to consider the impacts of radioactive decay, and to predict instrument responses. Finally, a comparison is made between the unrestricted release ARCL values for the 100 Area facilities and existing decommissioning and land disposal regulations. For surface contamination, the comparison shows good agreement. For soil contamination, the comparison shows good agreement if reasonable modification factors are applied to account for the differences in modeling soil contamination and licensed low-level waste. (EDB)

11

Kennedy, W.E., B.A. Napier, and J.K. Soldat, Pacific Northwest Laboratory, Richland, WA

Allowable Residual Contamination Levels in Soil for Decommissioning the Shippingport Atomic Power Station Site

PNL-4801; 50 pp. (1983, September)

As part of decommissioning the Shippingport Atomic Power Station, a fundamental concern is the determination of Allowable Residual Contamination Levels (ARCL) for radionuclides in the soil at the site. The ARCL method described in this report is based on a scenario/exposure-pathway analysis and compliance with an annual dose limit for unrestricted use of the land after decommissioning. In addition to naturally occurring radionuclides and fallout from weapons testing, soil contamination could potentially come from five other sources. These include operation of the Shippingport Station as a pressurized water reactor, operations of the Shippingport Station as a light-water breeder, operation of the nearby Beaver Valley reactors, releases during decommissioning, and operation of other nearby indus-

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

tries, including the Bruce-Mansfield coal-fired power plants. ARCL values are presented for 29 individual radionuclides and a worksheet is provided so that ARCL values can be determined for any mixture of the individual radionuclides for any annual dose limit selected. In addition, a worksheet is provided for calculating present time soil concentration value that will decay to the ARCL values after any selected period of time, such as would occur during a period of restricted access. The ARCL results are presented for both unconfined (surface) and confined (subsurface) soil contamination. The ARCL method and results described in this report provide a flexible means of determining unrestricted-use site release conditions after decommissioning the Shippingport Atomic Power Station. (EDB)

12
Large, A.J.

First Nuclear Plant, Grown Old, Prepares to Meet its Wrecker

Wall Street Journal, December 16, 1983 (1983, December 16)

The DOE's plans to decommission the first nuclear power plant, located at Shippingport, Pennsylvania, are discussed. The old plant will be torn down and hauled away, the seven-acre site smoothed over, and spent fuel sent to a government installation in Idaho. It is hoped that the actions will demonstrate that power reactors can be decommissioned safely and at a reasonable cost. (BDC)

13
Mickelson, J.R., UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Surplus Facilities Management Program Priority Listing

RLO/SFM-81-9; 49 pp. (1981, December)

Approximately 500 nuclear facilities under the jurisdiction of the U.S. Department of Energy (DOE) have, to date, been retired from service and assigned to the DOE Surplus Facilities Management Program (SFMP) for supervision and eventual decommissioning. Since funding for the disposition of these facilities is limited, a methodology was needed to assist in setting decommissioning priorities. This report presents a defensible methodology for establishing such a priority listing. Factors used in the methodology were: potential for an offsite radiological release, potential for an onsite radiological release, continued maintenance and surveillance costs, compatibility of the project with planned use of the site, and local government, social, and economic concerns. Since decommissioning funds are allocated from both commercial and defense funding sources, two separate priority lists were generated and are presented in Appendix B. (Auth)(EST)

14
Miller, R.L., UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects Program Plan

NUREG/CR-2522 (Rev. 1); 30 pp. (1983, December)

The 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 the 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 implementation of future decommissioning proposals. The program is currently limited to nuclear reactors, and 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)(CAJ)

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

15

Myrick, T.E., R.W. Schaich, and J.R. DeVore, Oak Ridge National Laboratory, Oak Ridge, TN

Metal Recovery Facility Decommissioning Project Plan

ORNL/TM-9018; 125 pp. (1984, April)

The Metal Recovery Facility (MRF) was a pilot and small-scale production reprocessing plant, operated during the 1950's. The facility was primarily used to recover fuel and other nuclear materials from a variety of low-burning feed materials. Since facility shutdown, the MRF has been maintained in a protective storage mode. Due to the facility radionuclide inventory and the building's deteriorating structural condition, the decommissioning of the MRF has been given high priority. This project plan has been prepared to satisfy the program documentation requirements for Surplus Facilities Management Program planning. The plan outlines the scope of the proposed effort, describes the proposed method of project accomplishment, and provides estimates of the project resource needs and schedule. (Auth) (BDC)

16

Myrick, T.E., R.W. Schaich, and F.V. Williams, Oak Ridge National Laboratory, Operations Division, Oak Ridge, TN

Fission Product Development Laboratory Cell Decommissioning Project Plan

ORNL/TM-8779; 123 pp. (1983, August)

The Fission Product Development Laboratory (FPDL) at Oak Ridge National Laboratory (ORNL) operated at full capacity from 1958 to 1975 as a full-scale processing facility for separating megacurie quantities of Sr-90, Cs-137, and Ce-144 for a variety of source applications. Since facility shutdown, the inactive portions of the FPDL have been maintained in a protective storage mode as part of the ORNL Surplus Facilities Management Program. Because of the significant radionuclide inventory remaining in the facility, the high surveillance and maintenance costs necessary to ensure radionuclide containment, and the potential for reuse of the facility by other programs, the decommissioning of the inactive portions of the FPDL has been given a high priority. Plans are being made for initiation of these activities in late FY 1983. This project plan has been prepared to satisfy the progr . documentation requirements for planning. The plan outlines the scope of the proposed effort, describes the proposed methods of project accomplishment, and provides estimates of the project resource needs and schedule. (Auth)

17

National Lead Company of Ohio, Cincinnati, OH

Study of Radioactive Waste Storage Areas at ERDA-Weldon Spring Site

NLCO-1144 (Special); 52 pp. (1977, April)

The ERDA-Weldon Spring operation comprises two separate sites approximately four miles apart. Because each site is distinct in functions, characteristics, and problems, each must be assessed separately. Part I of the report deals solely with the approximately 52 a remaining in ERDA possession from the original Atomic Energy Commission Weldon Spring Production Center. Its major point of interest and concern is the four "raffinate" pits containing settled radioactively contaminated sludges. Part II assesses the Quarry, an abandoned rock quarry formerly used for disposal of radioactively contaminated building rubble and residues. The wastes stored at each site are described, and monitoring data from water samples are presented in tables. Recommendations are given for decommissioning, reprocessing, site surveillance, and monitoring. (MFB)

18

National Lead Company of Ohio, Cincinnati, OH

Study of Radioactive Waste Storage Areas at ERDA-Niagara Falls Site

NLCO-1145 (Special); 34 pp. (1977, April)

The ERDA-Niagara Falls site originally was part of the Lake Ontario Ordnance Works (LOOW). The Department of Defense decommissioned LOOW in 1948 and disposed of most of the site. The report presents details of the site, facilities, operating practices, and recommendations. Results of the logs of selected borings and chemical analyses of well and stream water are presented in tables. It was concluded that the geology and hydrology of the site are suitable for the existing methods of storage of the radioactive waste in buildings and other enclosed structures. Confinement of these radionuclides should not present major problems The ground surface stored or buried material could cause radioactive contamination of surface water runoff and subsurface water tables if adequate drainage of the storage areas is not maintained. (MFB)

19

General Electric Has Won the $60 to $70 Million Decommissioning Contract

Nucleonics Week 24(43):5 (1983, October 27)

The decommissioning contract for the Shippingport reactor has been awarded to General Electric, in conjunction with Morrison-Knudsen as the integrating subcontractor. General Electric has responsibility for dismantling the defueled plant, disposing of parts, and restoring the site to its original condition. (BDC)

20

U.S. General Accounting Office, Washington, DC

Decommissioning Retired Nuclear Reactors at Hanford Reservation

GAO Report B-211412 (1983, April 15)

The U.S. Department of Energy's (DOE's) strategy for decommissioning eight retired plutonium production reactors at its Hanford Reservation in Washington is evaluated. DOE may be overlooking two issues vital to selecting the most cost-effective decommissioning option: the long-term future of Hanford and its suitability as a permanent disposal site for radioactive wastes resulting from dismantlement of one or more of the reactors. DOE's Richland Operations Office has determined that the 100-F reactor building has deteriorated to the point where DOE must take some protective action to prevent radioactivity contained in the reactor from posing a threat to public health and safety. Total costs of dismantling all eight retired reactors - a measure which may be required if DOE intends to permit general public use of the site - could exceed $175 million. If DOE intends to maintain long-term federal control of Hanford, or use it for nuclear activities, a less costly decommissioning strategy that adequately protects the public health may be more appropriate. (Auth)

21

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

Surplus Facilities Management Program - Program Plan, FY 1984-1988

RL/SFM-83-12 (Vol. 1); 130 pp. (1983, October)

This program plan is the principal control document issued by the U.S. Department of Energy's Surplus Facilities Management Program (SFMP). It is formally revised each fiscal year primarily to address sequential five-year planning periods; however, it may be revised more frequently to provide long-range program planning updates and current administrative and procedural information. The first issue of the plan, RLO/SFM-79-2 (issued 10/79), was published as a single volume and covered the period FY 1980-1984. The current issue, addressing FY 1984-1988, is divided into three volumes. Volume 1 presents SFMP administrative policies, guidelines, and procedures. Program participants are expected to comply with the requirements and instructions set forth in this document, as well as all referenced regulations, criteria, standards, etc. It is not intended that SFMP administrative policy supersede the normal programmatic responsibilities of the participating field offices. Volume 1 consists of nine chapters: Chapter 1, Introduction; Chapter 2, Program Administration; Chapter 3, Public Information; Chapter 4, Facility Acceptance and Transfer; Chapter 5, Maintenance and Surveillance; Chapter 6, Project Priorities; Chapter 7, Technology Development; Chapter 8, NEPA Compliance; and Chapter 9, Project Planning. A list of abbreviations referencing SFMP participating organizations, project sites, and facility designations, and a glossary of terms are also provided in Volume 1. (Auth)(BDC)

22

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

Surplus Facilities Management Program - Program Plan (Civilian), FY 1984-1988

RL/SFM-83-12 (Vol. 2); 362 pp. (1983, October)

This is the second of three volumes of the FY 1984-88 SFMP Program Plan. This volume outlines the civilian D&D Program Work Breakdown Structure, and identifies and describes the tasks/projects currently planned for the accomplishment of SFMP near-term objectives. It also includes five appendices of supplemental information on the FY 1984-88 Civilian D&D Program budget, project/facility inventory, site descriptions, long range schedule, and waste volume projections. Volume 1 presents SFMP administrative policies, guidelines, and procedures. Volume 3 addresses the Defense D&D Program. (Auth)

23

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

Surplus Facilities Management Program - Program Plan (Defense), FY 1984-1988

RL/SFM-83-12 (Vol. 3); 311 pp. (1983, October)

The third of three volumes of the FY 1984-88 Surplus Facilities Management Program (SFMP) Program Plan, this volume outlines the defense D&D Program Work Breakdown Structure, and identifies and describes the tasks/projects currently planned for the accomplishment of SFMP near-term objectives. It also includes five appendices of supplemental information on the FY 1984-88 Civilian D&D Program budget, project/facility inventory, site descriptions, long range schedule, and waste volume projections. Volume 1 presents SFMP administrative policies, guidelines, and procedures. Volume 2 addresses the Civilian D&D Program. (Auth) (CAJ)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

24
Bechtel National, Inc., Advanced Technology Division, Oak Ridge, TN

Engineering Evaluation of Alternatives for the Disposition of the Weldon Spring Raffinate Pits Site

DOE/OR/20722-5; 295 pp. (1984, April)

This report evaluates the Weldon Spring Raffinate Pits (WSRP) site in Weldon Spring, Missouri, as a potential location for permanent storage of the low-level radioactive waste. Engineering, occupational radiation exposure, design and construction schedule, manpower, maintenance and surveillance, and cost details are presented. Three options are considered: (1) no action, (2) retain and manage the WRSP Site as a long-term waste management facility, and (3) decontaminate and release the site for other use. No conclusions were drawn. (BDC)

25
Bechtel National, Inc., Advanced Technology Division, Oak Ridge, TN

Geologic Report - Niagara Falls Storage Site, Lewiston, New York

DOE/OR/20722-8; 310 pp. (1984, June)

The Niagara Falls Storage Site (NFSS) is a U.S. Department of Energy surplus facility located in Lewiston Township, Niagara County, New York. The 77-ha (191-acre) site is a small portion of the original Lake Ontario Ordnance Works (LOOW) and was formerly used for uranium ore processing and radioactive waste storage and trans-shipment. An inventory of radioactive residues and wastes is stored at the NFSS. Some areas of the site have also become contaminated from previous burial and spills of contaminated materials, and from radionuclide migration along drainage pathways. The R-10 and South Dike Areas had been identified as planned locations for interim storage of contaminated materials from on-site and vicinity property cleanup activities; the Northern Disposal Area for the storage of a portion of the vicinity property cleanup, if required; and the K-65 Tower Area for temporary storage of residues from inside the tower. Planned storage facilities include shallow burial within a diked containment area. This report presents the results of a geological investigation by Bechtel which consisted of two phases. Phase 1 includes geologic mapping, geophysical surveys, and a limited drilling program in the vicinity of the R-10 Dike. Phase 2 included: excavation of test pits; geophysical surveys; drilling; observation well installation; and field permeability testing in the South Dike Area, the Northern Disposal Area, and the K-65 Tower Area. The purposes of the phase 1 investigation were to document the dike foundation materials and to report the existence of zones of potentially high permeability. The purposes of the phase 2 investigation were to determine whether the gray clay unit is continuous beneath the surficial brown clay unit at the NFSS and to extend the knowledge of site stratigraphy by expanding on data from previous investigations so that the suitability of the site for long-term storage of low-level radioactive wastes could be assessed. (Auth) (PTO)

26
Bills, C.W., General Public Utilities, Parsippany, NJ; Electric Power Research Institute, Palo Alto, CA; U.S. Nuclear Regulatory Commission, Washington, DC; U.S. Department of Energy, Washington, DC

SL-1 Recovery Experience

GEND-002 (Vol.1); CONF-7911104; Facility Decontamination Technology, Proceedings of a Workshop, Hershey, PA, November 27, 1979; (pp. O.1-O.24) (1979, November 27)

A pinhole camera was used to establish the spatial distribution of the radioactivity in the SL-1 reactor after the accident on January 3, 1961. The difficulties of photographing the top of the reactor are described. A shielded box was used in cutting in order to obtain access to the reactor. A shielded cherry picker and other equipment-shielding improvisations are described. (EDB)(DLC)

27
Denham, D.H., M.G. Barnes, and R.E. Jaquish, Pacific Northwest Laboratory, Richland, WA

A Guide for Radiological Characterization and Measurements for Decommissioning of U.S. Department of Energy Surplus Facilities

DOE/EP-0100; 220 pp. (1983, August)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

This guide provides an overview of the decommissioning process, the types of problems that may be encountered, and the general considerations relevant to planning decommissioning operations under these programs. It is specifically intended to address the decommissioning of DOE-owned excess facilities but it may also be helpful in planning decommissioning activities for other remedial action programs. Many types of excess facilities are involved in the DOE remedial action programs: uranium processing facilities, nuclear reactors, fuel reprocessing plants, nuclear material production plants, research laboratories, burial trenches, and waste storage and disposal facilities. The radiological contaminants which may be encountered among these facilities and their potential impacts can vary widely depending on the facility and its operating history. This guide does not address in detail the multitude of specific situations that might be encountered at the various facilities but provides general guidance for planning and managing decommissioning operations and situations mentioned above. (Auth) (BDC)

28

Flynn, K.F., A.L. Justus, C.M. Sholeen, W.H. Smith, and R.A. Wynveen, Argonne National Laboratory, Argonne, IL

Post-Remedial-Action Radiological Survey of the Westinghouse Advanced Reactors Division Plutonium Fuel Laboratories, Cheswick, Pennsylvania, October 1-8, 1984

DOE/EV-0005/36; ANL-OHS/HP-84-100; 84 pp. (1984, January)

A comprehensive post-remedial-action radiological assessment was conducted at the Westinghouse Advanced Reactors Division Plutonium Fuel Laboratories in Cheswick, Pennsylvania, to determine if any radioactive material contamination remained. Radiological assessment indicated that six areas of contamination existed in one of the buildings and three areas in the other. Further decontamination was conducted at four of the nine areas; radiation levels following the additional decontamination were below the appropriate surface contamination limit. Elevated levels of radioactivity were known to exist prior to the survey in two areas which were therefore not considered for unrestricted-use release. Contamination at the last three areas remained. Background exposure rates in Building 7 generally ranged from 9.4 to 10.1 uR/h. Radon daughter concentrations measured in air samples collected at selected locations in the buildings ranged from 0.15 to 1.2 milli-Working Level (mWL) and was 0.41 mWL in the Advanced Fuels Laboratory in Building 8. Concentrations of thoron daughters measured in the air samples were well below the concentration guide of 0.6 pCi/l for Thoron-B (Pb-212). No long-lived radionuclides were detected in any air sample. Radiochemical analyses of four dirt/sludge or water samples collected from Building 7 sanitary drain lines disclosed uranium, plutonium and americium contaminants. Ten soil corings and a sand and gravel sample from a storm sewer outfall showed Co-60 concentrations ranging up to 279 pCi/g. One coring indicated 6.4 pCi/g of enriched uranium, 315 fCi/g of plutonium and 160 fCi/g of americium, indicating release or spillage. Other radionuclide concentrations in the soil corings and storm sewer outfall samples were within the range of normally expected background concentrations. (Auth)(BDC)

29

Kaiser, L.L., R.L. Rolfe, B.J. Sneed, and E.L. Wills, Idaho National Engineering Laboratory, Idaho Falls, ID

Characterization of the Engineering Test Reactor Facility

EGG-PR-5784; 440 pp. (1982, September)

The physical and radiological conditions of the inactivated Engineering Test Reactor (ETR) facility are characterized. The 175-MW(t) light-water reactor was in service from 1957 to 1981 at the Idaho National Engineering Laboratory. The facility is described, radiological survey data and radioactively-contaminated and clean material volumes are given, potential hazards of the inactivated facility are identified, and a material volume summary is provided. Decommissioning methods are not addressed. Radiation survey results (in mR/hr) and contamination levels (in disintegrations per min) are given by building, room, or area. Material (waste) volumes are given that were calculated for in-place contaminated waste [151,036 cu ft]. Boxed and oversize contaminated waste volumes and meltable metal volumes are also given. Contaminated waste volumes are approximately 25% of the total ETR facility material volume. (GRA)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

30

Kasper, R.B., Rockwell Hanford Operations, Richland, WA

216-Z-12 Transuranic Crib Characterization: Operational History and Distribution of Plutonium and Americium

RHO-ST-44; 165 pp. (1982, November)

Past radioactive liquid waste disposal practices at the Hanford Site included the discharge of process waste solutions containing low-level concentrations of plutonium directly to the ground via underground structures collectively termed cribs. The spatial distribution of plutonium and americium beneath the retired 216-Z-12 Crib has been studied. The 216-Z-12 Crib received low-salt aqueous waste from 1959 to 1973, when the crib was retired from service. The crib received 2.8 X 10(E+8) liters of aqueous waste containing 25.1 kg of plutonium. Americium activity was determined to be derived from the in situ decay of Pu-241, not from a separate waste source. No other transuranic elements were discharged to the crib in any significant amounts. Wells were drilled in and around the crib using specialized techniques for obtaining radioactively contaminated sediment samples. Samples from each well are analyzed to determine sediment type, moisture content, and plutonium and americium concentrations. Study results show that plutonium concentration is highest (on the order of 1 to 5 million pCi/g of sediment) in the sediment immediately beneath the crib bottom. Plutonium concentrations decrease rapidly with distance from the bottom of the crib. Three meters below the crib, plutonium activity is less than 1000 pCi/g and 10 m below the crib, activity is less than 1 pCi/g. Plutonium activity increases to a few tens of picocuries per gram 30 to 36 m beneath the crib bottom. The activity is associated with a silt unit at that depth and is probably related to the silt unit's greater sorption capacity. Results from groundwater monitoring beneath the 216-Z-12 Crib indicate measurable concentrations of plutonium did not break through to the ground water. (EDB)

31

Korte, N.E., P.M. Kearl, J.M. Sewell, H.L. Fleischhauer, and I.N. Abramiuk, Bendix Field Engineering Corporation, Grand Junction, CO

The Monticello, Utah, Uranium Mill Tailings Site - A Case History

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 387-396) (1984, February)

A study was conducted to characterize the potential for contamination from the inactive millsite in Monticello, Utah. Emphasis was given to site geology, hydrology, and geochemistry for two reasons: a perennial stream flows through the tailings area, and a culinary aquifer is overlain by an alluvial aquifer contaminated by the tailings area. Study results indicated that surface-water contamination attributable to the piles exists for approximately 6 km downstream from the site. Contamination also exists in the alluvial aquifer underlying the millsite. Hydrologic studies indicate an active alluvial system, with recharge to the gravels by infiltration through the tailings. Water level and water quality data, together with the results of a 51-hr pump test, indicate that the Dakota Formation is an effective aquitard, restricting the downward movement of contaminated water to the underlying culinary aquifer. (Auth)

32

U.S. Department of Energy, Washington, DC

Extension of Comment Period for Scoping the Environmental Impact Statement for Long-Term Management of Existing Radioactive Wastes and Residues at the Niagara Falls Storage Site

Federal Register 48(38):7805-7806 (1983, February 24)

On February 1, 1983, the Department of Energy (DOE) published in the Federal Register, a Notice of Intent to prepare an Environmental Impact Statement (EIS) relative to the long-term management of radioactive wastes and residues currently stored at the Niagara Falls Storage Site (NFSS) in Lewiston, New York. The scoping comment deadline specified in 48 FR 4522 was February 25, 1983. On February 11, 1983, the New York State Department of Environmental Conservation requested that this deadline be extended until March 11, 1983. DOE has determined that the requested extension is reasonable. (Auth)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

33

U.S. Department of Energy, Washington, DC

DOE to Prepare EIS on the Long-Term Management of Existing Radioactive Materials at the Weldon Spring Raffinate Pits and the Weldon Spring Quarry, Missouri - Comment Deadline March 30, 1984

Federal Register 49(43):7851 (1984, March 2)

Two Department of Energy (DOE) sites in the vicinity of Weldon Spring, Missouri, contain radioactive materials as a result of activities conducted in support of federal programs. DOE is currently evaluating long-term management alternatives for the radioactive materials at these sites. In addition to engineering and cost considerations, DOE will factor consideration of potential environmental impacts into its decisions. DOE invites interested agencies, organizations, and members of the general public to submit comments or suggestions to assist them in identifying significant environmental issues and determining the appropriate scope of the EIS. (Auth)(LFG)

34

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

Environmental Protection Experience in AI's Decommissioning Programs

DOE/EV-0046 (Vol. 2); CONF-781109; Energy Environmental Control, Volume 2 - Nuclear Energy and Transportation, Proceedings of the U.S. Department of Energy Symposium, Washington, DC, November 28, 1978; (pp. 159-182) (1979, September)

In the past five years, the Atomics International Division has completed or has in the works for DOE the decommissioning of eight nuclear facilities ranging from a hot cave laboratory to the Sodium Reactor Experiment and a contaminated sanitary leach field. These are DOE-funded programs to remove all radioactive materials significantly in excess of background and to return the sites and facilities to unrestricted use. The radioactive materials involved are fission and activation products, occurring both as surface contaminants and integrated within structural materials. Contaminated soil was also identified and removed. The decommissioning activities were planned, engineered and performed so as to preclude detrimental impacts to the environment. During decommissioning, the operating areas were controlled to very low levels of surface contamination to prevent airborne contamination generation and prevent transfer from the site. Activities where the potential for contamination spread was great, required special controls and techniques to limit dispersal. The principal successful controls and techniques, as developed to meet the singular conditions of the decommissioning programs are: Na reaction exhaust gases condensing, venting, and hydrogen dilution; hot cell personnel air locks; thermal ring cut-up enclosure and exhaust; reactor vessel cut-up water shielding and water purification; surface decontamination with foam; concrete surface decontamination using scrubbers, sandblasting, and jack hammers in dust containments; bagging techniques for large components; dust control during excavation; and packaging and transportation controls for disposal by burial. (EDB)

35

Wynveen, R.A., W.H. Smith, C.M. Sholeen, M.C. Boggs, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Post-Remedial Action Survey Report for SNAP-8 Experimental Reactor Facility, Building 010 Site, Santa Susana Field Laboratories, Rockwell International, Ventura County, California

DOE/EV-0005/47; ANL-OHS/HP-84-102; 88 pp. (1984, April)

Between 1959 and 1965, two System for Nuclear Auxiliary Power (SNAP) space-type compact experimental reactors were tested in Building 010 at the Santa Susana Field Laboratories (SSFL) of Rockwell International's Energy Systems Group (ESG) in Ventura County, California. The first was a 50-kW SNAP-2 reactor, and the second was a 600-kW SNAP-8 reactor. In 1974, the SNAP-8 facility was declared excess to the government's program needs, and a decommissioning program was begun in 1976 that provided for complete removal of all radioactive materials remaining from the operation of the SNAP reactors. The Department of Energy (DOE) requested the Radiological Survey Group from Argonne National Laboratory (ANL) to conduct a post-remedial-action assessment (certification) survey of the facility. Because the area had been converted to an asphalt-paved parking area prior to the first visit by the survey team in 1979, the primary mode of assessment was subsurface investigation. However, the surface was also surveyed for alpha and beta-gamma, energy x and gamma, and ambient external penetrating radiation. Twenty-two boreholes were drilled through the asphalt pad. A NaI(Tl) scintillation detector was lowered into the boreholes to log the gamma-ray spectra at 2-ft intervals and split-spoon soil samples were removed from all of the holes in 1-ft increments. The gamma-ray spectral logging revealed Co-60 in the material adjacent to six of the holes. Gamma spectral and uranium fluorometric analysis of the soil indicated Co-60 in samples from eight of the holes, Eu-152 in samples from one hole, and uranium in samples from two holes. However, the measured concentrations of the radionuclides (up to 48 pCi/g Co-60, up to 0.8 pCi/g Eu-152, and up to 12.8 pCi/g uranium) were below guidelines for decontamination of the site (100 pCi/g gross detectable beta activity). The activity detected during the borehole logging appears to be from the activity in the soil. The origin of this activity was never determined but probably is the result of the activation of either the soil itself or the Building 010 construction material by the SNAP reactors. A second trip in 1981 was organized to drill additional boreholes. The results from these boreholes indicated that the activity was from the soil itself. (Auth)(NPK)

36

Wynveen, R.A., W.H. Smith, C.M. Sholeen, K.F. Flynn, and A.L. Justus, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Post-Remedial Action Survey Report for the Kinetic Experiment Water Boiler Reactor Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California, October 1981

DOE/EV-0005/45; ANL-OHS/HP-83-110; 64 pp. (1983, October)

The Kinetics Experiment Water Boiler (KEWB) Reactor was last operated in 1966. The facility was subsequently declared excess and decontamination and decommissioning operations were conducted during the first half of 1975. The facility was completely dismantled and the site graded to blend with the surrounding terrain. A post-remedial-action survey was conducted in 1981. This survey confirmed that the site was free from contamination and could be released for unrestricted use. (Auth)(BDC)

37

Wynveen, R.A., W.H. Smith, C.M. Sholeen, K.F. Flynn, and A.L. Justus, Argonne National Laboratory, Argonne, IL

Post-Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California, November 1979, May and October 1981, July and September 1982

DOE/EV-0005/46; ANL-OHS/HP-84-101; 112 pp. (1984, February)

During the operational life of the Sodium Reactor Experiment (SRE) Facility at the Santa Susana Field Laboratories, Ventura County, California, induced radioactivity was produced by neutron activation of surrounding material, and mixed fission products were released into the reactor primary sodium coolant system when a fuel element ruptured. After decontamination, a series of radiological measurements and analyses were conducted. During the surveys, 46 locations with elevated activity were detected. Twenty-seven of these had contamination in excess of acceptable limits. All of these areas were subsequently cleaned to below detectable limits. Radioactive contamination was found in the sanitary sewer and storm drain systems. The interior inaccessible surfaces of these systems were considered contaminated in accordance with statements in the NRC Regulatory Guidelines issued in July 1982. Effluent from the outfall of this drain system must also be considered as being potentially contaminated. (Auth)(BDC)

38

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Argonne, IL

Post-Remedial Action Survey Report for Building 003, Santa Susana Field Labora-

tories, Rockwell International, Ventura County, California, October 1981 to April 1982

DOE/EV-0005/44; ANL-OHS/HP-83-109; 65 pp. (1983, October)

One of the buildings on the Santa Susana Laboratories site, Building 003, contains a "hot cave" facility that was used in conjunction with the System for Nuclear Auxiliary Power (SNAP) Program conducted for the Atomic Energy Commission. The hot cave has been inactive since the closeout of the SNAP Program in 1973. Decontamination and decommissioning were done during 1975 and the building was given a preliminary release. A post-remedial-action survey of the hot cave facility showed residual contamination in various parts of the building necessitating additional decontamination work which was concluded in March 1982. A confirmatory post-remedial-action survey was conducted during April 1982. The results of this confirmatory survey indicated that both the interior and exterior of Building 003 were free of radioactive contamination. Sewer lines within the building were removed when sludge samples showed elevated levels of enriched uranium contaminant. This permitted unconditional release of the building for unrestricted use. However, the sewer lines exterior to the building, which remain in place, must be considered potentially contaminated and, therefore, subject to restricted use. (Auth)(BDC)(ARE)

39

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, K.F. Flynn, and P.W. Zelle, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of CEER Rio Piedras Facility, San Juan, Puerto Rico, June 15-25, 1982

DOE/EV-0005/42; ANL-OHS/HP-83-104; 62 pp. (1983, June)

In 1976, radiological survey and decontamination activities were conducted at the Puerto Rico Nuclear Center by personnel of the Center for Energy and Environment Research. In June 1982, the Argonne National Laboratory's Radiological Survey Group conducted a post-remedial-action survey. Results of that survey are reported in this document. Elevated radiation readings from residual radioactive material were measured at four locations. Three of these were cleaned up to the point that no contamination was detectable. The fourth location was on the second floor of the biomedical building above a shielded enclosure in which radioactive materials could be handled with remotely controlled manipulators. The enclosure contained a quantity of molybdenum-99. It was recommended that the second and third floors and roof of the biomedical facility and associated facilities be released for unrestricted use. At the time of the survey, use of radiation sources continued in other areas of the building. (Auth)(BDC)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

40

Parrott, J.R., Oak Ridge National Laboratory, Chemical Technology Division, Oak Ridge, TN

The Decontamination of Concrete Surfaces in Building 3019, Oak Ridge National Laboratory, Draft Report

CONF-800542; Concrete Decontamination, Proceedings of a Workshop, Seattle, WA, May 28-29, 1980; (pp. 15-19) (1980, May 28-29)

Building 3019 was constructed in 194^ to serve as a pilot plant for the separation of a variety of isotopes from irradiated fuels and has operated almost continuously through 21 different programs. A chemical explosion led to widespread plutonium contamination to the facility and surroundings. Results of extensive decontamination procedures led to the conclusion that surface treatment of concrete during construction would greatly facilitate decontamination. It is suggested that walls be finished with hard enamel and floors with fiberglass or epoxy paint in areas of high probability of contamination or with vinyl sheet or tile in areas of lower probability of contamination. (BDC)

41

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

Decontamination of the Curium Source Fabrication Facility

CONF-821103; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 14, 1982; (6 pp.) (1982)

The Curium Source Fabrication Facility (CSFF) at Oak Ridge National Laboratory (ORNL) was decontaminated to acceptable contamination levels for maintenance activities, using standard decontamination techniques. Solid- and liquid-waste volumes were controlled to minimize discharge to the ORNL waste systems. This program required two years of decontamination effort at a total cost of $580K. (EDB)

42

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

Final Report on the Decontamination of the Curium Source Fabrication Facility

ORNL/TM-8376; 35 pp. (1983, December)

The Curium Source Fabrication Facility at Oak Ridge National Laboratory (ORNL) was decontaminated to acceptable contamination levels for maintenance activities, using standard decontamination techniques. Solid and liquid waste volumes were controlled to minimize discharges to the ORNL waste systems. This program required two years of decontamination effort at a total cost of approximately $700,000. (Auth)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

43

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

SRE Underwater Plasma Arc Cutting Development Test Report

N704TR990-005; 58 pp. (1976, June 10)

A demonstration tank plasma arc cutting system composed of an ORNL plasma arc console, a Linde plasma torch, a high frequency generator, power supplies, KAT torch positioner, torch water cooler, and demonstration tank was tested. Underwater plasma arc cutting parameters for SRE vessel segmentation are presented along with process parameter ranges and trends. (ARE)

44

Tuttle, R.J., W.D. Kittinger, C.C. Conners, and J.P Page, Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Successful Control Measures for Hazardous Materials in Decommissioning Nuclear Facilities

Transactions of the American Nuclear Society 46:65-66; CONF-840614; Proceedings of an American Nuclear Society Annual Meeting, New Orleans, LA, June 3-7, 1984; (pp. 65-66) (1984, June)

A number of control measures have been used by Rockwell International in the past 10 years during decommissioning projects to prevent mobilization of hazardous materials in the environment during D&D and waste disposal operations. The variety of aerosol generating processes for which control were employed include: plasma arc, explosive and oxyacetylene cutting; concrete scabbling; sawing and bulk removal techniques; vacuum and compressed air cleaning; chemical passivation and decontamination processes; and various other dismantling, surface removal, system cleaning, and decontamination processes. The major tasks for which potentially hazardous material controls were employed during the decommissioning of the Sodium Reactor Experiment at the Santa Susana Field Laboratories, Canoga Park, California include: dismantling the reactor vessel system; sectioning the reactor thermal ring components; dismantling asbestos insulation from the reactor vessel system and coolant systems; explosive cutting of reactor vessel internal piping; removing sodium residues from coolant and reactor vessel systems; sectioning coolant system piping; removing contaminated surface and bulk concrete; and handling and packaging of the contaminated wastes. (PTO)

45

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Issues Order Authorizing Dismantling of Rockwell International Corporation (License No. R-118) L-85 Nuclear Examination Reactor in Ventura County, California

Federal Register 48(44):9409-9410 (1983, March 4)

In an application dated March 10, 1980, amended by a letter dated December 14, 1982, Rockwell International requested authorization to dismantle its L-85 Nuclear Examination Reactor, located at the Santa Susana Field Laboratory, Ventura County, California, and to dispose of the component parts in accordance with the plan submitted as part of the application. The NRC has reviewed the application and found that the dismantling and disposal of component parts will be in accordance with 10 CFR Chapter I, and will not be inimical to the common defense and security or to the health and safety of the public. The NRC has determined that an environmental impact statement need not be prepared. (Auth)(PTO)(EST)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM SITE STABILIZATION AND RECLAMATION

46

Bradford, J.D., EG&G Idaho, Inc., Idaho Falls, ID

Decommissioning of the SPERT-3 Large Leach Pond at the Idaho National Engineering Laboratory

EGG-2306; 29 pp. (1984, April)

This report describes the decontamination and decommissioning of the SPERT-3 large leach pond. Prior to decontamination and decommissioning the pond basin was enclosed by a mesh and barbed wire fence. An 8-in. carbon steel discharge pipe ran from the SPERT-3 reactor building to the pond basin. The outlet of the discharge pipe rested on a concrete apron in the pond basin. The soil in the pond basin contained low-level radioactive contamination. The fence and apron were removed, radiologically surveyed, found to be uncontaminated, and sent to the sanitary landfill for disposal. The discharge pipe was left buried in place. The pond basin was backfilled with radiologically clean soil to reduce the surface activity to background. The area was then seeded with crested wheatgrass. A permanent marker was erected at the center of the pond basin to indicate the presence of subsurface radioactive contamination and the location of the buried discharge pipe. (Auth)

47

McKnight, R.K., C.E. Rosenberry, and J.A. Orcutt, Reynolds Electrical and Engineering Company Inc., Las Vegas, NV

Nevada Test Site Area 25 - Radiological Survey and Cleanup Project, 1974-1983, Final Report

DOE/NV/10327-5; 81 pp. (1984, January)

This report describes radiological survey, decontamination and decommissioning of the Nevada Test Site (NTS) Area 25 facilities and land areas incorporated in the Nuclear Rocket Development Station (NRDS). Buildings, facilities and support systems used after 1959 for nuclear reactor and engine testing were surveyed for the presence of radioactive contamination. The cleanup was part of the Surplus Facilities Management Program funded by the Department of Energy's Richland Operations Office. The radiological survey portion of the project encompassed portable instrument surveys and removable contamination surveys (swipe) for alpha and beta plus gamma radiation contamination of facilities, equipment and land areas. Soil sampling was also accomplished. The majority of Area 25 facilities and land areas have been returned to unrestricted use. Remaining radiologically contaminated areas are posted with warning signs and barricades. (EDB)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

48

Carroll, J.W., C.C. Conners, J.M. Harris, J.M. Marzec, and B.F. Ureda, Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Sodium Reactor Experiment Decommissioning, Final Report

ESG-DOE-13403; 231 pp. (1983, August 15)

Decommissioning of the Sodium Reactor Experiment (SRE) located at Rockwell International Field Laboratories northwest of Los Angeles began in 1974 with the objective of removing all significant radioactivity from the site and releasing the facility for unrestricted use. The site consisted of the main reactor building, support buildings, and facilities. Planning documentation was prepared that described in detail the equipment and techniques development and the decommissioning work scope. The documentation defined the decommissioning in an SRE dismantling plan, in activity requirements for elements of the decommissioning work scope, and in detailed procedures for each major task. The decommissioning operations generated 136,411 cu ft of radioactive waste, which was sent to a burial site. A final radiological survey was conducted to verify that the SRE site had been decontaminated to levels that would allow unrestricted use of the facility. Physical activities at the SRE ended in September 1982. (Auth)(BDC)

49

Commander, J.C., L. Lewis, and R. Hammer, Aerojet Nuclear Company, Idaho Falls, ID

Decontamination and Decommissioning of the EBR-I Complex - Topical Report 3: NaK Disposal Pilot Plant Test

ANCR-1170; 24 pp. (1975, June)

Decontamination and decommissioning of the Experimental Breeder Reactor No. 1 (EBR-I) requires processing of the primary coolant [an eutectic solution of sodium and potassium (NaK)] remaining in the EBR-I primary and secondary coolant systems. While developing design criteria for the NaK processing system, reasonable justification was provided for the development of a pilot test plant for field testing some of the process concepts and proposed hardware. The objective of this activity was to prove the process concept on a low-cost, small-scale test bed. The pilot test plant criteria provided a general description of the test including: the purpose, location, and description of test equipment available, waste disposal requirements, and a flow diagram and conceptual equipment layout. The pilot plant test operations procedure provided a detailed step-by-step procedure for operation of the pilot plant to obtain the desired test data and operational experience. It also spelled out the safety precautions to be used by operating personnel, including the requirement for alkali metals training certification, use of protective clothing, availability of fire protection equipment, and caustic handling procedures. The pilot plant test was performed on May 16, 1974. During the test, 32.5 gal, or 240 lb, of NaK was successfully converted to caustic by reaction with water in a caustic solution. (Auth)(NSA)(CAJ)

50

Conners, C.C., and L. Lanni, Atomics International Division, Rockwell International, Energy Systems Group, Canoga Park, CA

Power Plant Decommissioning Successfully Demonstrated on the Sodium Reactor Experiment

American Society of Mechanical Engineers 83-JPGC-NE; CONF-830905; Proceedings of the Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; (6 pp.) (1983)

The completion of the Sodium Reactor Experiment (SRE) decommissioning project provides further evidence that nuclear power plants can be decommissioned safely and for reasonable costs. The SRE project is defined and the major decommissioning activities and accomplishments are discussed. All decommissioning activities were accomplished without major problems, and while some development work was required, no new "inventions" were needed. During the decommissioning there was no measurable radiation exposure to the surrounding public and radiation exposures to the project crews were well below allowable criteria. The cost for decommissioning is approximately 10% of the current cost to build a duplicate facility. The site and facilities have been restored for future, unrestricted use. (EDB)(EST)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

51

Kaiser, L.L., EG&G Idaho, Inc., Idaho Falls, ID

Decontamination and Decommissioning MTR-657 Plug Storage Facility

EGG-2286; 15 pp. (1984, January)

The MTR-657 Plug Storage Facility consists of 32 horizontal shielded storage holes. Two of these holes contained contaminated hardware with high radiation fields. The decontamination and decommissioning (D&D) mode selected for the facility was removal of the contaminated hardware and decontamination of several of the storage holes to lower contamination levels. Special shielded disposal containers were constructed to allow removal and transport of the radioactive hardware without exposing personnel to high radiation fields. After removal of the hardware, long-handled mops and brushes were used to decontaminate the storage holes. In addition to describing D&D operations and the final facility condition, project cost and schedule information is reported. (Auth)

52

Link, B.W., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects, Summary Report, Ames Laboratory Research Reactor

NUREG/CR-3336; 49 pp. (1983, July)

This document summarizes the available information concerning the decommissioning of the Ames Laboratory Research Reactor, a 5-MW heavy water moderated and cooled research reactor. A computerized information retrieval/manipulation system permits future utilization of the data for comparative analysis. The information is presented in detail both as computer output and also as a manually assembled summarization which highlights the more important aspects of the decommissioning program. (Auth)(BDC)(ARE)

53

Lunis, B.C., Aerojet Nuclear Company, Idaho Falls, ID

Removal of the Materials Test Reactor Overhead Working Reservoir

ANCR-1257; 24 pp. (1975, October)

Salient features of the removal of an excessed contaminated facility, the Materials Test Reactor (MTR) overhead working reservoir (OWR) from the Test Reactor Area to the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory are described. The 125-ton OWR was an overhead 160,000-gal-capacity tank approximately 193 ft high which supplied cooling water to the MTR. Radiation at ground level beneath the tank was 5 mR/hr and approximately 600 mR/hr at the exterior surface of the tank. Sources ranging from 3 R/hr to in excess of 500 R/hr exist within the tank. The tank interior is contaminated with uranium, plutonium, and miscellaneous fission products. The OWR was lowered to ground level with the use of explosive cutters. Dismantling, decontamination, and disposal were performed by Aerojet Nuclear Company maintenance forces. (Auth)(NSA)

54

McConnon, D., United Power Association, Minneapolis, MN

Experiences in Decommissioning the Elk River Reactor

Transactions of the American Nuclear Society 46:65; CONF-840614; Proceedings of an American Nuclear Society Annual Meeting, New Orleans, LA, June 3-7, 1984; (p. 65) (1984, June)

This is an overview of the removal operations and radiological conditions during the dismantlement of the Elk River Reactor, a 58-MW(t) boiling water reactor, located at Elk River, Minnesota. The facility was successfully dismantled beginning in 1972. This was the first time a nuclear power reactor had been completely dismantled. Following removal and disposal of the highly radioactive structures, about 1400 cu yd of contaminated concrete were packaged and disposed of after being reduced to rubble by controlled explosions. During dismantlement, a total dose of 75 rem was received by about 100 people for an average dose exposure of about 0.8 rem/individual. The maximum total dose calculated was was 4.5 rem. (Auth)(PTO)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

55

Smith, D.L., and C.J. Wisler, EG&G Idaho, Inc., Idaho Falls, ID

Decontamination and Decommissioning of the TAN/TSF-3 Concrete Pad - Fin .l Report

EGG-2292; 28 pp. (1984, April)

This report describes the decontamination and decommissioning (D&D) of the TAN/TSF-3 concrete pad at the Idaho National Engineering Laboratory (INEL). This pad became contaminated in the 1960s and had been roped off until the 1983 decommissioning. The report includes radiological characterization of the pad area before D&D, after D&D, and after backfilling and grading. To accomplish the selected alternative of completely removing the concrete and contaminated soil, the pad was sawed into sections, and the concrete and surrounding soil were boxed and shipped to the Radioactive Waste Management Complex for burial. The excavated area was then backfilled and graded. Soil samples that were collected and analyzed as well as radiation fields measured after D&D, yielded results that permit the area to be released to INEL for equipment storage, or some other appropriate use. (Auth)(EST)(CAJ)

56

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

Practical Technological Benefits of SRE Decommissioning

American Society of Mechanical Engineers 83-JPGC-NE; CONF-830905; Proceedings of the Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; (6 pp.) (1982)

The decommissioning of the Sodium Reactor Experiment is essentially complete. Contaminated materials, equipment, and soil were removed, decreasing the residual radioactivity to levels acceptable for future unrestricted use of the site. The fuel was removed and declad, tooling and techniques to support the decommissioning were developed, bulk sodium and residual sodium films were removed, coolant systems were dismantled, the reactor vessel was dissected, the interior surfaces of the facilities were decontaminated, and waste materials were packaged and shipped to burial sites. Radiation exposure to workers and the public was within the guidelines and as low as reasonably achievable. In performing the project, new decontamination techniques were tested, decontamination equipment was evaluated, and waste disposal methods were developed. (EDB)

57

Ureda, B.F., and W.F. Heine

Hallam Nuclear Power Facility Retirement

CONF-691009; Reactor Operating Experience, Proceedings of a Conference, San Juan, Puerto Rico, October 1-3, 1969; Transactions of the American Nuclear Society 12:53-54 (1969, October)

The sodium-cooled, graphite-moderated reactor in the Hallam, Nebraska, Nuclear Power Facility went critical in 1962 and was shut down in September 1964 when moderator elements became defective. General requirements for the retirement program included: the removal of all fuel from the site; removal of all bulk sodium; chemically react residual sodium; disposal of all radioactive residues; decontamination of all above-grade system components; and prevention of release of contamination from and physical access to any subsurface volumes. A retirement plan with activity specification, which delineated the discrete retirement tasks and detailed procedures, was prepared. (BDC)

58

Walls, A.A., W.G. Tatum, T.E. Myrick, and S.P. du Mont, Oak Ridge National Laboratory, Operations Division, Oak Ridge, TN; Union Carbide Corporation, Engineering Division, Oak Ridge, TN

The Intermediate-Level Waste Transfer Line Decommissioning Project, Final Report

ORNL/TM-8897; 65 pp. (1983, December)

The Intermediate-Level Waste (ILW) transfer line at Oak Ridge National Laboratory (ORNL) was an integral part of the liquid radioactive waste disposal system, operating from 1952 until 1975. This line was used to transport ILW from the waste processing facilities in the

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

Bethel Valley area at ORNL to final disposal sites in adjacent Melton Valley. During the history of pipeline operations, about 45 million gallons of liquid waste, containing over 1.5 million curies of mixed fission products, were transferred through the line to waste disposal trenches and to the ORNL hydrofracture facility. Use of the line was discontinued in 1975 when a new, doubly contained line was installed to service the expanded hydrofracture program. Because of the presence of contaminated soil at two former leak sites along the line and the potential for radionuclide migration from that portion of the abandoned line that traverses White Oak Creek and the floodplain, decommissioning of the ILW line was given a high priority. Decommissioning activities have been completed. The portion of the line in the White Oak Creek floodplain was removed and the two leak sites entombed. This report presents the results of the project, the scope of the effort, the decommissioning experiences, and a summary of project costs and schedules. (Auth)(BDC)(CAJ)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

59

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

DOE Decontamination and Decommissioning Program Experiences

UNI-SA-118; CONF-8311105; Defense Waste Management, Proceedings of a DOE/CEA Meeting, Knoxville, TN, November 9, 1983; (28 pp.) (1983, November 9)

Approximately 475 U.S. government-owned facilities used in national defense and energy development programs have been shutdown and declared excess to present needs. These facilities include nuclear reactors, fuel reprocessing plants, waste treatment systems, laboratory facilities, and liquid and solid waste disposal grounds. Many of the facilities contain large quantities of man-made radioactive materials. Some of the facilities were constructed in the early 1940's, and have been deteriorating since their shutdown up to 20 years ago. Maintenance of these facilities has been performed to assure adequate control of the radioactive materials; however, this work has been expensive. None of these surplus facilities were designed to be long-term waste repositories; therefore, final decommissioning must be performed. In many instances, decommissioning work can make serviceable facilities, equipment, or materials available for other government uses. In other cases, the contamination can be fixed and the facility sealed to prevent intrusion or spread of radioactive material. In some instances, it may be most cost effective to dismantle the facility and release the land for other uses or for sale. This paper presents a general overview of the DOE program for decommissioning of surplus facilities and provides specific information for five typical decommissioning projects that are currently underway. These projects involve work on a plutonium laboratory, a liquid waste handling system, two hot cell facilities, and a large production reactor. Decommissioning techniques, equipment and results of actual field experiences are described. (EDB)

60

Cleaning Up Nuclear Facilities - An Aggressive and Unified Federal Program is Needed

EMD-82-40; 66 pp. (1982)

Current limitations in the federal decommissioning program for nuclear facilities increase costs and make it difficult to locate facilities in need of decommissioning. (JMF)

61

Myrick, T.E., and J.H. Coobs, Oak Ridge National Laboratory, Oak Ridge, TN

The ORNL Surplus Facilities Management Program

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983; (p. 7) (1983)

The Surplus Facilities Management Program (SFMP) at Oak Ridge National Laboratory (ORNL) is conducted in support of the Department of Energy's SFMP, directed through the Richland Operations Office. The objectives of the ORNL program are to: (1) provide for surveillance and maintenance of surplus radioactively contaminated DOE facilities awaiting decommissioning; and (2) implement a structured decommissioning plan to accomplish the final disposition of all facilities included in the program. Currently, 44 facilities are being managed through the program, ranging from abandoned underground waste tanks to shutdown experimental reactors. Most of the facilities are being maintained in a protective storage mode while plans are made for their ultimate decommissioning. Two projects will be removed from the program in 1983 when D&D activities are completed. This paper presents an overview of the ORNL-SFMP, including a brief description of the current projects, discussion of the guidelines being used during D&D operations, and an outline of the future activities at the Laboratory. Results of the decommissioning work completed to date are provided, including a discussion of the lessons learned. (Auth)

62

Paxton, H.C., Los Alamos National Laboratory, Los Alamos, NM

Thirty-Five Years at Pajarito Canyon Site

LA-7121-H (Rev.): 61 pp. (1981, May)

A history of the research activities performed at the Pajarito Canyon Site from 1946 to 1981 is presented.

Critical assemblies described include: the Topsy assembly, Lady Godiva, Godiva 2, Jezebel, Flattop, the Honeycomb assembly for Rover studies, KIWI-TNT, PARKA reactor, Big Ten, and Plasma Cavity Assembly.

63
Schmeh, B.A.

Operational Data for Power Reactors in the United States

Power Reactor Technology and Reactor Fuel Process Technology 10:32-58 (1967)

Operational data is provided for the following reactors: Shippingport Pressurized-Water Reactor, Peach Bottom Power Reactor Unit 1, Sioux Falls Power Reactor, Indian Point Power Reactor Unit 1, Humboldt Bay Power Reactor, Hallam Power Reactor, Elk River Power Reactor, Piqua Power Reactor, Carolinas-Virginia Tube Reactor, Yankee Power Reactor, Dresden Power Reactor Unit 1, Hanford Production Reactors, Boiling Reactor Experiments, Los Alamos Power Reactor Experiments, Homogeneous Reactor Test, Gas-Cooled Reactor Experiment, Los Alamos Molten Plutonium Reactor Experiment, Molten Salt Reactor Experiment, Army Reactors SM-1, SL-1, PM-2, PM-1, PM-3, ML-1) Experimental Boiling Water Reactor, Vallecitos Boiling Water Reactor, Organic Moderated Reactor Experiment, Plutonium Recycle Test Reactor, Saxton Power Reactor, Savannah River Components Test Reactor, Sodium Reactor Experiment, Vallecitos Superheat Reactor, Experimental Breeder Reactor, Fermi Fast Breeder Reactor, and Puerto Rico Power Reactor. (Auth)

64
U.S. Department of Energy, Surplus Facilities Management Program, Washington, DC

Decommissioning: The Problem - The Solution - Questions and Answers about the Surplus Facilities Management Program

Brochure; 4 pp.()

Questions and answers about the Surplus Facilities Management Program are presented and surplus facilities are defined. The primary emphasis of the program is to manage the decommissioning of these facilities in a manner that protects the public and the environment. Alternatives for decommissioning are discussed. (BDC)(NPK)

65
UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Office of Surplus Facilities Management Monthly Progress Report, July 1983 - Civilian Program

UNC/OSFM-83-10; 97 pp. (1983, July)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - An additional 210 linear ft (480 linear ft total) of PP conveyer system was size reduced and packaged for disposal. This completes and exceeds milestone 5 (remove 350 linear ft of PP conveyor system) for this activity ahead of schedule. An additional 480 linear ft (1250 linear ft total) of the WTS underground lines was removed, size reduced, and packaged for disposal. This completes and exceeds the goal of milestone 10 (remove 1000 linear ft of WTS lines) for this activity ahead of schedule; (2) Chicago - The ANL-East "Building 350 Fabrication Area Decontamination and Decommissioning (D&D) Project Final Radiation Survey Report" was issued by CH; (3) Idaho - INEL Site Planning and Risk Assessment - The decision analysis for the SPERT I pond was completed and the final report published. Additionally, a draft of the SPERT III decommissioning plan was completed and is currently undergoing EG&G internal review. Monticello Site Remedial Action - Conceptual design and cost estimates of impoundments for alternative disposal sites listed in the "Remedial Action and Cost Benefit Analysis" were completed. A draft report on the shallow aquifer system at Monticello was completed and is currently undergoing GJAO review; (4) Oak Ridge - ORNL Site Planning and Risk Assessment - Radiological characterizations of the HRE and ORR experimental facilities were completed and corresponding reports prepared. These reports are currently undergoing ORNL internal review. Weldon Spring Site (WSS) - As a result of contamination found in the DOA controlled manhole 12, the Raffinate Pit #3 drainline was excavated in order for it to be resealed. The drainline was found dry when excavated, leading DOA and NRC to conclude that the source of contamination was not the pits. DOA and NRC will continue the source investigation on their own. A revised draft of the Weldon Spring Site ADM and the initial draft of the Notice of Intent to prepare an EIS for WSS were completed and are currently undergoing OR review. Niagara Falls Storage Site (NFSS) - SFMPO/OSFM staff members met with OR and HQ in German-town to discuss allocation of $7.3 million in AFRIMET settlement funds. The revenues will be apportioned between SFMP and FUSRAP at NFSS and Fernald where the remainder of the AFRIMET residues are being stored. A tentative plan for conducting additional local scoping in Oak Ridge and Hanford (possible recipients of NFSS wastes) was prepared and sent to HQ for review. The new Hittman water treatment equipment arrived onsite and was installed. The pump for transferring water from Building 410 to Building 411 and the holding ponds was installed and the water transfer completed; (5) Richland - Shippingport Station Decommissioning Project (SSDP) - BRISC submitted the Safety Analysis Report and Decommissioning Plan. Review and comment by OSFM Engineering is more extensive than originally anticipated and has caused the scheduled completion to be extended to the end of August. The engineering effort is still on schedule to be completed before the end of the fiscal year. Program Administration - FY 1983 third-quarter review was completed. Necessary field office financial plan adjustments were made, and field offices as well as HQ were notified of the results. An interim response to the United Kingdom Atomic Energy Authority's offer to prepare a United Kingdom-United States decommissioning exchange agreement was prepared and sent; (6) San Francisco - RMDF/ISF Maintenance Support - The septic tank line removal efforts were completed satisfying milestone 2 for this activity. (Auth)(MFB)

66

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

Office of Surplus Facilities Management Monthly Progress Report, August 1983 - Civilian Program

UNC/OSFM-83-11; 96 pp. (1983, August)

Highlights from the progress reported by the area offices for commercial program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - An additional 70 linear ft of the PP conveyor system was removed and packaged for disposal, making a total of 550 out of 930 linear ft completed to date. During this period, 400 linear ft of WTS underground lines were removed, size reduced, and packaged for disposal, making a total of 1650 out of approximately 5000 linear ft completed to date; (2) Chicago - ANL-East Surplus Facilities Decommissioning - Decommissioning operations on air handling units K, L, and M were completed during this period. The units were disassembled, and components were segregated between contaminated and non-contaminated materials and disposed of accordingly; (3) Idaho - Monticello Remedial Action Project - A pump test for evaluating the culinary aquifer was successfully completed after 51 hr of pumping. Results from the test indicate the Dakota formation, which separates the upper contaminated alluvial aquifer from the underlying Burro Canyon culinary aquifer, is relatively impermeable. This data, in addition to results of some chemical testing, led to the preliminary conclusion that the mill tailings are not contaminating the culinary aquifer; (4) Oak Ridge - ORNL Surplus Facilities Surveillance - Decontamination activities at the C-14 Facility were initiated. The new airlock was installed, and much of the contaminated equipment was removed from the 3033-A Building. ORNL Site Planning and Risk Assessment - The engineering assessment of the shielded transfer tanks was completed. The proposed disposition for the tanks involves grouting of the tank contents to their burial onsite. Weldon Spring Site Remedial Action - The revised draft of the WSS Project Management Plan was reviewed by SFMPO and HQ per DRAP-HQ direction; the plan will have to be readjusted to include only SFMP related work. The draft WSS 1982-1983 geologic characterization report was submitted to SFMPO and HQ for review. The document, as presented, does not adequately establish the geologic condition of the site and therefore must be revised. Niagara Falls Storage Site Remedial Action - OR has prepared a response to the Oversight Committee's comments on the NFSS Engineering Evaluation of Alternatives. That response has been submitted to SFMPO and HQ for review. NYDEC has advised OR that the request to modify the water discharge permit to increase iron and strontium acceptance levels will require thorough technical evaluation in NYDEC, followed by formal public notice and solicitation of comments. OR has requested an interim limited discharge authorization. NYDEC has also requested that several additional analyses be performed on future testing work. Clearing of the West and Central Ditch haul roads on SCA property was completed. Excavation of the ditches was initiated, and excavation of contaminated soils throughout the site continued. By months end, approximately 34, 000 cu yd of contaminated soils had been excavated and placed in the R-10 storage area; (5) Richland - Shippingport Station Decommissioning Project - DOE-RL, DOE-HQ, and UNC/OSFM met with Mr. Rick Rawles of the Department of Transportation (DOT), Office of Hazardous Materials, to exchange information on recent changes and potential future changes to DOT and International Atomic Energy Agency (IAEA) regulations

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

governing the packaging and transportation of radioactive wastes, specifically those governing the SSDP one-piece reactor vessel shipment. While the content of DOE and IAEA regulations for 1987 (which is the year of the SSDP one-piece vessel shipment) is uncertain, Mr. Rawles recognized the relative safety and efficiency of the one-piece vessel packaging and shipment method. It was also recognized that the proposed method does not fit into current regulating categories. In order to accommodate the one-piece shipment, DOE-RL will attempt to obtain exemptions from the low specific activity (LSA) regulations. Program Administration - Notification letters were transmitted to participating field offices on the upcoming FY 1984 SFMP Budget and Program Planning Conference to be held November 15-17, 1983, in Richland, Washington. The FY 1984 SFMP budget guidance letter that notifies participating field offices of their authorized FY 1984 funding levels was sent out this month. Official concurrence was received from DOE-HQ on the Management Action Plan for the SFMP International Decommissioning Exchange Program; (6) San Francisco - SRE Decommissioning - The SRE decommissioning final report was edited and printed and is currently being distributed. This action completes the project. (Auth)(CAJ)

67

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

Office of Surplus Facilities Management Monthly Progress Report, September 1983 - Civilian Program

UNC/OSFM-83-12; 96 pp. (1983, September)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The PP conveyor system was removed in PP-113, 136, and 143. To date, 600 linear ft (65%) of the conveyor system removal effort has been completed. Concrete floor decontamination was completed in PP-141. This completes milestone 6 for this activity. An additional 100 linear ft (1750 ft total) of WTS underground lines were removed, size-reduced, and packaged for disposal. Planning continued on the design of a containment structure to be used in the decommissioning of Building 41. The FY 84-88 Mound ANSPD Program Plan was completed. This completes milestone 9 for this activity; (2) Chicago - ANL-East Planning and Risk Assessment - The ANL-East Site Surveillance and Maintenance Plan was finalized by ANL and is currently undergoing CH review. This completes milestone 1 for this activity. ANL-East Surplus Facilities Decommissioning - Total dismantlement of the last Rotoclone/Precipritron in Building 37 was completed during this period. Unit J was size-reduced, separated into radioactive and nonradioactive components, and disposed of as contaminated wastes. The duct work for associated various filtration units was also dismantled, surveyed, and disposed of according to criteria. To date, the project has generated 30 gal of contaminated material; (3) Idaho - Monticello Remedial Action Project - All sections of the Monticello Remedial Action Project Site Analysis Report, with the exception of the "Radiation Exposure Pathways and Potential Health Impacts" sections, were completed in draft form. The report is currently scheduled for November completion; (4) Oak Ridge - ORNL Surplus Facilities Surveillance - Decontamination activities at the C-14 Facility were concluded after removing contaminated equipment and service piping from the laboratory and replacing the ceiling. ORNL Site Planning and Risk Assessment - Work on engineering assessments for the ORR experimental facilities and the HRE was initiated. Summaries of these assessments will be utilized as the basis for the project description, cost, and schedule sections of the ORNL Long Range Plan. Niagara Falls Storage Site - Clean-up operations have been completed on the the onsite portions of the west (700 linear ft) and central (2570 linear ft) ditches. This completes milestone 5 for this activity. The east and west walls of the south dike extension were excavated and backfilled to 80 and 20% completion, respectively. The south wall of the dike was about 95% excavated and 10% backfilled. The hydraulic mining and slurry transfer subcontract for the interim remedical actions was awarded in mid-September. Approximately 45,000 cu yd of contaminated materials have been excavated and placed in the R-10 storage area during this construction season; (5) Richland - RAPIC - The final copy of ORNL/EIS-154/V4 (annotated bibliography) has been sent to the printer for publication. This completes milestone 3 for this activity. Shippingport Station Decommissioning Project - The SSDP Quarterly Review Meeting was held September 21, 1983. An excellent review of the total engineering phase of the project was presented by BRISC. Attendees included representatives from DOE-HQ, DOE-RL, BRISC, and UNC. Members of the review meeting concluded that the engineering phase will provide the information necessary for the Decommissioning Operations Contractor (DOIC) to complete the project and that the engineering was of high quality and was completed on time and within budget. A change control board meeting was conducted for the SSDP, and actions were taken to increase allocations for FY 1983. Costs were increased by $268,000. The Safety Analysis has been completed, which satisfies milestone 4 for this activity. Program Administration - The draft SFMP FY 1984-1988 Program Plan was completed and submitted to DOE for review on September 1, 1983. This completes milestone #5 for this activity. Arrangements were finalized for the FY 1984 Surplus Facilities Management Program Budget and Program Planning Conference, to be held November 15-17, 1983, in Richland, Washington. Presentation materials were prepared for a briefing to be made by DOE-HQ to the Office of Management and Budget (OMB). This briefing, held on September 26, 1983, was to justify the FY 1985 budget to OMB for the SFMP Civilian and Defense Programs; (6) San Francisco - SSFL Site Planning and Risk Assessment - The draft Long Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories was completed and is currently being reviewed by SFMPO. This satisfies milestone 2 for this activity. Disposal of Na/NaK/LiH Waste - 3050 lb of sodium were oxidized during the month of September. The total quantity disposed of to date is 8450 lb, which completes milestone 1 for this activity. NMDF (Building 055) Decommissioning - Decontamination efforts remain on schedule with the completion of removal of services and equipment from 26 gloveboxes. Also, the fifth glovebox this fiscal year has been decontaminated to LSA levels. These actions complete milestones 2 and 3 for this activity. (Auth)

68

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

Office of Surplus Facilities Management Monthly Progress Report, May 1983 - Defense Program

UNC/OSFM-83-20; 69 pp. (1983, May)

Highlights from the progress reported by the area offices for defense program work include: (1) Idaho - While examining CPP-601 Process Cell D prior to initiating decommissioning work, unexpected uranium was encountered which could have caused a criticality. All work was halted and the cell turned back over to Exxon for removal of the uranium. All vessels within the cell are being examined for uranium. Work is not expected to resume until August and completion will be delayed until October. Funding is not expected to be impacted even though work will carry over into FY 1984; and (2) Richland - (a) The decontamination of the 117-F Exhaust Filter Building was completed during May, ahead of schedule. The final radiological profiling is in progress. Upon radiological release the structure will be demolished and the excavation left open for disposal of the adjacent exhaust stack; and (b) Program Administration - The FY 1985 Surplus Facilities Management Program Budget Submission notification schedules for the field offices and their contractors was completed. The Abridged SFMP Program Plan for FY 1983-1987 was issued. (Auth)(BDC)

69

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

Office of Surplus Facilities Management Monthly Progress Report, June 1983 - Defense Program

UNC/OSFM-83-21; 74 pp. (1983, June)

Highlights from the progress reported this month by the area offices for defense program work are presented. The INEL, ORNL, and Hanford Surveillance and Maintenance Plans were completed and issued as scheduled. Work continued by Exxon Nuclear Idaho personnel on a plan to recover the enriched uranium which was unexpectedly found in the CPP-601 Process Cell D in May. The uranium recovery and cleanup work is expected to be completed in late July or August. A revised schedule for the decommissioning of Cell D is expected to be available by September 1, 1983. Completion of Cell D is expected to be delayed into FY 1984. (Auth)(BDC)(CAJ)

70

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

Office of Surplus Facilities Management Monthly Progress Report, July 1983 - Defense Program

UNC/OSFM-83-22; 78 pp. (1983, July)

Highlights from the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Decommissioning - Removal and replacement of 6,050 sq ft of SM Building roof was completed this month. Removal and replacement of the remaining area (8,600 sq ft) was initiated and is expected to be completed this fiscal year; (2) Idaho - Idaho National Engineering Laboratory (INEL) Surplus Facilities Decommissioning - Final plans were prepared and submitted to DOE-ID concerning resumption of decommissioning work on CPP Process Cell D following completion of the uranium removal and cleanup activities in FY 1983. The strategy is to use the remaining FY 1983 funds from the Cell D work to accelerate FY 1984 characterization activities on identified INEL surplus facilities. Process Cell D work would then be completed in FY 1984 using characterization funds; (3) Oak Ridge - Fission Products Development Laboratory (FPDL) Decommissioning - The final version of the FPDL Project Plan was completed and issued this month. The plan reflects completion of identified cell decontamination work in FY 1988 at a projected cost of approximately $4 million; (4) Richland - (a) Hanford 200 Areas Surplus Facilities Surveillance - Dismantlement and burial of the 4,000 ft-long UNH Transfer Line was completed this month utilizing excess funds identified under the 200 Areas surveillance task; (b) Hanford 100 Areas Site Planning and Risk Assessment - In support of the long-range planning effort for the 100 Areas, Battelle-Pacific Northwest Laboratory (PNL) completed the pathway analysis work for determining allowable residual contamination levels for the 100 Areas decommissioning effort. Following DOE-RL approval, this pathway analysis approach will be used for determining the release levels for decommissioning the contaminated facilities. This method could significantly reduce decommissioning costs in the 100 Areas, up to as much as 50%; and (c) Program Administration - SFMPO/OSFM review of the Field Office inputs to the Civilian and Defense Programs Third-Quarter Review was completed this month. Notification letters were subsequently mailed to the field offices and contractors. Notification of the FY 1984 SFMPO Defense budget was received this month from DOE-HQ. The budget levels are $10.5 million B/A expense and $0.59 million B/A for capital equipment. Preparation of notification letters to the participating Field Offices of their authorized funding levels for FY 1984 is now underway. The Hanford Site in Richland, Washington was selected as the host site for the FY 1984 Budget and Program Planning Conference. The conference is scheduled to be held November 15-17, 1983. Preparation of notification letters to the participating field office and contractors is underway. (Auth)(BDC)

71

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

Office of Surplus Facilities Management Monthly Progress Report, August 1983 - Defense Program

UNC/OSFM-83-23; 82 pp. (1983, August)

Highlights from the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Decommissioning - The excess duct removal work on the SM Building was completed this month as scheduled. Removal of 8,600 sq ft of SM Building roof material was also completed. Replacement of the roof area is currently underway and scheduled for completion by September 30, 1983; (2) Chicago - New Brunswick Laboratory (NBL) Decommissioning - Excavation and removal of the Main (I) Building floor slab, initiated in July, was completed this month. Activities for the remainder of the fiscal year will concentrate on excavation and removal of contaminated drain lines, foundation, and footings under and around the perimeter of the Main (1) Building; (3) Oak Ridge - ILW Transfer Line Decommissioning - Isolation and entombment of the two ILW line leak sites was completed this month. The Project Final Report is scheduled for issue by September 30, 1983; (4) Richland - (a) 100F Area Facilities Decommissioning - Demolition of the 117-F Filter Building was completed this month. The subcontract for demolition of the 116-F, 116-H, and four other surplus exhaust stacks in the 100 Areas was awarded this month. Demolition of all six stacks is expected to be completed by fiscal year end; (b) 305-B Physics Test Reactor Building Decommissioning - The two test reactors stored in the 305-B Building basement area were disassembled and removed for disposal. Cleanup of the contaminated areas in the basement are currently in progress, with completion expected in early September; and (c) Program Administration - The FY 1984 SFMP Budget Guidance Letter was completed this month and transmitted to participating Field Offices notifying them of their authorized funding levels for FY 1984. Notification letters were completed and transmitted to participating Field Offices on the FY 1984 SFMP Budget and Program Planning Conference, to be held November 15-17, 1983, in Richland, Washington. (Auth) (BDC)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

72

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

Office of Surplus Facilities Management Monthly Progress Report, September 1983 - Defense Program

UNC/OSFM-83-24; 87 pp. (1983, September)

Highlights from the progress reported by the area offices for defense program work include: (1) Albuquerque - Special Metallurgical (SM) Building Decommissioning - Replacement of the Phase II section of the SM Building roof, involving an 8,600 sq ft area, was completed. This completes all currently scheduled maintenance items on the SM Building. Also completed this month was the preparation and issue of the SM Building Decommissioning Project Plan; (2) Idaho - INEL Surplus Facilities Decommissioning - Decommissioning of the TAN/TSF-3 Concrete Pad and the MTR-657 Plug Storage Facility was completed this month as scheduled. Preparation and issuance of the project final reports is expected in early FY 1984. Decommissioning work on CPP Process Cell D, originally expected to be completed this fiscal year, was deferred to late FY 1984 as a result of unexpected uranium contamination found in early FY 1983; (3) Oak Ridge - (a) ILW Transfer Line Decommissioning - Final certification surveys of the two ILW line leak sites were completed and the sites were released to ORNL. The ILW Transfer Line Decommissioning Project Final Report was completed and issued for publication as scheduled. This completes all currently scheduled decommissioning work on the ILW line; (b) Metal Recovery Facility (MRF) Decommissioning - A combined Conceptual Design Report and Decommissioning Project Plan for the MRF was completed and issued this month, as scheduled; and (c) Fission Products Development Laboratory Decommissioning - Equipment removal and cell decontamination activities were completed this month in Process Cell 8, and the cell was closed and sealed. Final decontamination of the cell and certification survey work will be done at a later date. (Auth) (BDC)

73

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

Office of Surplus Facilities Management Monthly Progress Report, May 1983 - Civilian Program

UNC/OSFM-83-8; 97 pp. (1983, May)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The glovebox removal phase has been completed in PP-130 with the removal, size reduction, and packaging of the two fumehoods in that laboratory. This completes milestone 4 of this activity ahead of schedule. Additionally, the glovebox removal phase in PP-122 has been completed. (2) Chicago - (a) Building 350 (Pu Glovebox Decommissioning) - ANL has received authorization from the Hanford Waste Management site to ship the remaining Pu contaminated material (to Hanford) for disposal as LSA waste. These waste shipments had been temporarily held up while waste classification was being determined; (b) ANL-East Surplus Facilities Decommissioning - The Decommissioning Project Plan has been completed by CH and is currently being reviewed by RL; (3) Idaho - (a) INEL Site Planning and Risk Assessment - A draft of the decision analysis for the SPERT I Pond was completed and issued for ID review, thus satisfying milestone 7 for this activity; (b) Monticello Site Remedial Action - The contract for the monitor well drilling program was awarded and all associated drilling and logging operations were completed by the end of the month. Calculations of the radium-226 concentrations in the pile were performed in support of the Site Description Study. The total inventory was set at 5.1 Ci. The late start in data collection from the culinary aquifer monitoring program was due to late winter conditions. This has necessitated rescheduling of the completion dates for the Site Description Study, Radioactive and Pollutant Impact Study, and the Cost Benefit Analysis Study and will delay the completion of the Site Analysis Report; (4) Oak Ridge - (a) Weldon Spring Site - OR comments were incorporated into the draft WSS Project Plan, and the revised draft was issued for review and comment. On May 5, OR staff members conducted two progress review sessions with St. Charles County Administrative Court Judge Tom Grosier and the editor of the St. Louis Globe-Democrat. OR was requested by the newspaper to consider a series of releases to better inform the public; (b) Niagara Falls Storage Site - Draft editions of the NFSS Action Description Memorandum, for interim actions (ADM), the Engineering Evaluation of Alternatives for the Disposition of the Niagara Falls Storage Site, its Wastes and Residues (EER, often referred to as the

Referenceable Engineering Document), and the final draft of the Project Management Plan (PMP) were completed, issued, and commented on. The drafts were often of poor quality. There were several instances of inconsistent correlation of data among the documents. SFMPO/OSFM staff members met with HQ, OR, and BNI in Oak Ridge to discuss RL comments to the aforementioned documents and to identify specific areas that will most likely be topics of greatest concern at the upcoming briefings to the New York State officials, Oversight Committee, and the Lewiston/Porter Town Boards. The issue of quantities of nonradiological elements found in impounded waters in excess of the quantities specified in the SPDES has been resolved. A total of 508,000 gal of water were subsequently discharged from the site. Work on the Building 411 roof removal was essentially completed during this report period; (5) Richland - (a) Shippingport Station Decommissioning Project (SSDP) - RL initiated the process for selection of the Shippingport Station decommissioning operations contractor (DOC) on May 2, 1983 with the announcement of the procurement action in the Commerce Business Daily. The Requests for Proposal were issued on May 16, 1983. Approximately 50 sets of Activity Specifications were distributed to firms interested in the DOC contract. The SSDP Updated Project Plan, incorporating RL comments, was provided to HQ for approval. The update reflects changes due to technical baseline revisions; a reduction in FY 1984 available funding; a change from capital to line item operating funds; a change in turnover date to June 4, 1984; and a change in text due to the completion of a final Environmental Impact Statement. Copies of the detailed Shippingport Station Decommissioning Program (SSDP) Project Cost Estimate were also provided to HQ, preparatory to the HQ Budget Validation Review held on May 23, 1983. Supplemental information was prepared and supplied in response to questions raised on several areas in the cost estimate details. (b) Program Administration - UNC/OSFM assisted with the cost, scheduling, and engineering reviews of the Niagara Falls Storage Site Remedial Action Project. This included review of the revised Project Management Plan, Action Description Memorandum, and Referenceable Engineering Document. OSFM's Program Planning completed the FY 1985 Surplus Facilities Management Program Budget Submission notification schedules for the field offices and their contractors. SFMPO/OSFM staff members participated in a program review meeting and tour of the ORNL facilities on May 10; (6) San Francisco - (a) SRE Decommissioning - The SRE Interim Post Remedial Action Survey Report prepared by ANL was received. This report recommends the following: unrestricted release for Buildings 041, 143, 166, and adjacent areas and conditional release for the sewer and storm drain systems, which were found to have some low-level contamination. The interior inaccessible surface of these systems may be contaminated in excess of acceptance limits because the contamination found was detected at the access point. The sewer and storm drain system was common to several DOE facilities used for work with radioactive materials and will be included as an ancillary facility in the Long Range Decommissioning Plan for SSFL; (b) NMDF (Building 055) Decommissioning - Fourteen gloveboxes had all equipment and services removed from their interiors. The entire analytical line has now been emptied, and the gloveboxes are awaiting decontamination. (Auth)(MFB)

74

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

Office of Surplus Facilities Management Monthly Progress Report, June 1983 - Civilian Program

UNC/OSFM-83-9; 93 pp. (1983, June)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The glovebox removal phase was completed in PP-14 with the removal, size reduction, and packaging of the last two gloveboxes in that laboratory. This completes milestone 1 for this activity. Decommissioning operations were concluded in the R-127 laboratory with the execution of the final verification radiological survey. This completes milestone 8 for this activity in accordance with the original schedule. Chicago - Building 350 (Pu Glovebox Decommissioning) - The remaining Pu contaminated material was shipped to Hanford for disposal. Except for the final report, all work associated with Building 350 decommissioning has been completed; (3) Idaho - INEL Site Planning and Risk Assessment - The draft BORAX V Pond decision analysis was completed and is currently under ID review. This satisfies milestone 8 for this activity. Monticello Site Remedial Action - The "Disposal Site Selection Study" and the "Mill Tailings Stabilization Technology Study" were completed and are currently undergoing GJAO review. This completes milestones 3 and 4 for this activity. Additionally, the "Site Preparation and Handling of Tailings," the "Socioeconomic Land Use Impact Study," and the reprocessing summary and transportation portions of the "Remedial Action and Cost Benefit Analysis" were completed in draft form; (4) Oak Ridge - ORNL Site Planning and Risk Assessment - The final version of the Surveillance and Maintenance Plan was completed, and distribution of the document was made. Radiological characterizations of the shielded transfer tanks were completed. Weldon Spring Site (WSS) - Five representatives from the Missouri Department of Natural Resources (MO-DNR) met with OR and BNI personnel in Oak Ridge on June 14 to discuss possible options for treating and discharging water in raffinate pits. A tour of several facilities at ORNL was then given to the MO-DNR group. The 1982 Environmental Monitoring Report was finalized, and along with the 1981 report, was distributed. The final draft of the WSS Project Management Plan was issued to HQ, RL, and ANL for review and comment. Niagara Falls Storage Site (NFSS) - On June 2, a briefing on the NFSS was given to the New York State Congressional Delegation (Congressman John LaFalce, Marty Machowski of LaFalce's staff, Sueanne Pfifferling from the staff of Senator Moynihan, and Kieran Mohoney from the staff of Senator D'Amato). The presentation covered the NFSS FY 1983 work plans, environmental monitoring, and long-range planning. At this briefing, the final draft of the Engineering Evaluation of Alternatives (EEA or RED), the Project Management Plan (PMP), and the 1981 and 1982 Environmental Monitoring Reports were distributed. Copies of these documents were also furnished to the Citizens Oversight Committee, New York State officials and the Lewiston/Porter Town Boards. These documents, as well as recent accomplishments at the site, were the topics of briefings with New York State officials and the Citizens Oversight Committee on June 8 and the Lewiston/Porter Town Boards on June 9. These organizations expressed strong opposition to transferring the K-65 residues from building 434 to 411. They also expressed the opinion that DOE has made an internal predecision to utilize NFSS for permanent storage of wastes and that the aforementioned documents were prepared to support that decision. A tentative agreement of \$7.3 million in settlement revenues has been reached between AFRIMET and the U.S. Government for assuming responsibility for the AFRIMET residues; (5) Richland - Hallam/Piqua Facilities Surveillance - The annual physical and radiological inspections of the facilities were performed as scheduled. Shippingport Station Decommissioning Project (SSDP) - SFMP/OSFM staff members participated in the Preproposal Conference for the Shippingport Station Decommissioning Operations Contract (DOC) at the site on June 4. Representatives from approximately 25 contractor/subcontractor groups attended the conference. The turnout and enthusiasm suggest that there will be strong competition for the DOC contract. The SSDP Decommissioning Project Plan was completed and is currently under UNC internal review. Program Administration - OSFM assisted SFMPO in the FY 1983 Third-Quarter Review of the Surplus Facilities Management Program. A Management Action Plan was prepared for the International Decommissioning Exchange Program for FY 1983-84; (6) San Francisco - SSFL Site Planning and Risk Assessment - The Surveillance and Maintenance Plan for SSFL contaminated surplus facilities was edited per AI internal comments and is currently being distributed to SAN and RL for review. This satisfies milestone 1 for this activity. RMDF/ISF Decommissioning - The individual project plans for the RMDF and ISF were edited per AI internal review and are currently being distributed to SAN and RL for review and comment. This satisfies milestone 1 for this activity. (Auth)

75

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

Office of Surplus Facilities Management Monthly Progress Report, October/ November 1982 - Defense Program

UNC/OSFM-84-1; 74 pp. (1983)

Highlights from the progress reported by area offices for Defense Program work include: (1) Albuquerque - Special Metallurgical (SM) Building Decommissioning - Construction of an enclosure around the R&R Annex to support FY 1984 decommissioning activities was completed in December. Initiation of the R&R Annex decommissioning was subsequently started, with removal of the sheetmetal roof decking completed to date. Disposition of the remainder of the building, including removal of the associated contaminated drains and soil, is expected to be completed this fiscal year; (2) Chicago - New Brunswick Laboratory (NBL) Decommissioning - Excavation and removal of all remaining NBL facility foundations, sewer lines, and contaminated soil was completed. Backfill and leveling of the excavated areas was initiated; approximately 80 percent of the effort is completed. Results of a field survey of the site taken in December indicated radiation levels onsite are below background. Analysis of soil and water samples taken onsite are in progress; (3) Richland - (a) Hanford 200 Areas Surplus Facilities Surveillance - Installation of the 291-C HEPA Filter System, initiated in August, was

completed; and (b) Program Administration - The SFMP FY 1984-1988 Program Plan was completed and issued in final form to program participants in October as scheduled. The document, in part, addresses planned decommissioning activities at the participating SFMP sites for the next five year period. The FY 1984 Budget and Program Planning Conference was held November 15-17, 1983 in Richland, Washington. Approximately 110 people, representing 14 contractor and 9 DOE Field Office organizations participating in the SFMP, were in attendance. Representatives from SFMPO and UNC/OSFM completed the SFMP European Decommissioning Tour, October 14-29, 1983. A summary decommissioning agreement between the United States and United Kingdom was completed and presented for discussion at meetings during the tour, as was the International Decommissioning Questionnaire (Supplement). Meetings were held with representatives from Sweden, United Kingdom, France, Federal Republic of Germany, and the Organization for Economic Cooperation and Development-Nuclear Energy Agency. The FY 1986 Surplus Facilities Management Program Budget Call Letter was completed and transmitted to participating DOE Field Offices on December 22, 1983. Field office responses are due to SFMPO by February 10, 1984. (Auth)(PTO)

76

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

Office of Surplus Facilities Management Quarterly Progress Report, January/March 1984 - Defense Program

UNC/OSFM-84-1; 77 pp. (1984)

Highlights from the progress reported by the area offices for defense program work include: (1) Idaho - (a) INEL Site Planning and Risk Assessment - A draft of the decision analysis for the MTR-603 HB-2 Cubicle was completed in February and transmitted to DOE-ID for review. The recommended decommissioning alternative for this facility was to remove all equipment from the cubicle, decontaminate the walls and floor, and release it for potential reuse. Final issue of the document is expected in April. Because of the work load on the MTR-605 Process Water Building D&D Plan, and the nature of DOE-ID comments received in January on the MTR Characterization Report, a decision was made to extend the date for publishing the MTR Characterization Report until April 30. Milestone 8 will be delayed approximately two months; and (b) Materials Testing Reactor Facilities Decommissioning - The D&D Project Final Report for the MTR-657 Plug Storage Facility was issued in final form in January. This completes milestone 1 for this activity as scheduled; (2) Oak Ridge - (a) ORNL Site Planning and Risk Assessment - Decommissioning studies (alternative assessment work) on the ORNL Graphite Reactor were completed in March. This completes milestone 1 as scheduled. Also in March, the radiological characterization and decommissioning studies on the ORNL surplus waste tanks were completed. Based on the survey results for the tanks, the decommissioning studies concluded that tank removal was the preferred disposition option. This completes milestone 2 for this activity two months early; (b) Fission Products Development Laboratory Cell Decommissioning - To take advantage of the high potential reuse of Manipulator Cells 13-15 and the subsequent cost savings of near-term disposition, the project schedule for FPDL was revised to support completion of disposition activities in Manipulator Cells 13-15 in FY 1984. Following approval by SFMPO in February, the project schedule was revised to reflect completion of Manipulator Cells 13-15 by 4Q/FY84, Manipulator Cell 18 by 4Q/FY85, and Process Cell 6 by 2Q/FY85; and (c) Metal Recovery Facility Decommissioning - The revised MRF Project Plan was issued to DOE in final form in March. This completes milestone 1 for this activity as scheduled. The revised project schedule, based on the approved project plan, involves a delay in the building preparations for MRF decommissioning. Completion of milestone 2 (installation of makeup area cooling unit) and milestone 3 (installation of cell ventilation system) will be delayed from September 30, 1984 to December 31, 1984. This delay will not adversely affect funding or project goals for this fiscal year; (3) Richland - (a) Hanford 100 Areas Site Planning and Risk Assessment - The Alternatives Assessment for decommissioning of the surplus facilities in the 100 Areas was completed and issued to DOE-RL in February. This completes milestone 1 for this activity as scheduled; (b) 100-F Area Facilities Decommissioning - The equipment removal/decontamination of the 115-F Gas Recirculation Building was completed to the Allowable Residual Contamination Levels (ARCL) in March. This completes milestone 3 four months ahead of schedule; (c) 201-C Strontium Semiworks Decommissioning - The Safety Analysis Report (SAR) for decontamination and decommissioning of the Strontium Semiworks was completed and submitted to DOE-RL on March 30, 1984. This completes milestone 3 for this activity as scheduled; and (d) Program Administration - The SFMP FY 1986 Budget Submittal for Defense Waste and By-Products Management, Decontamination/Decommissioning was completed and transmitted to DOE-HQ on schedule. The FY 1984 SFMPO Mid-Year Review letter was issued to program participants in March. (Auth)(BDC)

77

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

Office of Surplus Facilities Management Monthly Progress Report, October/ December 1983 - Civilian Program

UNC/OSFM-84-1; 97 pp. (1983)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - The PP conveyor system has been removed in Building PP-141. This completes milestone 1 for this activity six weeks ahead of schedule. Removal of WTS lines between the creek and Building 41 has been completed; (2) Chicago - ANL-East Surplus Facilities Decommissioning - Work during this quarter consisted of continuing with the surveying and decontamination of the walls, ceilings, floors, and the remaining piping, conduit, and ductwork on the upper level of Building 37. In addition, the remainder of the 44 floor drains in the second floor slab and the associated pipes on the first floor have been removed from the facility. All were contaminated and have been packaged for radioactive disposal; (3) Idaho - Monticello Remedial Action - GJAO completed the draft site analysis report (SAR) and forwarded it to SFMPO in November. Remedial action engineering designs, construction management, and monitoring and surveillance costs were estimated for the final version of the SAR. The action description memorandum (ADM) was issued and accompanied the SAR. It recommended a stabilization in place option based on technical data indicating no contamination of the culinary aquifer; (4) Oak Ridge - ORNL Surplus Facilities Surveillance - The planned completion of the C-14 decontamination effort was delayed due to need for further assessment and planning for the removal of the below-grade tankage. Repair of the filter house roof at the MSRE was completed early in October. ORNL Site Planning and Risk Assessment - Radiological characterization efforts were completed at the LITR as scheduled. Engineering alternative assessments were completed for the HRE site, with entombment specified for the main reactor cell and in situ stabilization of the process waste pond. Niagara Falls Storage Site - The Engineering Evaluation of Alternatives document was submitted to SFMPO for final approval in November. The South Dike Extension was completed in November. Installation of an EPDM cover over areas where contaminated material has been placed was completed in December. The residue transfer and dewatering subcontractor completed the removal of water and residues from Bay A in Building 411. Preparation and the initial phase of the program to chemically treat water in Building 411 were completed. Grading of the route for the slurry pipeline from Building 434 to Building 411 is complete. The holding pond for the slurry water at the tower, Building 434, is complete and the pad has been prepared for the subsequent installation of the pumps. Representatives of DRAP-HQ, SFMPO, OR, UNC, and BNI met at Richland, Washington, on November 14, 1983, to discuss the status of the Niagara Falls Storage Site (NFSS) Project. Primary topics of discussion were FY-1983 year-end status, a schedule for completion of NFSS interim remedial actions, and final disposition of NFSS. Weldon Spring Site - The revised draft of the Weldon Spring Project Management Plan has been submitted and is undergoing review by SFMPO. Subcontracts for fencing around the Raffinate Pits and for installation of a septic tank at the site were awarded during December. The revised draft of the Weldon Spring project management plan has been submitted and is undergoing review by SFMPO; (5) Richland - Shippingport Station Decommissioning Project - UNC has completed preparation of an operational readiness review plan. It is currently being reviewed by DOE-RL. The project management plan is currently under review by UNC and will be submitted to DOE-RL in the near future. An interface meeting among the major decommissioning project participants was held at the Shippingport Atomic Power Station on December 8, 1983. It was agreed that site turnover (from DOE-NR to DOE-NE) would take place in September 1984. Contract negotiations between DOE-RL and General Electric are in progress. Program Administration - The FY 1984 SFMP Budget and Program Planning Conference was held on November 15-17, 1983, in Richland, Washington. Approximately 110 persons, representing 14 contractor and 9 DOE field office organizations participating in the SFMP, were in attendance. Representatives from UNC traveled to Hallam, Nebraska, to meet with officials from the State of Nebraska Department of Health and observe the fall survey of the entombed Hallam Nuclear Power Facility. The FY 1986 SFMP budget call letter has been completed and was transmitted to participating DOE field offices on December 22. Field office responses are due February 10, 1984, to SFMPO. The SFMP Program Plan (FY 1984-1988), RL/SFM-83-12, was mailed to program participants on October 14, 1983. Representatives from SFMPO and

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

UNC completed the SFMP European Decommissioning Tour, October 14-29, 1983. A summary decommissioning agreement between the United States and United Kingdom was completed and presented for discussion at meetings during the tour, as was the International Decommissioning Questionnaire (supplement). Representatives from SFMPO and UNC attended the Annual Division of Remedial Action Projects (DRAP) Program Review meeting November 29-30, 1983, in Gaithersburg, Maryland. The purpose of the meeting was to review civilian D&D program activities in FY 1983 and planned FY 1984 work; (6) San Francisco - SNAP 8 Building 059 Decommissioning - Representatives from SFMPO and UNC attended a Rockwell program review meeting at the Santa Susana Field Laboratory in October. The purpose of the meeting was to review FY 1983 D&D activities at SSFL and planned activities for FY 1984. Water has been removed from the pipe-chase room and the area between the concrete wall and liner in the RPT pit. No water was found in the reactor vacuum chamber vault. A total of 49, 000 gal of contaminated water has been removed. Water in the sump well adjacent to the building was pumped down to within approximately two ft of the water level in the pipe chase room. Water leakage into the pipe-chase room has been reduced to an estimated 50 gal per day. Upgrading of the RMDF evaporator for the purpose of processing water from Building 059 is 85% complete. Disposal of Na/NaK/LiH Waste - Two large carbon steel cold traps were disassembled, and the disposal of 69 lb of sodium was accomplished. The total quantity of sodium disposed of to date is 11,320 lb. (Auth)

78

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

Office of Surplus Facilities Management Quarterly Progress Report, January/March 1984 - Civilian Program

UNC/OSFM-84-1; 99 pp. (1984)

Highlights from the progress reported by the area offices for civilian program work include: (1) Albuquerque - Mound ANSPD Areas Decommissioning - Structural decommissioning of PP-128 and PP-130 (milestone 2) has been revised to the end of the fiscal year. This will result in a more logical sequence of work. Milestone 4, "complete compactor structural decontamination of PP-45 and PP-46" has been deleted for this fiscal year and PP-142W, 158W, 159, 160, 162, 163, 164, 175, and 176 were added. These changes were made to reflect a more logical sequence of work; (2) Chicago - ANL-East Surplus Facilities Decommissioning - Decommissioning activities in Buildings 37 and 16F were completed in March, except for performing radiological surveys and performing any necessary decontamination on exterior building surfaces and surrounding soil. Since heat is unavailable in either Building 38 or 41, the cleanup of debris, decontamination of floor areas, and the removal of exhaust ductwork in the heated Building 17 has been initiated ahead of schedule. Work will resume in Buildings 38 and 41 once warmer weather returns; (2) Idaho - (a) INEL Site Planning and Risk Assessment - The decision analysis report for decommissioning of the SPERT-I Reactor Building was published as a final report in January. This completes milestone 1 for this activity as scheduled; (b) INEL Facilities Decommissioning - Milestone 2, publication of the SPERT-III Ancillary Facilities report, is being delayed due to diversion of staff resources to another project. This activity will be delayed approximately one month. The final D&D plan for the SPERT-I Seepage Pit was published and distributed, completing milestone 3 for this activity as scheduled; (c) Monticello Site Remedial Action - Work on the NEPA Compliance Document has not been initiated pending a decision by DOE-HQ on the requirement for an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) for the Monticello Site Remedial Action Project. Scheduled NEPA compliance documentation and environmental activities are being impacted by this delay. Also, attorneys at DOE-HQ have requested copies of reference documents used in the draft Site Analysis Report (SAR) for a lawsuit involving the millsite. Final issuance of the SAR is being delayed pending DOE-HQ's comments, which are impacted by the litigation. Milestone 1 (issue SAR-DRAP controlled), milestone 2 (issue Project Plan update-DRAP controlled) and milestone 3 (select NEPA contractor) will be delayed until DOE-HQ comments are received and incorporated; (d) Monticello Vicinity Properties - Land surveys were initiated on fifteen designated properties and completed in March. Milestone 1 was achieved on schedule; (4) Oak Ridge - (a) ORNL Surplus Facilities Surveillance - Decontamination of the C-14 facility was completed in March. The below-grade dissolver was extracted and disposed of without incident and the contaminated flooring was removed. The facility is in a passive protective storage mode that will require minimal routine maintenance and surveillance. This completes milestone 2 for this activity three months later that originally scheduled. It was delayed due to the need for further assessment and planning for the removal of the below-grade dissolver tank. The shielded transfer tank RD-C-44 was relocated to the surplus equipment storage yard to provide more controlled access. This completes milestone 3 six weeks ahead of schedule, due to availability of manpower and good weather; (b) ORNL Site Planning and Risk Assessment - Completion of the characterization and decommissioning studies on LITR will be delayed until approximately May 15, 1984 due to emphasis being placed on the characterization and decommissioning studies of the surplus (Defense) waste tanks. This delay will not have a long-term affect on milestones or funding for the fiscal year; (c) Weldon Spring Site - Work continued on the Geologic Report (milestone 1) for the Weldon Spring Raffinate Pits (WSRP) and on the Engineering Evaluation of Alternatives (EEA) (milestone 2) for the Disposition of the Raffinate Pits Site. In response to concerns raised in the review of the draft Geologic Report concerning the geologic conditions beneath the Weldon Spring raffinate pits, and particularly pit 4, the EEA report was revised to incorporate a discussion on the development of a new disposal cell at the WSRP site. Should future site investigations identify local flaws in the clay beneath any of the pits, additional clay could be placed in the existing pit bottoms or a new above-grade or partially above-grade pit could be constructed at another location on the site. Also, consideration may be given to the use of a short-term leachate monitoring system as part of the post-construction monitoring program. The need to construct an alternative pit with a leachate monitoring system will be further evaluated if the decision is made to stabilize the waste onsite. The Preliminary Geologic Report was also revised to incorporate reviewer comments. It is anticipated that the Preliminary Geologic Report and the EEA will be issued in April resulting in a delay of both DRAP controlled milestones; and (d) Niagara Falls Storage Site - The Niagara Falls Storage Site Engineering Evaluation of Alternatives was issued in January, completing milestone 5 (DRAP controlled) for this activity as scheduled. Work continued on the Preliminary Draft Environmental Impact Statement II (PDEIS-II). SFMPO reviewed the draft in February and the comments are being reviewed and incorporated by Argonne National Laboratory personnel. It is not anticipated that the Draft EIS will be issued before July, due to major revisions resulting from the review process. Milestone 4 (DRAP controlled) will be delayed for approximately four months; (5) Richland - (a) Program Administration - The Civilian Program field office budget submittals were processed during the quarter. Editing of the Draft Civilian Remedial Action Program FY 1986 Budget submittal was completed in March and the final document will be transmitted to DOE-HQ in April; (b) Shippingport Station Decommissioning Project - The Decommissioning Operations Contractor (DOC) contract was awarded on March 14 completing milestone #3 as scheduled. The letter contract with General Electric/ Morrison Knudson covers an initial 90-day period. A full DOC contract will be negotiated between DOE-RL and General Electric during the 3rd quarter, FY 1984. Assistant Secretary of Nuclear Energy (ASNE) approval for the initiation of Shippingport decommissioning operations (Key Decision Point 3-DRAP controlled milestone) has been delayed, pending the outcome of a meeting to be held at Headquarters in April with the ASNE, UNC, DOE-RL and DOE-HQ. The meeting will center around the material presented in the Project Plan and the Project Management Plan. Milestone completion was originally scheduled for April 1 and will be delayed approximately two weeks, pending ASNE's approval; and (6) San Francisco - SNAP 8 (Building 059) Decommissioning - Initial water removal from Building 059 has been completed. The facility is now in a surveillance and pump-on-demand mode. Future work will be limited to monitoring and occasional water removal. (Auth)(BDC)

Chapter 2

NUCLEAR FACILITIES DECOMMISSIONING

- Design, Planning, and Regulations
- Environmental Studies and Site Surveys
- Decontamination Studies
- Dismantlement and Demolition
- Site Stabilization and Reclamation
- Waste Disposal
- Remedial Action Experience
- General Studies

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

79

American Nuclear Society, La Grange Park, IL

American National Standard for Decommissioning of Research Reactors

ANSI/ANS-15-10-1981; 19 pp. (1981)

This standard provides requirements and guidance for the decommissioning of research reactors and includes decommissioning alternatives, planning, radiation criteria, surveillance and maintenance, environmental impacts, quality assurance, and reports and documentation. (EDB)

80

JPDR Decommissioning Program

Atoms in Japan (March 1983):10-18 (1983, March)

A brief description is presented of national policy on decommissioning and the related JPDR program, both of which are the responsibility of the Japan Atomic Energy Research Institute (JAERI). The JPDR began operation in 1963 and was shut down in 1976. This article describes the phase 1 program for the decommissioning of the JPDR. The techniques described in phase 1 include: decommissioning system engineering; radionuclide inventory estimation; decontamination; reactor disassembly; remote handling; waste management; and radiation control. (PTO)

81

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

Residual Radioactivity

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 268-306) (1979)

The establishment of a standard, concerning 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)(JMF)

82

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

Evaluation of Nuclear Facility Decommissioning Projects Program

UNI-SA-117; CONF-8310143; Proceedings of 11th Nuclear Regulatory Commission Water Reactor Safety Research Information Meeting, Gaithersburg, MD, October 14, 1983; (7 pp.) (1983, September 9)

The objective of the Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) program is to provide the NRC licensing staff with data that will allow an assessment of radiation exposure during decommissioning and the implementation of ALARA techniques. The data will also provide information to determine the funding level necessary to ensure timely and safe decommissioning operations. Actual decommissioning costs, methods, and radiation exposures are compared with those estimated by the PNL, ORNL, and NRC on decommissioning. Exposure reduction techniques applied to decommissioning activities to meet ALARA objectives are described. The lessons learned concerning various decommissioning methods are evaluated. (EDB)

83

Baumann, B.L., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects Program: A Reference Research Reactor - Project Summary Report

UNI-2596; 91 pp. (1983, October)

This document presents, in summary form, generic conceptual information relevant to the decommissioning of a reference research reactor (RRR). All of the data presented were extracted from NUREG/CR-1756 and arranged in a form that will provide a basis for future comparison studies for the Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) program. (EDB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

84
Bermanis, G.

Recovery of Decommissioning and Spent Fuel Charges

Atomnaya Tekhnika za Rubezhom 6(86):37-39 (1982)

The licensing and financial aspects of NPP decommissioning, deactivation, and dismantling of radioactive equipment in the USA are considered. Data on the costs of spent fuel transport and conservation are given. The state of the problem development in other countries is briefly described. It is pointed out that the technical aspect of the problem has been better studied than the licensing and financial aspects. At the same time, in contrast to TPP, NPP use is connected with considerable expenses at the end of a power plant's service. (EDB)

85
Burns, R.E., J.S. Henderson, W. Pollard, T. Pryor, and Y.M. Chen, National Regulatory Research Institute, Columbus, OH

Funding Nuclear-Power-Plant Decommissioning - Final Report

DOE/RG/10268-T2; 134 pp. (1982, October)

The report is organized according to the steps that may be gone through when analyzing funding of decommissioning costs. The first step in analyzing decommissioning costs may be to review the present regulatory framework within which decommissioning cost decisions must be made. A description is presented of the present NRC regulations that address the decommissioning of a nuclear power plant. A description is also presented of recent public utility commission activities concerning funding the costs of decommissioning. Possible future trends in NRC regulation are also discussed. The estimation of decommissioning costs is analyzed. A description of each of the possible decommissioning options is presented. The options of decommissioning include immediate dismantlement, various types of safe storage, and entombment. A discussion is presented of cost estimations for each decommissioning option for nuclear units containing pressurized water reactors and boiling water reactors. A description is included of the various methods of collecting funds for decommissioning as well as a discussion of their possible regulatory treatment. Material is presented to provide the reader with background information that may assist state utility commissioners or their staffs in choosing or evaluating one of the financial mechanisms for covering decommissioning costs. (EDB)

86
Calkins, G.D., U.S. Nuclear Regulatory Commission, Washington, DC

Suggested Policy and Rule Changes

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 375-399) (1979)

Preliminary thoughts on regulatory changes for decommissioning are presented. The technical reports from Battelle Pacific Northwest Laboratory, the preliminary staff studies on financial assurance and radioactive residues, and the preliminary draft generic environmental impact statement of Carl Feldman are the sources of information. (EDB)(JMF)

87
Calkins, G.D., U.S. Nuclear Regulatory Commission, Washington, DC

Brief Review and Status of Reevaluation Program

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 92-136) (1979)

Reevaluation of U.S. Nuclear Regulatory Commission decommissioning procedures for nuclear power plants, fuel fabrication plants, and fuel reprocessing plants is presented. (EDB)(JMF)

88
Central Electricity Generating Board, London, United Kingdom

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Decommissioning of CEGB Nuclear Power Stations

Brochure; 7 pp. (1982, July)

The Central Electricity Generating Board (CEGB) operates nine nuclear power stations in England and Wales and has four others under construction. This leaflet outlines the Board's plans for dealing with these stations when they reach the end of their useful lives and are closed down, including the measures that will be taken to ensure public safety at all times. (Auth)(EDB)

89
Clement, B., Minsitere de l'Industrie et de la Recherche, Paris, France

Safety and Regulation Aspects of Nuclear Facilities Shutdown

CONF-7703138; FRNC-CONF-192; Decommissioning of Nuclear Installations, Proceedings of an Information Session, Paris, France, March 31, 1977; (7 pp.) (1977)

An evaluation is presented of the various disposition modes that will be acceptable to the authorities responsible for safety in shutdown nuclear facilities. Disposition modes, ranging from surveillance and maintenance after removal of fissile materials and radioactive fluids to complete dismantlement, are discussed. Each disposition mode was studied to ensure protection of public health and the environment. (JMF)(PTO)

90
Denham, D.H., Pacific Northwest Laboratory, Richland, WA

Plea for Realistic Environmental Surveillance: Decommissioning Criteria Based on Radiation Dose

CONF-820613; Radiological Protection - Advances in Theory and Practice, Proceedings of the Third International Symposium, Inverness, Scotland, June 6-11, 1982; (pp. 506-511) (1982)

Annual whole body equivalent radiation doses were calculated for ingestion or inhalation of specific environmental media contaminated with radionuclides at the lower limits of detection given in U.S. NRC Regulatory Guide 4.8. The "minimum" dose rates calculated were found to vary by more than an order of magnitude depending on the nuclide and medium chosen. This paper focuses on the need for consistent and realistic dose criteria for environmental surveillance and decommissioning programs, especially the relationships between environmental detection levels and potential annual doses, as well as the need for establishing de minimis dose criteria. (EDB)

91
Detilleux, E.J., and W. Lennemann, International Atomic Energy Agency, Vienna, Austria

Criteria, Standards and Policies Regarding Decommissioning of Nuclear Facilities

IAEA-CN-36/490; CONF-770505; Nuclear Power and Its Fuel Cycles, Proceedings of the International Conference, Salzburg, Austria, May 2-13, 1977; (13 pp.) (1977)

The paper discusses the decontamination and decommissioning experiences encountered at the Eurochemic Fuel Reprocessing Plant and the implications and knowledge gained from these experiences. It includes the results of technical reviews made by the Nuclear Energy Agency of the Organization for Economic Cooperation and Development and the International Atomic Energy Agency regarding decommissioning nuclear facilities. The conclusions presented should weigh heavily in the considerations of national authorities involved in regulating nuclear power programs. Special planning should be conducted by those responsible for the nuclear facility. This planning should include a realistic determination of the eventual disposition of the nuclear facility, even before it is built. Recommendations are made concerning the responsibilities of nuclear plant designers, entrepreneurs, and operators, as well as public and regulatory authorities. (EDB)(JMF)

92
Doerge, D.H., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Evaluation of Nuclear Facility Decommissioning Projects: Summary Report - Plum Brook Reactor Facility

NUREG/CR-3605; 54 pp. (1984, February)

This document summarizes information concerning the decommissioning of the Plum Brook Reactor Facility, which was placed in a Nuclear Regulatory Commission (NRC) approved safe storage configuration. The data were placed in a computerized information retrieval/manipulation system which permits future utilization of this information in decommissioning of similar facilities. The information is presented both in computer output form and a manually assembled summarization. Complete cost data were not readily available and decommissioning activities did not in all cases conform with current criteria for the SAFSTOR decommissioning mode, therefore no cost comparisons were made. (EDB)

93

Evaluation Research Corporation, Oak Ridge, TN

Characterization of Contaminated Nuclear Sites, Facilities and Materials: Accelerators, Final Report

PB-83-178343; 146 pp. (1983)

The U.S. Environmental Protection Agency (EPA) is developing environmental protection standards for evaluating the risks and characterizing problems associated with disposal of radioactive wastes arising from decontamination and decommissioning (D&D) operations. A list was compiled of organizations operating 1042 active particle accelerators. A review of the operational health physics problems at these facilities, was used to characterize the types and volumes of wastes which are likely to result from D&D. The accelerators were grouped into three general classes (constant direct current field machines, incremental acceleration machines and magnetic field machines) based upon the method of particle acceleration. (EDB)

94

Federal Energy Regulatory Commission, Washington, DC

FERC Receives Maine Yankee Atomic Power Filing of Jurisdictional Rate Increases to Recover Costs of Decommissioning Its Nuclear Generating Facility and for an Increase in the Return on Common Equity, to be Effective May 22, 1984 - Comment Deadline April 18, 1984

Federal Register 49(69):13912 (1984, April 9)

On March 23, 1984, Maine Yankee Power Company tendered for filing proposed changes in its FPC Electric Rate Schedule No. 1. The proposed changes would increase revenues from jurisdictional sales and service by $26,088,420, based on the 12-month period ending December 31, 1981. Maine Yankee proposes to make the changes effective May 22, 1984. Maine Yankee states that the changes include two amendments to the Power Contract between Maine Yankee and its ten owner-sponsors. Amendment 1 would ensure Maine Yankee's ability to recover its estimated costs of decommissioning its nuclear generating facility during the term of the Power Contract. Amendment 2 would authorize an increase in the return on common equity and would authorize imposition of a late payment charge on overdue bills. Maine Yankee further states that it is proposing to increase its return on common equity from 10.0% to 17.5%. Maine Yankee is also proposing to increase its equal collection for estimated decommissioning costs from $1.826 million to $17.9 million. Finally it proposes to change its accounting and billing practices to expense and bill currently the carrying costs associated with all projects other than those specifically undertaken to increase the potential output of its nuclear generating and maintaining nuclear fuel in process and in inventory. An effective date of May 22, 1984 is proposed. (Auth)(LFG)

95

Foyt, W.W., Houston Lighting and Power Company, Houston, TX

Decommissioning a Nuclear Power Plant: The Tax Effects

Public Utilities Fortnightly 110(11):46-47 (1982, November 22)

The tax treatment of decommissioning costs is as important a consideration as construction costs. The principles also apply to offshore operations and pipeline systems having a negative salvage value. Estimates place the cost at somewhere between 15 and 100% of construction

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

costs, depending on how the decommissioning is done. It is essential to find an accurate way to project decommissioning costs and to decide how they should be reported for tax purposes. The Internal Revenue Service (IRS) does not plan to apply Section 167, which deals with negative net salvage. Utility customers will ultimately provide the funds, but current IRS rulings count these funds as ordinary income and do not allow matching the additional revenue with decommissioning expenses. (EDB)(DCK)

96

Gesellschaft fur Reaktorsicherheit mbH, Koeln, Federal Republic of Germany

Annual Report on Reactor Safety Research Projects Sponsored by the Ministry for Research and Technology of the Federal Republic of Germany

GRS-F-115(3-82) (1981)

Information is presented concerning: blowdown and emergency core cooling; core meltdown; external influences; behavior, transport, and release of radioactive substances; containment and associated systems; instrumentation, control, and computerized protection; safeguards; core and primary circuit in steady state conditions; material and mechanical problems under normal and accident conditions; quality assurance; probabilistic methods of safety analysis; and nuclear accident recovery and decommissioning. (EDB)

97

Goddard, A.J.H., Imperial College of Science and Technology, Department of Mechanical Engineering, London, United Kingdom

Decommissioning of Nuclear Generating Stations

Scientific and Technical Studies Report (1982)

Decommissioning of nuclear reactors is discussed, with reference to the Nuclear Installations Inspectorate safety assessment principles, radiation doses, light-water and gas-cooled reactors, and waste disposal. (EDB)

98

Greenwood, D.F., Stone and Webster Engineering Corporation, Boston, MA

Analysis of Decommissioning Costs for Nuclear Power Reactors

American Society of Mechanical Engineers 82-NE-20; 10 pp. (1982)

This paper presents the results of an analysis of recent decommissioning cost studies, which was originally performed for the National Environmental Studies Project (NESP) of the Atomic Industrial Forum (AIF) in 1981. The purpose of the study was to compare the cost analyses presented in the NESP decommissioning study, "An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives," which was performed in 1976, with other government and industry studies of the cost of decommissioning conventional light-water reactor generating stations (PWRs and BWRs), published since 1975. The costs reported in each study are examined and tabulated by reactor type and decommissioning alternative and are escalated to a common base of January 1, 1982, dollars to provide a reasonable comparison. The differences in estimated decommissioning costs reported by the various studies are then reviewed, reconciled, and/or clarified, where possible, and the various factors that contribute to the cost differences are identified. (EDB)

99

Greenwood, D.F., J.W. Rymsha, E.A. Tondu, and R.K. Westfahl, Stone and Webster Engineering Corporation, Boston, MA

Analysis of Nuclear Power Reactor Decommissioning Costs

AIF/NESP-021; 39 pp. (1981, May)

The study was undertaken by the National Environmental Studies Project to examine various studies and cost estimates for decommissioning, to determine whether differences are real or apparent, and to explain the reasons for significant differences. The objective was to provide information to help develop perspective and reduce confusion over decommissioning costs and the methods used by the industry in estimating them. (Auth)(MFB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

100
Greenwood, D.F., J.W. Rymsha, E.A. Tondu, and R.K. Westfahl, Stone and Webster Engineering Corporation, Boston, MA

Analysis of Nuclear Power Reactor Decommissioning Cost: Summary Report

AIF/NESP-021-SR; 245 pp. (1981, May)

This report is a summary of AIF/NESP-021, which analyzes in detail the decommissioning cost estimates for nuclear power reactors and provides a framework for the reconciliation or clarification of the various approaches to the problem. (Auth)(MFB)

101
Greenwood, D.F., J.W. Rymsha, and R.K. Westfahl, Stone and Webster Engineering Corporation, Boston, MA

Analysis of Decommissioning Costs for Nuclear Power Reactors

Nuclear Technology 62(2):190-205 (1983, August)

An analysis of decommissioning cost studies compared the cost analysis presented in the 1976 National Environmental Studies Project decommissioning study with 18 other government and industry studies of the cost of decommissioning conventional light-water reactor generating stations. Six major factors that contributed to the cost differences were differences in the scope of work, the level of detail of the estimate, variations in significant cost factors, inclusion/exclusion of major cost items, plant size and configuration/design differences, and site-specific factors. (EDB)

102
Gregory, A.R., Central Electricity Generating Board, London, United Kingdom

Sizewell 'B' Power Station Public Inquiry: CEGB Proof of Evidence - Decommissioning

CEGB-P-24; 24 pp. (1982, November)

The procedure for decommissioning a CEGB nuclear power station is described. Regulatory and licensing procedures in the UK are first listed. The principal sources of radioactivity in the station after final shutdown are classified. The three stages of the decommissioning procedure are then described. Finally, the following topics are dealt with briefly: the management of decommissioning wastes, radiological protection during the operation, possible faults arising having radiological significance, design for decommissioning, and costs. (EDB)

103
Hall, T.M., UNC Nuclear Industries, Inc., Richland, WA; U.S. Energy Research and Development Administration, Washington, DC

Practical Application of ALARA (ALAP) Philosophy

CONF-761101; Remote Systems Technology, Proceedings of the 24th Conference, Washington, DC, November 14-19, 1976; (42 pp.) (1976)

The N Reactor is the only dual-purpose reactor in the United States. It is owned by ERDA and is currently operated by United Nuclear Industries, Inc (UNI). The plant began operation in 1964. Monitoring of the primary coolant piping radiation levels indicated a build-up that was not linear with time. It has been forming at an accelerating rate. It was apparent that radiation exposure was going to be a significant factor in the plant's operation. By 1967, connector piping radiation level was 1 rem/hr and a radiation exposure reduction task force was chartered to develop and carry out an exposure reduction plan. A decontamination task force was also chartered to determine how to chemically clean out the primary piping in order to reduce the radiation level. In October 1967, the first reactor piping decontamination was performed, and connector radiation levels were reduced from 1 rem/hr to 20 mrem/hr. The task forces also attacked other radiation exposure problems with success. In 1974, an exposure reduction program manager position was created to carry on the work of the task force. Out of this came the current effort for as-low-as-reasonably- achieved (ALARA) and/or as-low-as-possible (ALAP) radiation levels. By necessity, N Plant operation has been applying the principles of ALARA and ALAP since 1967. The methods have improved with time, new techniques have been put to use, and others have been discarded. The purpose of this paper is to describe how UNI has made practical the application of the ALARA and ALAP principles. (Auth)(JMF)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

104

Huber, B., and S. Orlowski, Commission of the European Communities, Brussels, Belgium

The Community's Research and Development Programme on Decommissioning of Nuclear Power Plants - 1982 Annual Progress Report

EUR-8962-EN; 103 pp. (1984)

This is the third progress report of the European Community's program (1979-1983) of research on the decommissioning of nuclear power plants. It covers the year 1982 and follows the 1980 and 1981 Reports. The program seeks to promote a number of research and development projects as well as the identification of guiding principles. The projects concern the following subjects: (1) long-term integrity of buildings and systems; (2) decontamination for decommissioning purposes; (3) dismantling techniques; (4) treatment of specific waste materials such as steel, concrete, and graphite; (5) large transport containers for radioactive waste, arising from decommissioning of nuclear power plants in the Community; and (6) influence of nuclear power plant design features on decommissioning. The research is carried out by public organizations and private firms in the community under cost-sharing contracts with the Commission of the European Communities. The Commission budget planned for this five-year program amounts to 4.7 million ECU. (Auth)(MFB)

105

International Atomic Energy Agency, Vienna, Austria

Safety in Nuclear Power Plant Operation Including Commissioning and Decommissioning

IAEA-50-C-O; 35 pp. (1980)

Safe operation of a nuclear power plant postulates satisfactory siting, design, construction, and commissioning, together with proper management and operation of the plant. This standard deals with the safety aspects of managing, commissioning, operating, and decommissioning a plant. (Auth)

106

Koch, D.A., and M.J. Akins, Gilbert Associates, Inc., Reading, PA

Preparing a Decommissioning Cost and Technology Study

CONF-821005; International Decommissioning Symposium - 1982, Proceedings of the U.S. Department of Energy's Remedial Action Program/OECD Nuclear Energy Agency Conference, Seattle, WA, October 10-14, 1982; (pp. VII.51-VII.65) (1982)

Decommissioning planning requires a systematic approach to determine costs, radiation exposure, waste disposal, manpower requirements, dismantling and decontamination procedures, personnel protection, and schedules. The basic document of decommissioning planning is the cost and technology study prepared for the specific site. It is important that this study yield results that are complete and comprehensive. This is accomplished by utilizing a methodology known as the Work Package concept which accounts for all significant cost factors and technical activities. The Work Package concept divides all labor and materials into specific increments which are basically suitable for all power plants and produces summaries of the major results. This paper describes the major study outputs, the work package format and function, and the type of input criteria which must be collected prior to the commencement of the study. It is concluded that correct formatting is essential to the complete and consistent processing of large and varied amounts of data and that details and input criteria are crucial to assure adequate sensitivity and reliable results. (EDB)

107

Koch, D.A., and R.E. Huebner

Planning for Nuclear Power Plant Decommissioning

Power Engineering 87(7):56-59 (1983, July)

Over the years, many of the early nuclear demonstration and experimental facilities have been decommissioned providing a large store of experience and technology. Currently, in anticipation of the decommissioning of larger and more complex nuclear units over the next several decades, the nuclear community is preparing a formalized procedure that sets forth the alternative methods, the pertinent regulations, and the design considerations that will facilitate the decommissioning. (INSPEC)

108
Lawton, H., United Kingdom Atomic Energy Authority, Windscale Nuclear Power Development Laboratories, Seascale, United Kingdom

Decommissioning the WAGR

Atom 313:228-232 (1982, November)

The planned decommissioning of the Windscale Advanced Gas-cooled Reactor, which will take about ten years, is discussed with special reference to the radioactive decay of the reactor components, the problems of disposal of the resulting radioactive waste, and the planning of the necessary engineering works. (EDB)

109
McHugh, B., Chalmers Tekniska Hoegskola, Institutionen foer Energiteknik, Goeteborg, Sweden

List of Abnormal Occurrences at Swedish Nuclear Power Stations

CTH-IE-74-55; 32 pp. (1974, August)

This report consists of a list of extracts from documents belonging to Statens Kaernkraftinspektion (SKI) in Sweden. It deals with non-routine occurrences at the Swedish nuclear power stations which are in operation or where test operations of components and systems have started. The investigation has included matter about the following nuclear power plants: Barsebaeck-1, Oskarshamn-1, Oskarshamn-2, Ringhals-1, Ringhals-2, Agesta. All cases are from the start of the test operations up to June 1, 1984. (EDB)(EST)

110
Miller, R.L., and B.L. Baumann, UNC Nuclear Industries, Inc., Office of Surplus Facilities Management, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects: Annual Report, Fiscal Year 1983

NUREG/CR-3550; 152 pp. (1984, January)

This document summarizes work performed during the 1983 fiscal year for the Nuclear Regulatory Commission's Evaluation of Nuclear Facility Decommissioning Projects program. The report describes actual work performed during the reporting period and work planned for the future. Included as an appendix to the report is a draft of the Decommissioning Code Table/Indexes for BWR, PWR, Research, and Test Reactors included in this study. Other appendices list current data from the TMI-2 recovery efforts and Shippingport Atomic Power Station Decommissioning. (Auth)

111
Mohrhauer, H., M. Krey, G. Haag, J. Wolters, E. Merz, and P.F. Sauermann, Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Supply, Operation and Radioactive Waste Disposal of Nuclear Power Plants

JUEL-CONF-41; CONF-810287; Proceedings of a Seminar, Juelich, Federal Republic of Germany, February 10, 1981; (57 pp.) (1981)

The subject of 'Nuclear Fuel Cycle' is treated in 5 reports: (1) Uranium supply, (2) Fabrication and characteristics of fuel elements, (3) Design, operation and safety of nuclear power plants after Harrisburg, (4) Radioactive waste disposal of nuclear power plants - changed political scenery after 1979, and (5) Shutdown and dismantling of LWR-KKW - state of knowledge and feasibility. (EDB)

112
Munson, L.F., G.A. Halseth, and J.R. Divine, Pacific Northwest Laboratory, Richland, WA

Safety Aspects of Decontamination as a Precursor to Decommissioning

PNL-SA-10291; CONF-821005; International Decommissioning Symposium - 1982, Proceedings

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

of the U.S. Department of Energy's Remedial Action Program/OECD Nuclear Energy Agency Conference, Seattle, WA, October 10-14, 1982; (5 pp.) (1982)

The single most important factor in decontamination safety is management commitment. Specific safety concerns are divided into five categories: industrial safety, radiation safety, industrial hygiene, fire safety, and life safety. (EDB) (DLC)

113
Licensing is Under Way in West Germany for One of First Dismantlings of a Nuclear Power Plant

Nucleonics Week 24(1):10 (1983, January 6)

The permit for tearing down the 100-MW Niederaichbach Nuclear Power Station is tentatively expected to be issued in late 1983 or early 1984. The operation will be handled by Noell GmbH, which estimates that the dismantling of the station will take four or five years and cost $33 to 42 million. (BDC)

114
Provision for Future Fuel Disposal and Decommissioning Expenses

Nucleonics Week 24(19):10 (1983, May 12)

Provision for future fuel disposal and decommissioning expenses has been included in Ontario Hydro nuclear power costing for the first time in reporting 1982 operations. Combined with slightly higher uranium costs, the annual disposal and decommissioning charges have increased unit costs for Pickering and Bruce nuclear stations by 14% over 1981 costs. The report shows that nuclear power is still about a third less expensive than coal-fired electricity. A comparison of costs for nuclear versus coal-fired power production using Pickering and Bruce nuclear stations and Lampton and Nanticoke coal-fired stations is presented. (BDC)

115
Pacific Gas and Electric Has Decided to Decommission Its Humboldt Bay Nuclear Plant

Nucleonics Week 24(26):7 (1983, June 30)

A decision has been made to decommission the Humboldt Bay Nuclear Plant rather than pay the high costs of remodeling it to withstand earthquakes. Costs of bringing the 63-MW plant into compliance with NRC safety standards would range between $241 million and $446 million. Decommissioning costs are estimated to be $16 million. The decommissioning option used will be SAFESTOR. The plant will be dismantled in 30 years, when radiation levels will be lower. (BDC)

116
Both Sides in a Squabble over Financing of Vermont Yankee Decommissioning

Nucleonics Week 24(29):9 (1983, July 21)

Vermont Yankee Nuclear Power Corporation requested of the Federal Energy Regulatory Commission that it be allowed to include $422 million in its rate base by the year 2007 to cover costs of decommissioning the 540-MW Vermont plant. Intervenors in the case include the state of Rhode Island and public utility commissions in Maine, Connecticut, and Vermont. Disagreement centers on the fact that current Internal Revenue Service policy does not allow decommissioning collections to be deducted from taxable income during plant operation. Deductions are taken after decommissioning occurs. Since Vermont Yankee Nuclear Power's sole asset is the Vermont plant, it will not have taxable income in the years after decommissioning against which to apply its credits. There are also questions raised about the kinds of liabilities involved under the proposed structure. (BDC)

117
Vermont Yankee Nuclear Power Has Started Collecting Money

Nucleonics Week 24(43):3-4 (1983, October 27)

Money from customer utilities is being collected to pay for the decommissioning of the Vermont Yankee nuclear unit. The plant is scheduled to be decommissioned in 2007. The proposal for collecting funds would raise $423 million over the next quarter century. Decommissioning costs are not yet being passed on to ratepayers. Some Vermont legislators are sponsoring a bill that would force stockholders to pick up half the costs. (BDC)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

118

Utilities Are Disenchanted with a Senate Tax Provision on Decommissioning

Nucleonics Week 25(10):12 (1984, March 8)

Under current Treasury policy, money that utilities collect from customers and place in a fund to cover future decommissioning expenses is taxed as income. No deduction on it is allowed until the actual costs of decommissioning are incurred at the end of the plant's life. Utilities argue that this puts the cost burden on current customers and gives the tax break to future customers. The Senate Finance Committee has attached a Treasury proposal to its $100-billion-deficit reduction package which would allow some deduction for contributions over the life of the plant. A utility official said that the discount rate the Treasury wants to use to calculate the present value of contributions is too large and will not save utilities or their customers money.(BDC)

119

Passant, F.H., Central Electricity Generating Board, London, United Kingdom

Sizewell 'B' Power Station Public Inquiry: CEGB Proof of Evidence, Radioactive Waste Management

CEGB-P-20; 106 pp. (1982, November)

The radioactive wastes expected to arise at the proposed Sizewell B PWR are identified. Provisions for the collection, processing, storage, and disposal of the wastes are described, and quantities and activities of wastes for disposal are derived. Proposed methods of transport and disposal, as well as wastes which would arise from reprocessing and from decommissioning Sizewell B, are discussed. Finally some of the radiological aspects of waste disposal are outlined. (EDB)(EST)(CAJ)

120

Perello, M., Junta de Energia Nuclear, Madrid, Spain

Decommissioning Licensing Procedure

CONF-7911101; Regulatory Review in the Licensing Process, Proceedings of the CSNI Specialist Meeting, Madrid, Spain, November 25-29, 1979; (19 pp.) (1979)

Decommissioning of a nuclear power plant, defined as the events occurring from the moment that the plant stops producing, is causing concern. The specialist meeting on Regulatory Review seems to be the proper forum for presenting and discussing the need of considering decommissioning in the Safety Analysis Report. This paper suggests the need of a new chapter in the Preliminary Safety Analysis Report (PSAR) dealing with the decommissioning of nuclear power plants. A format of the new chapter is presented. (EDB)(JMF)(ARE)

121

Rope, S.K., and S.R. Adams, Idaho National Engineering Laboratory, Idaho Falls, ID

Screening Levels for Radionuclides in Soil: Application to Decontamination and Decommissioning (D and D) Criteria

EGG-M-29182; CONF-821215; Proceedings of a DOE Environmental Protection Information Meeting, Denver, CO, December 7, 1982; (10 pp.) (1982)

Preliminary radionuclide concentrations in soil are presented which correspond to a 1.0 mrem/year dose equivalent to a homesteading individual. These concentrations are called screening levels. The theoretical individual resides on the contaminated area and derives all his food from locally-raised sources. Pathways considered are ingestion of meat, milk, and vegetables (no water ingestion pathway), inhalation of resuspended soil, and external radiation dose from soil. The relative significance of each pathway is discussed. Screening levels for each radionuclide are based on limiting the total radiation dose from all pathways to 1.0 mrem/year (specifically 1.0 mrem weighted committed dose equivalent using ICRP 26 methodology). Using site-specific data for Idaho, screening levels for 13 radionuclides associated with D and D activities are derived. Calculated screening levels are compared with those proposed by the EPA and other authors. The screening level derivation is only one factor used in the D and D decision analysis, and the derived values are guidelines, not rigid criteria. Because of the conservative scenario used, the screening level concentrations may be several orders of magnitude low compared to those from a realistic analysis. Screening levels derived in this paper generally cannot be measured with widely-available survey instruments. (Auth)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

122
Silver, R.

Letting a Nuclear Power Station Cool Off for 30 Years

Nucleonics Week 23(29):7-8 (1982, July 22)

Ontario Hydro engineers informed the Ontario Energy Board that the deferred dismantlement method should be considered in setting electricity rates. Hydro's reactor waste management engineer suggests that while the 30-year deferral would lead to unrestricted site use a generation later, it would actually cost about 20% less than almost-immediate dismantlement and 30% less than a 500-year delay, during which time the site would have to be continually monitored and subjected to restricted use. Based on the 30-year deferred-dismantlement option, Hydro proposes to allocate $12 million in 1983 to cover ultimate decommissioning of the Pickering and Bruce units now in service. An immediate dismantlement scheme would require a $31-million allocation in 1983, and a 500-year delay would need only $6 million at this time. (BDC)

123
Sissingh, R.A.P., Ontario Hydro, Toronto, Ontario, Canada

Preliminary Nuclear Decommissioning Cost Study

CONF-8106200; INIS-mf-8473; Proceedings of 21st Annual International Conference of Canadian Nuclear Association and Second Annual Conference of Canadian Nuclear Society, Part 1, Ottawa, Ontario, Canada, June 8, 1981. Atomic Energy of Canada Limited, Ottawa, Ontario, Canada; (pp. 245-252) (1981)

This preliminary nuclear decommissioning cost study addresses the technical and cost aspects of decommissioning Ontario Hydro's CANDU multi-unit nuclear stations. It concentrates on the logistical, technical and cost aspects of decommissioning, using Pickering Generating Station, Unit A as the reference design. It has been found that with the exception of reactor core dismantlement, which will be done remotely, the dismantlement of all other systems and buildings can be accomplished using Ontario Hydro's current operating, maintenance and construction procedures and practices. (EDB)

124
Sissingh, R.A.P., Ontario Hydro, Toronto, Ontario, Canada

Preliminary Nuclear Decommissioning Cost Study

OH-81156; 68 pp. (1981, April)

The decommissioning of a nuclear power plant may involve one or more of three possible options: storage with surveillance (SWS); restricted site release (RSR); and unrestricted site use (USU). This preliminary study concentrates on the logistical, technical and cost aspects of decommissioning a multi-unit CANDU generating station using Pickering Generating Station, Unit A as the reference design. The procedure chosen for evaluation is: (1) removal of the fuel and heavy water followed by decontamination prior to placing the station in SWS for thirty years; and (2) complete dismantlement to achieve a USU state. The combination of SWS and USU with an interim period of surveillance allows for radioactive decay and hence less occupational exposure in achieving USU. The study excludes the conventional side of the station, assumes waste disposal repositories are available 1600 km away from the station, and uses only currently available technologies. (EDB)(EST)

125
Smith, R.I., U.S. Nuclear Regulatory Commission, Washington, DC

Pressurized Water Reactor Addendum

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 164-194) (1979)

A decommissioning analysis of the Trojan plant, a 1175 MW reactor located near Portland, Oregon, is presented. The Trojan plant is a four-loop Westinghouse nuclear steam supply system. (EDB)(JMF)

126
Squilanti, R.G., and G.M. Gans, Jr., Burns and Roe Industrial Services Corporation, Paramus, NJ

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Planning Considerations in Nuclear Facility Decommissioning

American Society of Mechanical Engineers 83-JPGC-NE; 6 pp.; CONF-830905; Proceedings of the Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; (6 pp.) (1983)

The authors' experience in planning the decommissioning of the Shippingport Atomic Power Station has led to a number of pertinent conclusions concerning the planning concepts and sequences which should be applied when considering the decommissioning of nuclear facilities. Planning thoughts are presented for four different areas: for the period of time before operations start; for accumulation and recording of data during the operational life of the facility; for guiding the detailed engineering; and for the actual field dismantling period, when certain sequences are important. Definitive, well-conceived planning is required in all these areas if the decommissioning effort is to be efficiently and safely performed. (EDB)

127
Squilanti, R.G., and G.M. Gans, Jr., Burns and Roe Industrial Services Corporation, Paramus, NJ

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128
Stucker, J.P., Rand Corporation, Santa Monica, CA

Uncertainty in Estimating Power-Plant Closure Costs: A Review of Economic Impact of Closing Zion Nuclear Facility, A Report by the Comptroller General of the United States

AD-A-118807/7; 43 pp. (1982, March)

Comparison of the Government Accounting Office's (GAO) estimates of the costs that could result from the closure of Zion and Indian Point reveals the large range of uncertainty currently associated with such estimates and suggests a number of areas requiring further study. Better and more detailed information in general needs to be developed and documented on alternative generating costs, decommissioning costs, incremental financing costs, and secondary costs. The groups or institutions who will ultimately bear these costs need to be identified. Uncertainties in all these areas must be reduced and common costing methods and assumptions adopted before intelligent decisions can be made regarding the future of any of the nuclear generating facilities (either operational or under construction). (EDB)(EST)(CAJ)

129
Svensk Karnbranslefoersoerjning AB, Stockholm, Sweden

Technology and Costs for Dismantling a Swedish Nuclear Power Plant

KBS-TR-79-22; 95 pp. (1979, October)

The purpose of this study was to provide background material needed to estimate the costs and time required to dismantle an ASEA-ATOM Boiling Water Reactor for Swedish nuclear power utilities. The units Oskarshamn II and Barsebeck 1, both with an installed capacity of approximately 600 MW, served as reference plants. A forty-year period of operation before final shutdown was assumed. It was also assumed that dismantling operations will be initiated one year after shutdown. When the dismantling of the plant is finished, the site will be released for unrestricted use. Costs for dismantling and subsequent final disposal of the radioactive waste, are estimated at approximately SEK 500 million (approximately $120 million in U.S. currency) in terms of 1979 prices. The sum includes a 25% contingency. The dismantling cost is equivalent to 10%-15% of the installation cost of an equivalent new nuclear power plant. The exact percentage depends on the interest rate during the construction period. The study shows that total dismantling can be accomplished in less than five years. (Auth)(BDC)(ARE)

130

Svensk Karnbranslefoersoerjning AB, Stockholm, Sweden

Radioactive Waste Management Plan, Plan 82 - Part 2: Facilities and Costs

SKBF-KBS-TR-82-09-2; 66 pp. (1982, June)

This report is the first account by the nuclear power utilities of Sweden concerning the plans for final disposal of radioactive waste products. Part 2 describes the waste facilities in detail with layouts and estimated costs. The decommissioning and postponement of decommissioning of nuclear power plants is discussed. (EDB)(EST)

131

Svensk Karnbranslefoersoerjning AB, Stockholm, Sweden

Plan for the Radioactive Residual Products of the Nuclear Power - Part 2: Plants and Costs

SKBF-PLAN-82-2; 58 pp. (1982, June)

This report is the first account by the nuclear power utilities of Sweden concerning plans for the final disposal of radioactive waste products. Part 2 describes waste facilities in detail with layouts and estimated costs. The decommissioning and postponement of decommissioning of nuclear power plants is discussed. (EDB)(EST)

132

Tomik, L., E. Hladky, B. Zizka, and J. Strba, Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia; Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia

Deactivation and Dismantling of Nuclear Power Plants After Their Decommissioning

CONF-7904193; Nuclear Power and the Environment, Proceedings of a Conference, Zdar and Sazavou, Czechoslovakia, April 2, 1979 (1979)

A brief survey of methods used in the decontamination of nuclear power installations and their equipment is presented. The choice of method and deactivation means depends on a number of factors such as the character and form of the contaminant, the chemical composition of the deactivation material, the shape of the surface, its mechanical and/or chemical treatment, the required reduction in radiation level, and the type of reactor. The problem of deactivating the nuclear installation equipment prior to shut-down and final decommissioning is discussed. The basic variants of decommissioning are given, i.e., mothballing (putting the facility in a state of protective storage), in-place entombment, immediate removal of radioactive components and dismantling, or the combination of the three methods. (EDB)(JMF)

133

Toto, G., and H.R. Wyle, Westinghouse Electric Corporation, Nuclear Service Integration Division, Pittsburgh, PA

Remote Machine Engineering Applications for Nuclear Facilities Decommissioning

American Society of Mechanical Engineers 83-JPGC-NE; CONF-830905; Proceedings of the Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; (7 pp.) (1983)

Decontamination and decommissioning of a nuclear facility require the application of techniques that protect the worker and the environment from radiological contamination and radiation. Remotely operated portable robotic arms, machines, and devices can be applied. The use of advanced systems should enhance the productivity, safety, and cost facets of the efforts; remote automatic tooling and systems may be used on any job where job hazard and other factors justify application. Many problems based on costs, environmental impact, health, waste generation, and political issues may be mitigated by use of remotely operated machines. The work that man can not do or should not do will have to be done by machines. (EDB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

134

Turner, S.E., W.E. Carson, and W. Mitchell, Southern Science, Dunedin, FL

A Study of Research Needs and Priorities in Radioactive Waste Management - Decommissioning and Decontamination

DOE/ER/30042-T1; 69 pp; (pp. 11-14) (1984, February)

This report presents results of an assessment of long-range research needs in nuclear waste management. The section on decommissioning and decontamination includes background information and the following recommendations: (1) establish a range of options and use the Shippingport facility to determine the risks and costs involved in decommissioning and decontamination; (2) develop specific plans to obtain data to use as a basis for guiding development of performance standards and engineering requirements associated with decommissioning and decontamination; and (3) consider in detail the potential recovery of valuable materials and components, the postulated impacts for various regions of the country, the extent and nature of the impacts, and the time periods over which they are most significant. (BDC)

135

U.S. House of Representatives, Washington, DC

Financing the Cleanup of Three Mile Island Unit 2 Nuclear Power Plant

Hearings Before the Committee on Interior and Insular Affairs, United States House of Representatives, 97th Congress, April 23 and 27, 1982; 603 pp. (1982)

Hearings were conducted to learn the status of efforts to finance the cleanup of Three Mile Island, Pennsylvania, Unit 2 Nuclear Power Plant. The costs incurred by the cleanup are expected to be about $1 billion. Proposed cost-sharing agreements involving the U.S. Department of Energy (DOE), the State of Pennsylvania, and General Public Utilities are discussed. The possibility of passing on some of the costs to utility ratepayers is examined. Remedial actions required to clean up the reactor unit and associated radiation protection measures are surveyed. Testimony was delivered by Representative Allan Ertel (D-PA), General Public Utilities Chairman William Kuhns, Joseph Marrone of American Nuclear Insurers, and others. Related documents and memoranda are transcribed. (ENVIR)

136

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Initiates Proceeding on Proposed Decommissioning of Kerr McGee Chemical Corporation Rare Earth Facility, West Chicago, DuPage County, Illinois, Having Accepted Attorney General of Illinois Formal Revision of Statement of Interest on Behalf of Illinois Department of Nuclear Safety and the People of Illinois

Federal Register 49(67):13611 (1984, April 5)

On June 7, 1983, the Nuclear Regulatory Commission (NRC) published in the Federal Register a notice announcing Kerr-McGee's proposal to decommission their Rare Earths Facility. The notice indicated that Kerr-McGee proposed to demolish the existing buildings, remove the building rubble and contaminated soil to an adjacent disposal site, and stabilize the rubble, soil, ore residues and ore tailings on that adjacent site. The notice further indicated that NRC Staff's alternative of choice is stabilization and storage as proposed by Kerr-McGee for disposal, with future evaluation of the alternatives of permanent onsite disposal or removal to another site. The notice recited the availability of the staff's Final Environmental Statement and provided that Kerr-McGee or any person whose interest may be affected might file a request for a hearing by July 11, 1983. Timely hearing requests were filed by the Attorney General of Illinois on behalf of the People of the State of Illinois and by the Chamber of Commerce of West Chicago, Illinois. At a prehearing conference in Chicago, Illinois, on February 2, 1984, the Attorney General orally amended (and on February 29 filed a formal revision of) his petition and the Chamber of Commerce's request for a hearing was withdrawn. Consequently, consideration of the Kerr-McGee proposed decommissioning plan and Staff's alternative of choice commenced. (Auth)(LFG)

137

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Publishes Memorandum of Understanding Between NRC and State of Illinois, Providing for Detailed Subagree-

ments in such Areas as Low-Level Radioactive Waste Treatment, Storage and Disposal, Emergency Preparedness, Nuclear Facility Siting and Operation, and Decommissioning of Nuclear Facilities

Federal Register 49(95):20586 (1984, May 15)

The Atomic Energy Act of 1954 allows the Nuclear Regulatory Commission (NRC) to enter into agreements with the states "to perform inspections or other functions on a cooperative basis as NRC deems appropriate." Memorandum of Understanding (MOU) differs from agreements entered into between NRC and a state under the Agreement State program. This MOU signed by the NRC and the State of Illinois, provides principles of cooperation between the state and NRC in areas of concern to the state. The MOU provides the basis for detailed subagreements in areas such as low-level radioactive waste treatment, storage and disposal, emergency preparedness, nuclear facility siting and operation, and decommissioning of nuclear facilities. Under MOU, the state and NRC have committed to consult regularly and cooperate in devising procedures to minimize duplication of effort and avoid delays in decision making. (Auth)(LFG)

138

U.S. Nuclear Regulatory Commission, Washington, DC

State Workshops for Review of the Nuclear Regulatory Commission's Decommissioning Policy

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp. (1979)

Separate abstracts are included for each presentation concerning U.S. Nuclear Regulatory Commission policies on the decommissioning of nuclear power plants, fuel fabrication plants, fuel reprocessing plants, and radioactive waste burial sites. (EDB)(JMF)

139

Urushibara, E., Science and Technology Agency, Atomic Energy Bureau, Tokyo, Japan

Measures of Decommissioning Nuclear Reactors and Problems Thereafter

Denki Kyokai Zasshi 713:26-33 (1983, March)

Assuming the average operating lifetime of nuclear reactors to be 30 years, a number of reactors will be decommissioned around 1995 in Japan. The Atomic Energy Commission established a subcommittee of experts on reactor decommissioning countermeasures in November 1980. This report contains the procedures suggested by the subcommittee for planning the decommissioning of these reactors. (Auth)(PTO)(CAJ)

140

Williams, D.H., Arkansas Power and Light Company, Nuclear Operations, Little Rock, AR

A Utility Perspective on Needs for Technical Advances in Nuclear Decommissioning

American Society of Mechanical Engineers 83-JPGC-NE; CONF-830905; Proceedings of the Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; (4 pp.) (1983)

To a utility inexperienced in this area, there are some items related to the safety aspects of a nuclear decommissioning project that appear to present significant potential cost and project control impacts. This paper presents a few of these items that appear to present significant potential opportunities for improvement via technical advances either directly or through the impact of technical advances on regulatory and planning issues. These items are presented as exceptions to a relatively mature technology which lacks primarily experience. The presentation of each item discusses its relevance to this topic and qualitatively discusses the potential benefits of technical advances involving that item. (EDB)

141

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

Financial Assurance

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 235-264) (1979)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Available decommissioning funding options are compared and the merits, costs, and capabilities of each are analyzed. (EDB)(JMF)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

142

Alexander, W.A., T.W. Oakes, W.F. Ohnesorge, and H.M Hubbard, Oak Ridge National Laboratory, Industrial Safety and Applied Health Physics Division, Oak Ridge, TN

Site Characterization of Soil in Preparation for Decontamination and Decommissioning

Proceedings of the 27th Annual Meeting of the Health Physics Society, Las Vegas, NV, June 27-July 1, 1982 (1982, July)

Soil core samples were taken at various locations adjacent to the old Metal Recovery Building at the Oak Ridge National Laboratory, in preparation for planned decontamination and decommissioning of this facility. The facility was used to process spent reactor fuel. The main isotope recovered was plutonium-239. Soil core samples were collected using a large auger and a coring tube. The coring tube was driven into the soil and the core samples extracted in 46-cm (18-in.) segments to a maximum depth of 6 m (20 ft). Core samples were taken from 25 locations around the facility. Each 46 cm core segment was dried at 105 deg C and ground; a subsample was analyzed for gamma-emitting nuclides. The maximum level of radium-226 in any sample was 0.063 Bq/g. Detectable levels of cobalt-60 were found in five samples. (Auth) (JMF)(NPK)

143

Ausmus, B.S., and V.L. Trinoskey, Bechtel National, Inc., Oak Ridge, TN

Environmental and Health Implications of Chemical Wastes During Decommissioning Operations

Transactions of the American Nuclear Society 46:66-67; CONF-840614; Proceedings of an American Nuclear Society Annual Meeting, New Orleans, LA, June 3-7, 1984; (pp. 66-67) (1984, June)

There are three major steps in identifying the chemical hazards associated with D&D operations: identify and classify the types of hazards; identify significant exposure routes; and determine the environmental or work space distribution of potentially hazardous chemicals. The health and environmental challenges associated with decommissioning operations include: planning decommissioning operations to minimize exposure probability and distribution of contaminants; considering alternatives to decommissioning for environmental systems, especially older facilities; evaluating the risks and costs of decommissioning alternatives in terms of wastes generated and disposal requirements; and carefully estimating the cost of personal protection, procedure development, training, health surveillance, environmental surveillance, and mitigative measures potentially needed. (Auth)(PTO)(CAJ)

144

Bernhardt, D.E., M.W. Grant, D.C. Rich, C.M. Jensen, P.J. Macbeth, and A.A. Sutherland, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Radioactive Contamination at Nuclear Fuel Cycle Facilities

RAE-23-2; 229 pp. (1982, December)

Information is presented to characterize uranium fuel cycle facilities (excluding reactors), levels of contamination at those facilities, and volumes and activity of wastes associated with their decontamination and decommissioning (D&D). This is one of a series of reports developed to assist the U.S. Environmental Protection Agency in setting standards and guidelines for permissible residual levels of radioactivity from D&D. The categories of facilities covered by this report are uranium mines, uranium mills, uranium hexafluoride conversion plants, uranium enrichment plants, fuel fabrication plants (including both low and high enriched uranium and mixed oxide facilities), and fuel reprocessing plants. Both active and inactive facilities are identified. Although emphasis is placed on the light water reactor fuel cycle, other facilities (e.g., high enrichment fuel fabrication plants and Department of Energy conversion and fuel fabrication plants) are also identified. The technical assessments and associated estimates of D&D wastes are based on information in the open literature with an engineering judgment being used where necessary. The highest volumes of D&D waste (hundreds of millions of cubic meters) are associated with uranium mines, while the highest amounts of radioactivity are a result of D&D at fuel reprocessing plants. (Auth)(JMF) (CAJ)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

145

Brodzinske, R.L., Pacific Northwest Laboratory, Richland, WA

Portable Instrumentation for Quantitatively Measuring Radioactive Contamination Levels and for Monitoring the Effectiveness of Decontamination and Decommissioning Activities

PNL-4744; 25 pp. (1983, June)

Two completely portable high-resolution germanium diode spectrometer systems are described. These detectors are capable of measuring transuranics, activation products and fission products, including strontium-90, at sensitivities below the uncontrolled release criteria. The detectors measure x-rays, gamma-rays or bremsstrahlung radiation as needed and have been calibrated for a variety of decontamination and decommissioning scenarios. A new technology for the in situ determination of strontium-90 is also described. (Auth)(JMF)

146

Evaluation Research Corporation, Oak Ridge, TN

Characterization of Contaminated Nuclear Sites, Facilities and Materials: Radioisotope and Radiopharmaceutical Manufacturers and Suppliers, Final Report

PB-83-178327; 107 pp. (1983)

The U.S. Environmental Protection Agency (EPA) is developing environmental protection standards for evaluating the risks and characterizing problems associated with disposal of radioactive wastes arising from decontamination and decommissioning D&D operations. Information on operations conducted at sites authorized to possess radioactive materials for the production and/or distribution of radioisotopes and radiopharmaceuticals was compiled and evaluated. This information was used to project the types, nature, and volumes of wastes which are likely to be generated during decontamination and decommissioning at representative facilities and identifying special problems that may occur. Radioisotope and radiopharmaceutical manufacturers have been grouped together because decommissioning operations will be similar. Nuclear pharmacies were also evaluated because of their increasing numbers and their role as middlemen between manufacturers and users of radiopharmaceuticals. The majority of the radioactive waste will arise from the decontamination of the laboratories, rather than the disposal of components. (EDB)

147

Evaluation Research Corporation, Oak Ridge, TN

Characterization of Contaminated Nuclear Sites, Facilities, and Materials: Research and Development

PB-83-178335; 108 pp. (1983, February)

The U.S. Environmental Protection Agency (EPA) is developing environmental protection standards for evaluating the risks and characterizing problems associated with disposal of radioactive wastes arising from decontamination and decommissioning (D&D) operations. A list of sites authorized to possess radioactive materials for independent research and development (R&D) was compiled. Available information on operations conducted at these sites was used to project the types, characteristics, and volumes of radioactive wastes likely to be generated during their decommissioning. The facilities were divided into three categories according to the operation conducted and the probability of radiological problems arising during D&D. (EDB)

148

Feldman, C.

Generic Environmental Impact Statement

NUREG/CP-0008; CONF-7909106; State Workshop of Review of the Nuclear Regulatory Commission's Decommissioning Policy, Seattle, WA, September 25-27, 1979, 520 pp.; (pp. 314-371) (1979)

The Nuclear Regulatory Commission is reexamining its policy concerning decommissioning, which can have a major impact on the quality of the environment. Therefore, an environmental impact statement is required. The technical alternatives and the major environmental impacts are discussed. (EDB)(JMF)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

149

Hagee, G.R., P.H. Jenkins, and P.E. Figgins, Monsanto Research Corporation, Mound Facility, Miamisburg, OH

Survey of a Radium Contaminated Building by Grab Sample and Time Integrated Methods

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983 (1983, June)

In July 1951, a capsule containing 44.8 mCi of radium sulfate ruptured while being used for instrument calibration in a building at 930 York Street, Cincinnati, Ohio. Following cleanup and decontamination, parts of the building were used for light manufacturing and storage until about 1978. Surveys of the building were performed in 1955 and 1965 for surface alpha and ambient gamma-ray levels. A monitoring plan was designed to assess the airborne levels of radon and radon progeny within the building, and the work was carried out from January to April, 1982. Grab samples of radon and radon progeny were collected at over 80 locations in approximately 54 rooms in two screening surveys. Time integrated measurements of radon and radon progeny were made for periods of 20 days to 13 weeks in up to 15 rooms. Radon concentrations up to 5.5 pCi/l and radon progeny concentrations up to 0.04 working levels were measured. Results obtained by the two methods were in good agreement. High-volume air samples were collected for radium analyses. A representative number of surface alpha and ambient gamma-ray measurements was also made in each room. (Auth)

150

Landa, E.R., U.S. Geological Survey, Denver, CO

Radium-226 and Uranium Contents in Particle Size Fractions of Soil from a Former Radium Processing Site in Denver, Colorado

Health Physics 43(1):143; CONF-820655; Proceedings of the 27th Annual Meeting of the Health Physics Society, Las Vegas, NV, June 27-July 1, 1982 (1982)

Soil samples collected from a site in Denver, Colorado, formerly occupied by several radium extraction plants, were separated into particle size fractions by sieving. The fractions were analyzed for Ra-226 and Uranium by gamma-spectroscopic and delayed neutron techniques respectively. Ra-226 contents ranged from about 1 to 8200 pCi/g. Uranium concentrations ranged from about 5 to 7500 ppm. Highest contents of both were generally found in the finest (less than 45 um) fraction, but the pattern was not always of progressive increase in radionuclide content with decreasing particle size. In some samples, Ra-226 and Uranium contents in the 0.5 to 2.0 mm fraction approached or exceeded those of the less than 45 um fraction. Ra-226/U-238 activity ratios ranged from about 1 to 28, indicative of contamination by ores and processing residues. (Auth)

151

Landeen, D.S., and R.M. Mitchell, Rockwell Hanford Operations, Richland, WA

Role of Burrowing Activities of the Great Basin Pocket Mouse (PEROGNATHUS PARVUS) in the Dispersal of Radionuclides on a Decommissioned Pond

RHO-HS-SA-10-P; 10 pp. (1982, August)

The intrusion of waste burial sites by animals is a common occurrence at nuclear waste facilities. This study identifies parameters associated with burrowing activities of the Great Basin Pocket Mouse at the Hanford Site in southeastern Washington. The objectives of the study were to: (1) document and compare burrow depths on a control site and a decommissioned radioactive waste pond, and (2) document Cs 137 concentrations in pocket mice and the soil mounds created by their burrowing activities. Pocket mice burrowed deeper in the backfilled burial site (anti x = 72 cm) than they did in the control site (anti x = 38 cm). The small amounts of Cs 137 found in the mice were an order of magnitude below what was present in the mounds. This indicates that the burrowing habits of these mice and subsequent mound construction may be more important in terms of radionuclide dispersal than the small amounts contained within their bodies. The Cs 137 values reported in the mice and mounds are below Rockwell Hanford Operations (Rockwell) surface soil contamination limits. Information received from test plots will be used in formulating appropriate control mechanisms which may be deployed in the future. In the interim, surface stabilization efforts are being conducted on waste sites to control and deter burrowing animals. (EDB)

152
U.S. Department of the Navy, Washington, DC

Draft Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Draft Environmental Impact Statement; 434 pp. (1982, December)

This statement describes two methods for permanent disposal of decommissioned, defueled reactor plants: land disposal by burial at existing federal sites, and deep sea disposal. The costs of each disposal method and the radiological and non-radiological consequences are described and compared. The "no action" alternative of long term protective storage prior to permanent disposal at some time in the future is also discussed. It is concluded that either permanent method would have negligible environmental impact, with the sea disposal option having significantly lower cost. The "no action" alternative would only delay the decision for permanent disposal and would result in increased costs without significantly changing the environmental impact. (Auth)

153
U.S. Department of the Navy, Washington, DC

Department of the Navy Extends Comment Period on Draft EIS on Disposal of Decommissioned Naval Submarine Reactor Plants to June 30, 1983

Federal Register 48(54):11486 (1983, March 18)

On December 22, 1982, the Department of the Navy announced that a draft environmental impact statement (EIS) had been prepared to assess the environmental implications of alternatives that could be used to permanently dispose of decommissioned, defueled naval submarine reactor plants. Comments on the draft EIS were to be submitted on or before June 30, 1983, in order to be incorporated into the final EIS; however, it was requested that they be submitted as soon as possible to facilitate their evaluation by the Navy. (Auth)(LFG)(CAJ)

154
U.S. Department of the Navy, Washington, DC

Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants

Report (Vol. 1); 461 pp. (1984, May)

This impact statement describes two methods for permanent disposal of decommissioned, defueled reactor plants: land disposal by burial at existing federal sites, and deep sea disposal. The "no action" alternative of long-term protective storage prior to permanent disposal at some time in the future is also discussed. Based upon the research work performed in support of this effort, and the review of the public comments received, the Navy considers that permanent disposal can be conducted in an environmentally safe manner. Largely as a result of the highly uncertain regulatory status of sea disposal, the Navy considers land burial at existing federal sites to be the preferred alternative. The "no action" alternative would only delay the decision for permanent disposal and would result in increased costs without significantly changing the environmental impact. (Auth)

155
U.S. Department of the Navy, Washington, DC

Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants - Comment Letters and Record of Public Hearings

Report (Vol. 2, Book 1); 550 pp. (1984, May)

Volume 2 of this Environmental Impact Statement includes comment letters and the records of public meetings conducted by the Navy for the Draft Environmental Impact Statement. Public comments from December 22, 1982, through the end of August 1983, are included. Letters and statements have been reproduced exactly as received from their authors or from the records of the public meetings. An Author Index and an Exhibit Index are provided. (BDC)

156
U.S. Department of the Navy, Washington, DC

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants - Comment Letters and Record of Public Hearings

Report (Vol. 2, Book 2); 542 pp. (1984, May)

Volume 2 of this Environmental Impact Statement presents comment letters and the records of public meetings conducted by the Navy for the Draft Environmental Impact Statement. Public comments from December 22, 1982, through the end of August 1983, are included. Letters and statements have been reproduced exactly as received from their authors or from the records of the public meetings. An author index and an exhibit index are provided. (BDC)

157

U.S. Department of the Navy, Washington, DC

Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants - Responses to Issues from Public Review

Report (Vol. 3); 259 pp. (1984, May)

Volume 3 of this Environmental Impact Statement presents responses to 517 issues identified during the public review period for the Draft Environmental Impact Statement. The issues and their responses are organized into sections which correspond to the major sections in the four chapters of the EIS and to selected appendices, based on the subject of each issue. The individual issues are listed in order as shown in the table of contents. Each issue is stated, followed by a list of the respondents who identified the issue, their identification numbers from Volume 2, and the Navy's response to the issue. (BDC)

158

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Announces Availability of Final EIS Concerning the Decommissioning of Kerr-McGee Chemical Corporation, Rare Earths Facility, West Chicago, Illinois - Comment Deadline July 11, 1983

Federal Register 48(110):26381 (1983, June 7)

Pursuant to the National Environmental Policy Act of 1969 and the U.S. Nuclear Regulatory Commission's regulations in 10 CFR Part 51, notice is given that a Final Environmental Statement (FES) prepared by the Commission's Office of Nuclear Material Safety and Safeguards, related to the decommissioning of Kerr-McGee Chemical Corporation's Rare Earths Facility located in West Chicago, Illinois, is available for inspection by the public. Kerr-McGee's proposed decommissioning and stabilization plan involves demolition of the existing buildings, removal of building rubble and contaminated soil to an adjacent disposal site, and stabilization of building rubble, contaminated soil, ore tailings and ore residues on the adjacent disposal site. The Kerr-McGee proposed plan and alternatives to the plan are discussed in the FES. The NRC staff alternative of choice is stabilization and storage of the waste onsite on the same area proposed by Kerr-McGee for disposal, with future reevaluation of the options of onsite disposal or removal to another site at a time when an established offsite disposal site becomes available. The NRC recommends that the wastes be stored onsite in a safe and environmentally sound manner. Both the NRC alternative and KM proposal would utilize similar engineering plans to contain the wastes. (Auth)(LFG)(EST)

159

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Makes Available Final EIS Concerning Kerr-McGee Chemical Corporation for the Decommissioning of the Rare Earth Facility, West Chicago, Illinois - Comment Deadline August 1, 1983

Federal Register 48(136):32241; DOCKET 40-2061 (1983, July 14)

By notice published in the Federal Register on June 7, 1983 (48 FR 26381), the Nuclear Regulatory Commission (NRC) announced the availability of the Final Environmental Statement (FES) related to the decommissioning of Kerr-McGee Chemical Corporation's Rare Earths Facility located in West Chicago, Illinois. The notice provided that any person whose interest might be affected by the procedures could file a request for a hearing in the form of a petition to the commission. The commission has extended the time for filing such requests to August 1, 1983. Petitions must be filed in accordance with the criteria set out in the previous Federal Register notice. (Auth)(LFG)

160

Woollam, P.B., Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, United Kingdom

An Assessment of the Variability in Concrete of the Concentration of Elements Critical for Reactor Decommissioning

TPRD/B/0159/N82; DECOM-82/2; 20 pp. (1982, September)

A large number of concrete samples have been taken from the bioshield of the steel pressure vessel Magnox reactor used as the reference for decommissioning studies. The samples have been analyzed to determine the concentration of elements important in defining waste management and personnel exposure strategies. Analysis of the results has assessed the variability between the samples and compared the data with the concentration of these elements in concretes from other sources. (Auth)

161

Woollam, P.B., Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, United Kingdom

The Radioactive Inventory of a Decommissioned Magnox Power Station Structure: A Re-Assessment of Long Term Dose Rates Based on Further Measurements of Silver and Niobium in Mild Steel

TPRD/B/0220/N83; DECOM-83/1; 21 pp. (1983)

Samples of mild steel from the decommissioning reference Magnox reactor site have been analyzed to determine their Nb and Ag contents. The data have been assessed in terms of the radiological significance of the long lived gamma emitting isotopes Nb-94 and Ag-108m in the dismantling of a Magnox steel pressure vessel reactor structure approximately 100 years after reactor shutdown. (Auth)(MFB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

162

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

Electropolishing as a Large-Scale Decontamination Technique

CONF-771102; Proceedings of the 70th Annual AICHE Meeting, New York, NY, November 13-17, 1977; (p. 33) (1977)

Laboratory-scale studies have shown electropolishing to be rapid and effective for removing plutonium and other radionuclide contamination from a variety of metal surfaces. This paper summarizes work in progress at Battelle 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-gal 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 min of electropolishing time. 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)(JMF)

163

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

New Decontamination Techniques for Exposure Reduction - Electropolishing, Vibratory Finishing, and Liquid Honing

CONF-781109; Proceedings of an Environmental Control Symposium, Washington, DC, November 28, 1978; (25 pp.) (1978)

Work was sponsored by the U.S. Department of Energy to develop electropolishing, vibratory finishing, and liquid honing techniques into an integrated decontamination system capable of processing the large volumes of metallic waste that will be generated by the decommissioning of nuclear facilities. There are significant differences in the minimum contamination level that can be attained with each technique. Electropolishing is the only method that can consistently reduce surface contamination levels to background. As a general comparison, decontamination factors less than 100,000 are reasonable for electropolishing, less than 2000 for liquid honing, and less than 200 for vibratory finishing. Another important difference in the three decontamination techniques is the relative ease of maintaining a low-background contamination level in the decontamination system. The unique properties of the phosphoric acid electrolyte facilitate containment of the contamination removed by the electropolishing process. Similarly, the contamination removed by vibratory finishing is continuously washed out of the vibrating bed and collected in the sludge tank. In the case of the liquid honer, however, the blast system tends to disperse the contamination. Thus, although the liquid honer is very useful for the rapid decontamination of small parts, it would require a well-engineered containment system and a high degree of operator care for routine, high-volume decontamination application. (EDB)

164

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

Demonstration of Alternative Decontamination Techniques at Three Mile Island

CONF-7911104; Facility Decontamination Technology, Proceedings of a Workshop, Hershey, PA, November 27, 1979; (p. 41) (1979)

This paper discusses the following decontamination procedures: immersion electropolishing, in-situ electropolishing, barrel electropolishing, vibratory finishing, high-pressure freon spray, centrifugation, acid adsorption, and solidification. (DLC)(EDB)(JMF)

165

Becker, G.W., Savannah River Laboratory, Aiken, SC

TRU-Waste Decontamination and Size Reduction Review, June 1983, United

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

States DOE/PNL Technology Exchange - Electropolishing, Vibratory Cleaning and Spray Decontamination

DP-MS-83-30; 21 pp. (1983)

A review of transuranic (TRU) noncombustible waste decontamination and size reduction technology is presented. Electropolishing, vibratory cleaning, and spray decontamination processes developed at Battelle Pacific Northwest Laboratory (PNL) and Savannah River Laboratory (SRL) are highlighted. TRU waste size reduction processes at PNL, Los Alamos National Laboratory (LANL), the Rocky Flats Plant (RFP), and SRL are also highlighted. (EDB)

166

Bernard, A., and H. Gerland, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France

Research and Characterization of Protective Coatings for Concrete Structures

CONF-820420; Nuclear Energy with Emphasis on Fuel Cycles, Proceedings of an ENS/ANS Conference, Brussels, Belgium, April 26, 1982; (10 pp.) (1982, April)

The contamination of concrete structures in nuclear reactors can lead to significant amounts of wastes generated during dismantling operations. To avoid this situation, walls in 'hot' premises are covered with special paints. Experiments have been conducted on protective peelable coatings in organic and aqueous solutions. A machine for removing contaminated coatings has been developed recently. (EDB)

167

Brandt, D., and E. Voelz, Preussische Elektrizitaets AG, Beverungen, Federal Republic of Germany

Decontamination on Piping Replacement at the Wurgassen Nuclear Power Station

Atomwirtschaft Atomtechnik 28(12):629-630 (1983, December)

To enable the Wurgassen Nuclear Station to meet current requirements, work was carried out in 1982 that included changing all the fresh steam piping inside, and part of the piping outside, the containment vessel. Radiation levels at the pipe surfaces are given for 10 yr of operation. The decontamination method and procedures during the dismantlement and disposal of the piping are described, and statistical data are presented on radiation levels before and after decontamination and exposure levels of personnel during the various stages. (INSPEC)

168

Card, C.J., Pacific Northwest Laboratory, Richland, WA

Postaccident Decontamination of Reactor Primary Systems and Test Loops

EPRI-NP-2842; 108 pp. (1983, January)

This document was prepared to document past chemical decontamination efforts on reactor systems contaminated by accident fission products and fuel debris and to relate this information to the decontamination of LWRs and TMI-2 in particular. Documented procedures for the removal of fission products and fuel debris from reactor coolant systems were obtained for four reactors: the Plutonium Recycle Test Reactor (PRTR), the Westinghouse Testing Reactor (WTR), the Reactor DIORIT and the Homogeneous Reactor Experiment (HRE). Eight test loops also were reviewed in this report because they were used in studies on the removal of accident fission products and fuel debris. Twelve chemical solutions have been used in the decontamination of the reactors and test loops studied. The solutions include alkaline permanganate-acid/acid salt, sodium hydroxide, mineral acids, buffered oxalic-peroxide, peroxide-bicarbonate, film conditioning, oxidizing, reducing, hydrogen peroxide-acid, alkaline tartrate-peroxide, acid-sodium fluoride, and a proprietary mixture of potassium acetate, phenate, glycollate and hydroxide. In order to evaluate the effectiveness of the decontamination procedures, the amount and form of contamination that had been deposited on the systems was studied. (EDB)

169

Courtney, J.C., K.R. Ferguson, C.E. Holson, and J.P. Bacca, Louisiana State University, Baton Rouge, LA; Argonne National Laboratory, Argonne, IL

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Radiation Safety Aspects of a Hot-Cell Decontamination

Health Physics 43(4):465-480 (1982, October)

Extensive decontamination was conducted to prepare the interior of the argon cell at the Hot Fuel Examination Facility for refurbishment. The radiation field associated with 10 to 16 year-old fission products was reduced by remote cleaning before personnel entry. This paper describes the operations, dosimetry, protective clothing, hardware and procedures used to ensure compliance with radiation exposure guidelines. Contact decontamination was conducted in general radiation levels that varied from 300 to less than 30 mrem/hr for that component of the radiation that could penetrate 540 mg/sq cm of aluminium. However, it was the nonpenetrating component that controlled in-cell stay times; it varied from 1500 to less than 130 mrem/hr. Even after decontamination, several areas of fixed contamination emitting over 1000 mrem/hr of nonpenetrating radiation were identified and locally shielded. There were 916 person-entries required for decontamination. These resulted in integrated exposures of 99 and 599 man-rem for the whole body and skin, respectively. (EDB)

170

Cunnane, J.C., and S.L. Nicolosi, Electric Power Research Institute, Palo Alto, CA

Characterization of the Contamination in the TMI-2 Reactor Coolant System

EPRI-NP-2722; 92 pp. (1982, November)

The report presents the attempt made to characterize the contamination on the primary system surfaces of TMI-2 in support of decontamination process selection and planning. The identification of methods for analyzing fission-product and fuel-debris dispersion in a severe reactor accident is addressed, and the utilization of these methods to characterize the contamination in the TMI-2 reactor coolant system is discussed. Conclusions and recommendations are included. (INSPEC)(NPK)

171

Daniel, J.A., T.L. McVey, E.A. Schlomer, and D.G. Keefer, Electric Power Research Institute, Palo Alto, CA

Characterization of Contaminants in TMI-2 Systems

EPRI-NP-2922; 350 pp. (1983, March)

Sample and measurement data are used to characterize the contamination of the TMI-2 reactor coolant system and connected systems. Physical orientation, materials of construction, physical locations within the plant, operational notes, a brief history of operation, and decontamination efforts for individual components are described. Schematic flow diagrams of systems and general arrangement diagrams are included to assist the user in interpreting the data. (INSPEC)

172

Demtroeder, P., and D. Neupert, Nuklear-Chemie und Metallurgie GmbH, Hanau, Federal Republic of Germany

Chemical Decontamination for Repair and Decommissioning of Nuclear Power Plants: Final Report for the Period, August 1, 1979-May 31, 1981

FUE-81050; INIS-mf-8402; 87 pp. (1981)

Two decontamination processes, volatilization of metal-oxides and metal-alloys by reaction with aggressive gases and decontamination with strippable decontamination pastes, have been tested experimentally. Tests have been made with inactive and radioactive samples to assess the suitability of both decontamination processes. Because the material is damaged quite extensively by the gaseous-phase reaction, this process can only be used for special cases. The decontamination pastes developed by Nukem can be applied in all areas of nuclear technology in order to decontaminate radioactive components. Decontamination factors of 10(E+3) could be obtained after only one application of the pastes, which consist essentially of a decontamination compound, a thickening compound, a film-producing substance, and other secondary chemicals. (EDB)

173

Detilleux, E.J.

Decontamination of a Reprocessing Facility and Handling of the Resulting Wastes

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

CONF-7909192; Uranium and Nuclear Energy, Proceedings of the Fourth International Conference, London, United Kingdom, September 10-12, 1979; (pp. 174-187) (1979)

A description is given of dismantling, with intensive cleaning and decontamination operations, of 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)(JMF)(CAJ)

174
Detilleux, E.J., W. Hild, and J. van Geel, European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium

Reprocessing, Decontamination and Decommissioning Waste Management at Eurochemic: Current and Planned Activities

CONF-820424; The Treatment and Handling of Radioactive Wastes, Proceedings of an American Nuclear Society Topical Meeting, Richland, WA, April 19, 1982. Battelle Press, Columbus, OH; (pp. 76-83) (1982)

Since the shutdown of its reprocessing activities, Eurochemic has undertaken the decontamination of the reprocessing plant and management of the generated wastes. Decontamination has been satisfactorily completed, allowing access to all process cells. The waste management program, still going on, includes intermediate and high-level liquid waste treatment by bituminization and vitrification, respectively. Other activities involve spent solvent destruction and the digestion into acids of alpha-bearing solid wastes, etc. The paper outlines the main features of the program. (EDB)(CAJ)

175
Dippel, T., D. Hentschel, and S. Kunze, Abteilung Behandlung Radioaktiver Abfalle, Gesellschaft fur Kernforschung mbH, Karlsruhe, Federal Republic of Germany

Decontamination and Decommissioning

IAEA Waste Management Research Abstracts 11:46 (1976)

Decontamination methods currently applied to the decontamination of big components generate large amounts of decontamination waste solutions. Experiments have been initiated to determine optimum working conditions with respect to temperature and concentration for the standard decontamination agents such as nitric acid, nitric-hydrofluoric acid mixtures, alkaline potassium permanganate, and organic acids, aimed at the reduction of waste. (Auth)(PTO)

176
Divine, J.R., E.M. Woodruff, S.A. McPartland, and G.E. Zima, Pacific Northwest Laboratory, Richland, WA

Decontamination as a Precursor to Decommissioning Status Report - Task 2: Process Evaluation

NUREG/CR-2884; PNL-4343; 121 pp. (1983, May)

Current work on a U.S. Nuclear Regulatory Commission supported program on decontamination as a precursor to decommissioning is described. Laboratory efforts have been ongoing to compile a unified comparison of the decontamination ability and corrosiveness of twelve decontamination solvents. Some of the solvents, too reactive for use in normal operating plant decontamination, were found to be suitable for decommissioning purposes. (Auth)(JMF)

177
Dougherty, D., and J.W. Adams, Brookhaven National Laboratory, Upton, NY

Evaluation of Three Mile Island Unit 2 Reactor Building Decontamination Process

NUREG/CR-3381; BNL-NUREG-51689; 61 pp. (1983, August)

Decontamination activities from the cleanup of the Three Mile Island Unit 2 Reactor Building are generating a variety of waste streams. Solid wastes being disposed of in commercial shallow land burial include trash and rubbish, ion-exchange resins (Epicor-II) and strippable coatings. The radwaste streams arising from cleanup activities currently under way are characterized and classified under the waste classification scheme of 10 CFR Part 61. It appears that much of the Epicor-II ion-exchange resin being disposed of in commercial land burial will be Class B and require stabilization. Strippable coatings being used at TMI-2 were tested for leachability of radionuclides and chelating agents, thermal stability, radiation stability, stability under immersion and biodegradability. Results indicated that both radionuclide contamination and chelating agents leach from strippable coating waste. (Auth)

178

Eickelpasch, N., and M. Lasch, Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Federal Republic of Germany

In Situ Decontamination of KRB Primary Circuit Components

Atomwirtschaft Atomtechnik 24(5):247-251 (1979, May)

In 1977 and 1978, it was necessary to perfrom decontamination work in some areas of the steam generators and their piping in the 250 MW(e) boiling water reactor of the Gundremmingen Nuclear Power Station (KRB). Little technical experience has been available concerning the decontamination of primary circuit components, particularly unassembled components of the type described here. Decontamination, carried out as a radiation protection measure prior to repair work, was performed after more than ten years of plant operation. After eight months of outage exposure, rates between 500 and 1000 mR/hr were measured in areas in which welding work had to be performed. One other location, to which a remotely controlled manipulator had to be moved for repair purposes, had an exposure rate of between 5 and 15 R/hr. Both mechanical and chemical decontamination techniques were possible. These activities also required the provision of supply and measuring systems. (EDB) (EST)

179

Eickelpasch, N., and M. Lasch, Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Federal Republic of Germany

Electrochemical Decontamination Experience at Gundremmingen

CONF-831066; Water Chemistry of Nuclear Reactor Systems, Proceedings of the Third International Conference, Bournemouth, United Kingdom, October 17, 1983; (pp. 379-380) (1983, October)

The decontamination by electrochemical techniques for decommissioning purposes has been tested both in laboratory and technical scale. The influence of the intensity of current and of the nuclide mixture on the decontamination factor has been investigated. It is demonstrated that this special technique is convenient with respect to secondary waste and handling of radioactivity. (Auth) (CAJ)

180

Fitzpatrick, V.F., H.L. Butts, R.G. Moles, and R.A. Lundgren, Pacific Northwest Laboratory, Richland, WA

Decontamination Demonstration Facility Modularization/Mobility Study

PNL-3628; 36 pp. (1980, November)

The component decontamination technology, developed under the U.S. Department of Energy (DOE) sponsored TRU Waste Decontamination Program, has potential benefits to nuclear utility owners in four strategic areas: (1) meeting ALARA criteria for maintenance/operations, (2) management of wastes and waste forms, (3) accident response, and (4) decommissioning. The most significant step in transferring this technology directly to the nuclear industry is embodied in the TMI Decontamination Demonstration Facility. (GRA)

181

Galecki, G., and G.W. Vickers, Wroclaw Technical University, Wroclaw, Poland; University of British Columbia, Vancouver, British Columbia, Canada

The Development of Ice-Blasting for Surface Cleaning

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey,

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

United Kingdom, April 6-8, 1982, 501 pp.; (pp. 59-79) (1982, April)

The entrainment of small ice particles with air jets (ice blasting) to clean and abrade surfaces is considered as an alternative to grit blasting, water jets, or other mechanical cleaning methods. The approach utilizes the hardness and cutting potential of ice particles, with the benefit that, once the ice has performed its cleaning duty, it melts and drains away. An assessment is made of the important parameters of the ice-blasting process, and the cleaning effectiveness and efficiency are considered in relation to other cleaning methods. (Auth)(MFB)

182

Gardner, H.R., R.P. Allen, L.M. Polentz, W.E. Skiens, and G.A. Wolf, Quadrex Corporation, Richland, WA

Evaluation of Nonchemical Decontamination Techniques for Use on Reactor Coolant Systems

EPRI-NP-2690; 204 pp. (1982, October)

This work describes, characterizes, and evaluates a number of decontamination techniques that could be applied to the cleaning of fuel debris and corrosion products from reactor coolant systems and components. Excluded from consideration are the traditional or common chemical decontamination techniques. The information developed for each technique includes: theory of operation, methods of application, accessibility requirements, remote operation capability, state of development, previous applications, decontamination effectiveness, corrosion problems during and after decontamination, material removal, radiological and industrial safety, cost, post-decontamination cleanup, need for post-decontamination surface treatment, waste generation and disposal, and redistribution of contamination. The techniques treated are: mechanical methods; high-pressure water (less than 20,000 psi); ultrahigh-pressure water (less than 20,000 psi); abrasive cleaning; vibratory finishing; ultrasonics; high-pressure FREON cleaning; electropolishing; alternative electrolyte techniques; steam/hot-water cleaning and two-phase mixtures; decontamination foams, gels, and pastes; strippable decontamination coatings; reflux decontamination; dry ice blasting; electrochemically activated solutions; molten salt methods; and thermal erosion. (EDB)(CAJ)

183

Gardner, H.R., L.M. Polentz, R.P. Allen, and W.E. Skiens, Electric Power Research Institute, Palo Alto, CA

Comparison of Decontamination Techniques for Reactor Coolant Systems Applications

EPRI-NP-2777; 64 pp. (1982, December)

The report evaluates the suitability of various nonchemical decontamination methods for use in PWR primary cooling systems, specifically the system at Three Mile Island Unit 2 (TMI-2). A systematic, quantitative comparison, based on criteria dealing with effectiveness and impact and using a numerical weighting system that represents needs and concerns unique to the TMI-2 recovery effort, is made of techniques that were identified in EPRI Topical Report NP-2690. Different categories of components are defined, and a separate comparison is included for each. (INSPEC)(NPK)

184

Heshmatpour, B., G.L. Copeland, and R.L. Heestand, Oak Ridge National Laboratory, Metals and Ceramics Division, Oak Ridge, TN

Decontamination of Transuranic Contaminated Metals by Melt Refining

Nuclear and Chemical Waste Management 4(2):129-134 (1983)

Melt refining of transuranic contaminated metals is a possible decontamination process with the potential advantages of producing metal for reuse and of simplifying chemical analyses. By routinely achieving the 10 nCi/G (=0.1 ppm) level by melt refining, scrap metal can be removed from the transuranic waste category. To demonstrate the effectiveness of this melt refining process, mild steel, stainless steel, nickel, and copper were contaminated with 500 ppm (ng/g) $PuO2$ and melted with various fluxes. The solidified slags and metals were analyzed for their plutonium content, and corresponding partition ratios for plutonium were calculated. Some metals were double refined to study the effect of secondary slag treatment. The initial weight of the slags was also varied to investigate the effect of slag weight on the degree of plutonium removal. In general, all four metals

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

could be contaminated below 1 ppm (ng/g) Pu (=100 nCi/g) by a single slag treatment. Doubling the slag weight did not improve decontamination significantly; however, double slag treatment using 5 wt.% slag did decontaminate the metals to below 0.1 ppm (ng/g) Pu (10 nCi/g). (INSPEC)

185

Hobbick, C.W., D.R. Schatz, and G.D. Aden, Rockwell Hanford Operations, Richland, WA

Distribution and Removal of Radionuclides in Molten Stainless Steel

RHO-CD-1444; 31 pp. (1981, May)

Six laboratory scale melts made with contaminated stainless steel provided data that radionuclide distribution can be predicted when proper temperature rates and ranges are employed, and that major decontamination occurs with the use of designed slagging materials. Three categories of melt tests were performed with two tests per category: low temperature controlled temperature melts with the object of concentrating radionuclides within the slag; high temperature melts with the objective of capturing radionuclides within the ingot by the induction furnace induced electro-magnetic stirring; and melt tests with glass formulations added to enhance the concentration and capture of radionuclides within the glass/slag. Tests using controlled temperature ranges provided data showing radionuclide concentration on the upper slag surface of low temperature melts. Even distribution of radionuclides occur in high temperature melts employing electro-magnetic stirring. An approximately 98% decontamination of beta, gamma and actinide wastes was obtained with the use of a glass formulation, added as components, to the metal prior to the meltdown. Although considerable further development work is needed particularly with respect to metal types, melt size, and type of furnace employed, favorable results of these initial tests indicate by radionuclide distribution that melting provides a direct, straightforward method for decontamination and/or self shielding of contaminated stainless steel. (Auth)(BDC)

186

Illinois Department of Nuclear Safety, Springfield, IL

LPI Cleanup Hinges on Funding

Radiological Response Abilities 2(2):3 (1983, August)

The Illinois Department of Nuclear Safety has signed a contract with Alaron Corporation for a two-phase cleanup project at Ottawa's Luminous Process Plant, which used radium to manufacture luminous watch dials before the company went bankrupt. Phase one of the cleanup involves containment of materials and soils contaminated with radium. Phase two involves removal of other radioactive materials. Partial funding for the cleanup will come from the sale of abandoned equipment and from bankruptcy settlements. (BDC)

187

Ishibashi, M., and M. Sumi, Mitsubishi Heavy Industries Limited, Tokyo, Japan

Method of Decontaminating Primary Coolant Circuits

Japanese Patent 56-158,999/A/ (1981, December 8)

A method is described of eliminating hard as well as soft contaminated layers without injuring substrate materials when decontaminating radioactively contaminated parts of equipment and pipes constituting primary coolant circuits. Water from a high pressure pump is ejected from the nozzle of a spray gun to the contaminated area; for example, to the surface of the water chamber in a vapor evaporator. High pressure pure water or aqueous boric acid is ejected from the periphery, and boric oxide particles (ranging from 1-100 micron particle size) are ejected from the center of the nozzle of the spray gun. The particles (blasting material) emitted together with the high pressure water strike the contaminated surfaces to remove the contaminated layers. Upon collision, the high pressure water acts as the shock absorber for the blasting material and, afterwards, flows down to the bottom of the water chamber, where the blasting material is dissolved in the high pressure water. (EDB)(CAJ)

188

Jackson, O.L.

Radioactive Decontamination Apparatus and Process

U.S. Patent 4,401,532 (1983, August 30)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

An apparatus for removing radioactive contamination from metal objects is described. This apparatus consists of three separate sections constructed of stainless steel. The first is an electro-polishing tank, pump and filter assembly, ventilation duct and filter assembly, and DC power supply. The second is a rinse tank with a pump and filter assembly. The third is a divot crane. The electro-polishing tank assembly and the rinse tank assembly are separately mounted on pallets to facilitate moving. The filter systems of the electro-polishing tank and the rinse tank are designed to remove radioactive contamination from the fluids in those tanks. Heavy items or highly contaminated items are handled with the divot crane. The ventilation system on the electro-polishing tank exhausts acid fumes resulting from the tank heaters and the electro-polishing process. Inside the electro-polishing tank are two swinging arms that maneuver two stainless steel negative DC probes suspended in the electrolyte fluid. These probes are electrically isolated from the tank and the rest of the system. Across the top center of the tank, and also electrically isolated from the tank, is a copper pipe which comprises the positive side of the DC system. A metal object requiring decontamination is suspended from the positive copper pipe into the electrolyte fluid, with good electrical contact being maintained. The negative probes are then moved to a position of close proximity to the object without making actual contact. (EDB)(EST)(CAJ)

189
Johnson, J., General Public Utilities, Parsippany, NJ; Electric Power Research Institute, Palo Alto, CA; U.S. Nuclear Regulatory Commission, Washington, DC; U.S. Department of Energy, Washington, DC

Decontamination Experience at the Idaho Chemical Processing Plant

GEND-002 (Vol. 1); CONF-7911104; Facility Decontamination Technology, Proceedings of a Workshop, Hershey, PA, November 27, 1979; (pp. S.1-S.9) (1979, November 27)

This paper describes the ICPP plant and discusses some contamination problems encountered, decontamination provisions on the process equipment, anti-C clothing used, and special problems and techniques used. (EDB)

190
Knox, R.

Effectiveness of Decontamination Improves

Nuclear Engineering International 27(326):13-15 (1982, April)

Recent improvements in decontamination techniques for nuclear facilities are described. The principal methods are chemical, electrical (electrochemical cleaning, electropolishing, reverse electroplating), and mechanical (scrubbing, grinding, polishing, dry blasting, wet blasting), or combinations of the three. (EDB)

191
Knox, R.

Decontamination Cuts Costs

Nuclear Engineering International 27(335):26-28 (1983, January)

A report is given of the CNA/ANS conference on the decontamination of nuclear facilities held on 19-22 September 1982 in Niagara Falls, Canada. Some of the developments described include cleaning CANDU fueling machines, recycling irradiated fuel storage tanks, and decontaminating equipment using Freon-113 in a closed cycle system. (EDB)

192
Kovacs, K., and J. Seres, Paksi Atomeroemue Vallalat, Budapest, Hungary

Development of a Decontaminable Protective Coating System for Nuclear Power Stations

Eroeterv Koezlemenyek 20:30-34 (1982)

For the protection of concrete and steel surfaces of power generating units 3 and 4 in the nuclear power station Paks, an epoxy base 'family' of coatings was developed. Adding different crosslinking agents to the same component 'A' lends itself to the formation of solvent-free coating systems of category I and category II, emulsified with water as well. The paper deals with theoretical and practical aspects of establishing the formula of the coating system and gives an account of the test results. (EDB) (CAJ)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

193

Koyana, T., H. Yusa, and O. Kuriyama, Hitachi Limited, Tokyo, Japan

Method of Decontaminating Radiation-Contaminated Metal Wastes

Japenese Patent 56-115,998/A/ (1981, September 11)

A method is proposed to reduce the amounts of stored and secondary wastes. A plasma torch is applied to the surface of radiation-contaminated metal wastes with a predetermined acute angle and a water curtain is provided in front of the plasma arc jetting direction. The contaminated metal surface is locally melted and scattered by the scanning of the high temperature plasma arc, while the scattered molten metal is quenched and coagulated into particles by the water curtain. Accordingly, radiation-contaminated metal wastes deposited on the inner surfaces of pipeways and the like, due to adsorption, coagulation, or oxide film formation, can be eliminated easily and completely. (EDB)(EST)(CAJ)

194

Laraia, M., Fachinformationszentrum Energie, Physik, Mathematik GmbH, Karlsruhe, Federal Republic of Germany

Experience in the Decontamination of a Nuclear Power Plant

Comitato Nazionale per l'Energia Nucleare, Notiziario 27(12):70-80 (1981)

The decontamination of the auxiliary reactor building for fuel elements has been performed to an extent that almost unrestricted access has become possible. The question of restarting or decommissioning the reactor will not be settled until about 1985. Technical experience gathered from the TMI decontamination work has yielded a large amount of information. The risks are acceptable both for the population and for the operators. (EDB)

195

Leventhal, L., R. Wessman, S. Waligora, and R. Powell, EAL Corporation, Richmond, CA; Eberline Instrument Corporation, Albuquerque, NM

Instrumental and Radiochemical Assessment of Decontamination Operations

Health Physics 43(1):141 (1983, June)

The decontamination of nuclear facilities requires instrumental and radiochemical assessment prior to, during, and after cleanup operations. The management of these measurements with regard to the number of samples taken, processing turnaround time, the choice of method, and the location of the assessment function has direct impact on the costs of the assessment program. A recent document, NUREG/CR 2082, "Monitoring for Compliance with Decommissioning Survey Criteria," proscribes the sampling protocol for release for unrestricted use. Specific requirements for release for unrestricted use may be found in NRC Regulatory Guide 1.86. Other measurement needs stem from shipping under 10 CRF 76. Lastly, page 38097 of 10 CFR Part 61, proposed rules, lists the limiting amounts of radionuclides in low-level waste. The measurements can be performed on and/or offsite. They involve monitoring, screening, checking, approving, and auditing. Onsite field operation sacrifices sensitivity and accuracy for rapid turnaround, reduced costs per sample, and mobility. The work performed in the field is primarily instrumental and involves quick sample preparation. Samples may include a variety of matrices, including paint chips, ceiling tile, metals, asphalt, concrete, soils, liquids, etc. Additionally, they may require rudimentary radiochemical procedures. Offsite laboratory work stresses sensitivity and accuracy and requires wet chemistry facilities as well as a well-equipped and well-staffed laboratory. Experiences in the design and operation of on and offsite laboratories are presented. Typical analytical problems encountered are discussed. (Auth)(MFB)(CAJ)

196

Loercher, G., and W. Piel, Commission of the European Communities, Luxembourg, Luxembourg

Decommissioning of Nuclear Power Plants: Decontamination to an Extremely Low Residual Level Before Disposal Authorization

EUR-8704-DE; 120 pp. (1983)

During decommissioning operations on nuclear power plants, an important task is the decontamination of contaminated components to very low residual levels, which permits disposal at municipal refuse dumps. This practice reduces the quantity of radioactive waste remaining for disposal. To evaluate the economic aspects of such decontamination procedures, an estimate of costs for final disposal is needed. Such a cost comparison between final disposal and decontamination treatment requires that all cost elements are taken into account. The steps necessary for both management modes are presented and discussed. The estimated cost for final disposal ranged from 4000 to 6000 DM/Mg of component mass. As far as the legal aspects are concerned, an analysis of laws, regulations, and limit values for residual contamination in the member countries of the CEC showed that the procedures differ between countries and are ambiguous. Future research and development work needs are briefly presented. (Auth)(PTO)(CAJ)

197

Louis, H., and W. Schikorr, University of Hannover, Hannover, Federal Republic of Germany

Fundamental Aspects in Cleaning with High-Speed Water Jets

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 217-228) (1982, April)

The use of high-speed water jets for cleaning applications is increasing. Surfaces of steel or concrete, for example, can be cleaned of different types of layers. These layers may consist of rust, oil, paint, rubber, organic layers such as mussels on undersea constructions, or combinations of these. Up to the present, the parameters for jet cleaning have been optimized empirically. To optimize the cleaning conditions, it is necessary to classify the different types of layers and to investigate the interaction between jet, layer, and substrata. On the one hand, one can differentiate among brittle, ductile, and elastic layers as well as between firm and infirm adhesiveness to the substrata. On the other hand, the character of a jet varies with the change of pressure, distance, and type of nozzle. The loading time or the traverse speed of the jet and the number of traverses are further parameters. The main demand on every jet cleaning application is efficient removal of the layer without damage to the substrata. (Auth)(MFB)

198

McCoy, M.W., Pacific Northwest Laboratory, Richland, WA

Advanced Cleaning by Mass Finishing

PNL-SA-11743; 14 pp. (1983, October)

This paper describes a testing program that examined the effectiveness of vibratory finishing for removing a variety of radioactively contaminated soils. The vibratory finishing process was studied by measuring the radiation levels of the test material, the lining of the vibratory finishing tub, and the media. Many soils, including corrosion products, scale, oil, grease, and paint, were removed by the vibratory finishing process. The results of this program indicate that vibratory finishing should be an effective cleaning process for a variety of manufacturing operations. (EDB)

199

McCoy, M.W., R.P. Allen, L.K. Fetrow, and R.F. Hazelton, Pacific Northwest Laboratory, Richland, WA

Vibratory Finishing for Decontamination: Pilot Scale Operation - Mechanical Scrubbing with Chemical Cleaning Action

CONF-820424; Treatment and Handling of Radioactive Wastes. Proceedings of an American Nuclear Society Topical Meeting, Richland, WA, April 19, 1982. Battelle Press, Columbus, OH; (pp. 115-120) (1982)

This paper describes the development of the vibratory finishing decontamination process from laboratory demonstration to pilot scale operation. Vibratory finishing is a standard industrial process used in a variety of manufacturing processes. Substantial progress has been made in adapting this process to the needs of the nuclear industry, and especially to the management of TRU waste. The discussion includes a description of the vibratory finishing process; scale-up of the process including considerations of vibratory finisher size and configuration, rinsing and drying of the decontaminated material, materials handling, and contamination control; and a cost analysis of the operation of a vibratory finishing decontamination system. (EDB)(CAJ)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

200

Mis, F.J., and R.E. Voit, Rochester Gas and Electric Company, Rochester, NY

Liquid-Abrasive Decontamination Is Versatile, Safe, and Effective

Power 127(10):67-69 (1983, October)

The safety hazards inherent in electropolishing are eliminated by using liquid abrasives. Electropolishing requires high currents and electrolytes consisting of low-pH acids. In addition, the process generates hydrogen and oxygen. Under these conditions, electropolishing has an inherently high hazard potential, and elaborate precautions are necessary to protect the operating technician. The liquid-abrasive system isolates the operating technician from both direct contact with decontamination solutions and the atmosphere around those solutions. The entire process takes place in an enclosed area, and no corrosive, flammable, or explosive chemicals are involved. Most decontamination operations do not result in true cost savings because of slow processing times, marginal ability to decontaminate to free-release limits, and generation of large volumes of secondary waste. Experience shows that liquid-abrasive decontamination reduces these inadequacies to a minimum. The result is a truly cost-effective, volume-reducing operation. (EDB)

201

Miyachi, N., Toshiba Corporation, Kawasaki, Kanagawa, Japan

Method of Decontaminating the Surfaces Contaminated with Radioactive Substances

Japanese Patent 57-122,399/A/ (1982, July 30)

To enable simple and economical elimination of contaminating substances deposited on the surface of large equipment, an electrolyte mat, prepared by impregnating, with electrolyte, a fibrous sheet made of non-electroconductive and acid-resistant material such as polyethylene or tetrafluorate, is appended to the surface to be decontaminated. An electrode plate is laid over the mat and connected to a negative electrode, while the surface to be decontaminated is connected to a positive electrode. In this way, the surface to be decontaminated is electrochemically etched, thereby eliminating radioactive substances deposited on the surface. (EDB)(EST)

202

Miyakawa, M., K. Nozawa, M. Yamada, T. Mizutani, and K. Onozuka, Chubu Electric Power Company, Inc., Nagoya, Japan

Development of Remote Control Decontamination Machines for BWR Nuclear Power Plants

Karyoku Genshiryoku Hatsuden 32(7):645-654 (1981, July)

The dose rate of radiation on the surfaces of equipment and rooms tends to increase as radioactive substances accumulate during the continuous operation of nuclear power stations. In order to reduce the exposure of decontamination workers, save labor, and shorten decontamination time, Chubu Electric Power Company, Inc. has developed decontamination machines for the walls of reactor wells, the walls and bottoms of equipment pits, the internal surfaces of suppression chambers, and the internal surfaces of tanks. The decontamination machines have several remote-handling functions: (a) brushing up with sprinkling against complicated surfaces such as a wall with steps, (b) vertical transfer of brushing position with sucking force, (c) sucking out slurries under water in storage pools or inside pressure-supression pools, and (d) horizontal transfer of suction position with electric motors. (EDB)(EST)

203

Munson, L.F., C.J. Card, and J.R. Divine, Electric Power Research Institute, Palo Alto, CA

Assessment of Chemical Processes for the Post-Accident Decontamination of Reactor Coolant Systems

EPRI-NP-2866; 270 pp. (1983, February)

The examination of previously used chemical decontamination processes and potentially useful new decontamination processes is discussed. Both generic fuel damage accidents and the accident at Three Mile Island Unit 2 (TMI-2) Power Plant are considered, and a total of 14 processes are evaluated. Process evaluation includes data in the categories: technical description of the process, recorded past usage, effectiveness, process limitation, safety consideration, and waste management. (INSPEC)(NPK)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

204

Neupert, D., and P. Demtroeder, NUKEM, GmbH, Hanau, Federal Republic of Germany

Method for the Sealing and Decontamination of Radioactive and Radioactively Contaminated Components and Materials

Nuclear Technology 61(1):127-129 (1983, April)

A sealing process and a decontamination process are presented. The sealing process uses an elastic synthetic material based on a two-component polyurethane system, that is sprayed without propellant, cures within a short time, and can easily be removed. The sealing process has already been used in nuclear power plants in the Federal Republic of Germany. For chemical decontamination of surfaces, a paste containing aggressive agents is applied and, after a certain length of time, stripped from the surface in the form of a film. The contamination is contained in this film; there is no aerosol formation or secondary contamination. With this decontamination process, it is possible to avoid the use of large quantities of acid and rinsing water. (EDB)(EST)

205

Work Starts in January on Decontamination of the Primary Circuits in Sweden's First Power Reactor

Nucleonics Week 23(50):10 (1982, December 16)

The decontamination of the Agesta reactor located in the Stockholm suburb of Farsta will begin in January, 1983. Dismantling will be led by Studsvik Energiteknik, a Swedish state energy research and development company. Also participating in the project are organizations from the United States, United Kingdom, Switzerland, West Germany, and Italy. Financing of the project is by nuclear authorities and utilities of the six nations. (BDC)

206

Okamoto, H., S. Yoshimura, H. Fukumoto, and O. Sakurada, Central Research Institute of the Electric Power Industry, Tokyo, Japan

Remotely Operated Ultrasonic Decontamination System for Fuel Transfer Pool

CONF-791103; Proceedings of an American Nuclear Society Meeting, San Francisco, CA, November 12-16, 1979; (pp. 129-135) (1979)

A decontamination method using ultrasonic waves was developed for use in decontaminating the fuel transfer pool wall of a light water reactor. From the results of onsite basic experiments, a remotely operated ultrasonic decontamination installation was designed and fabricated. Onsite operational experiments were carried out. The results of the basic experiments, the remotely operated ultrasonic decontamination system, and the results of on-site operations experiments with the system are described. (EDB)(JMF)

207

Okamoto, N., H. Fukumoto, and S. Yoshimura, Central Research Institute of the Electric Power Industry, Tokyo, Japan

Remotely Operated Ultrasonic Decontamination System for Fuel Transfer Pool - (2): Development and Field Test of the Apparatus

Denryoku Chuo Kenkyusho Hokoku 280066:1-35 (1981, June)

The previously developed remotely operated decontamination system using ultrasonic waves has been improved, and on-site experiments were performed. This report describes the results of the experiments and the effects obtained by practical use. Moving and operational performance of the system is satisfactory. The decontamination factor is proportional to the ultrasonic radiation time; it reaches into 100 with 30 seconds in the completely immersed parts and two minutes near the water line. The following effects are expected when putting this system into practical use for the pool of a PWR type reactor: shortening the duration of decontamination work by one to three days; saving 60 to 70% on manpower for the pool wall decontamination work; and improvement of working conditions. (EDB)(EST)

208

Osamu, K., K. Makoto, and K. Takao, Hitachi Limited, Energy Research Laboratory, Hitachi, Ibaraki, Japan

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Decontamination of Radioactive Metal Surfaces by Plasma Arc Gouging

Nuclear Technology 61(1):93-99 (1983, April)

Experiments have been carried out to develop a new decontamination method that applies plasma arc gouging to remove a thin surface layer from radioactively contaminated metallic wastes. Plasma arc gouging has been carried out on stainless steel and carbon steel pipes. The torch nozzle and gouging angle have been optimized to increase the decontamination rate. A water film is formed on the pipe surface to reduce dust concentration in the off-gas and to prevent slag particles, which are splashed up by the plasma gas, from adhering to the gouged surface. Using chromium-electroplated carbon steel pipes as samples, a decontamination factor of greater than 10(E+3) is obtained after gouging to a depth of about 0.5 mm in combination with ultrasonic cleaning. (EDB)(EST)

209

Partridge, J.A., and R.E. Lerch, Hanford Engineering Development Laboratory, Richland, WA

Chemical Decontamination of Metals

HEDL-SA-1880; CONF-791103; Proceedings of an American Nuclear Society Meeting, San Francisco, CA, November 12-16, 1979; (p. 22) (1979)

A metal decontamination process based on removal of contamination by treatment with a cerium (IV)-nitric acid solution (or other redox agent in nitric acid) is feasible and highly promising. The technique is effective in dissolving the surface layer of stainless steel. Dissolution rates of approximately 1.5 mm/hr were demonstrated with cerium (IV)-nitric acid solutions. Removal of plutonium contamination from stainless steel was demonstrated in laboratory tests in which activity levels were reduced from greater than 500,000 counts/min to nondetectable levels in approximately one hour at 90 deg C. Removal of paint from stainless steel surfaces was also demonstrated. Advantages of this process over other chemical solutions are that: (1) less waste is generated because the solutions are not high salt systems; (2) cerium(IV) in nitric acid is a good dissolution agent for plutonium oxide; (3) regeneration of cerium(IV) during the decontamination is accomplished by electrolysis; (4) it is effective for irregularly shaped equipment; and (5) it could be effective as a spray or a flow-through system. (EDB)(JMF)(CAJ)

210

Pettit, P.J., Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada

Decontamination of CANDU Primary Coolant System

AECL-5113; CONF-741190; Activity Transport in CANDU, Proceedings of the Symposium, November 18, 1974; (pp. 73-85) (1975)

Decontamination of radioactive systems is necessary to reduce personnel radiation exposures and also to reduce exposure during special work. Mechanical decontamination methods are sometimes useful. Most contaminated surfaces are inaccessible, so chemical decontamination often is preferred. The A-P Citrox method will remove most contaminants from CANDU systems, but is costly and long, damages components, and produces large quantities of radioactive liquid waste. The Redox cycling process is fast and inexpensive, produces only solid wastes, but removes small quantities of deposit from Monel only. The CAN-DECON process removes deposits from most materials, including fuel cladding, and has many other advantages. (EDB)(JMF)

211

Saito, M., Hitachi Limited, Tokyo, Japan

Method of Decontaminating Radioactive Substances

Japanese Patent 57-45,499/A/ (1982, March 15)

This method was developed to decrease radiation exposure during operation, maintenance and disassembly of a nuclear power plant. It involves use of a cleaning water to which have been added particulate substances of approximately the same specific gravity as that of the cleaning water. The cleaning water is then applied to the surfaces of instruments and pipeways of the nuclear power plant such that the particulate substances cause impact shocks to the radionuclide-containing oxides deposited to the surfaces. The oxides are subsequently peeled off into the cleaning water and then filtered out after separation of the particulate substances. (EDB)(EST)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

212
Studsvik Energiteknik AB, Nykoping, Sweden

Agesta Decontamination Project: Phase 1, Final Report, Volume 1 - Project Description and Overview of Results

AGESTA-1-027; 25 pp. (1982, December)

The objective of the Agesta Decontamination Project, which has been organized by the Nuclear Energy Agency, Paris, is to utilize the four primary loops of the Agesta reactor to demonstrate decontamination methods for PWR primary systems. The first phase of the project consisted of laboratory scale tests. The methods tested were developed at Studsvik Energiteknik, AB, Sweden; Kraftwerk Union AG, Federal Republic of Germany; Swiss Federal Institute of Reactor Research, Switzerland; and Berkeley Nuclear Laboratories, United Kingdom. The test program consisted of decontamination tests on steam generator tubing, other active material from Agesta and a number of operating reactors, as well as material compatibility tests on standardized samples of a representative selection from modern PWR primary system materials. A total of six processes were tested (the four mentioned above and one process each from Italy and the U.S.). All six of the "soft" chemistries met the stipulated decontamination criteria for both general and localized corrosive attack. There was no evidence of stress or galvanic corrosion on the tubes or weld specimens. Another finding was that the Agesta samples were much easier to decontaminate than were active specimens from a modern, commercial PWR system. (Auth)(PTO)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

213

Abe, T., T. Nishizaki, S. Yamada, S. Nakayama, and S. Yamashita, Kawasaki Heavy Industries Limited, Kobe, Japan

Status on Underwater Plasma Arc Cutting in KHI

First Atomic Power Industry Group 98:39-44 (1981, July)

As one of the techniques required for the dismantling and removal of nuclear reactor facilities, the technique of remote control dismantling of thick-walled steel structures, such as radioactivated reactor pressure vessels and the structures in reactors, is important. Among the cutting techniques, underwater plasma arc cutting is considered to be powerful, and the improvement of its cutting capability is the future problem. Kawasaki Heavy Industries, Limited, has engaged in the research and development of such dismantling techniques for steel structures, and, in this paper, the basic tests for cutting thick-walled steel structures in water by remote operation are reported. It is important to establish the techniques for decommissioning large power reactors and for obtaining public acceptance on nuclear power generation. Also it has been pointed out that the construction and arrangement of plants that become the bottleneck of decommissioning works must be solved in the design stage. The features of the techniques of cutting steel structures in decommissioning, the principle of plasma arc cutting, the items of experiment, the experimental setup, the specimens, the cutting conditions, and the experimental results are described. The reduced cutting capability in water, as compared with that in air, is clarified to some extent. (EDB)

214

Barker, C.R., M. Mazurkiewicz, and M. Anderson, University of Missouri at Rolla, Rolla, MO

Evaluation of an Abrasive Cleaning System

CONF-824107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 429-446) (1982, April)

Cutting tests using glass samples were run using a production abrasive cleaning system to relate the sample weight loss to standoff distance and sand consumption for a constant power input. Four different water nozzles were tested with and without a cone mixing chamber to assist in accelerating the sand to cutting speed. Equations were fitted to the cutting data to project predicted cutting performance outside the region where data were taken and to compare the performance of the four nozzle arrangements tested. This comparison reveals that the best arrangement of those tested was the six-jet water nozzle. The most likely explanation for this result is that the abrasive can more easily penetrate into the smaller jets, and the area where the water is exposed to the abrasive is increased by using more water jets. (Auth)

215

Barton, R.E.P., and D.H. Saunders, BHRA Fluid Engineering, Cranfield, United Kingdom

Water/Abrasive Jet Cutting of Concrete and Reinforced Concrete

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 465-487) (1982, April)

The use of water jets with entrained abrasives was investigated as a method of cutting high strength concrete. Because the cutting head is small, the method could be particularly valuable where access by more conventional methods is awkward. Trials on a number of specially prepared high strength concrete blocks are described. Blocks up to 700 mm deep were cut through using a cutting head developed at BHRA and operating at pressures up to 965 bar (14000 psi). Some of the blocks included reinforcing steel (up to 32 mm diameter) which was cut at the same time as the concrete, using the same equipment. (Auth)

216

Baumann, J., S. Kausch, and J. Palmowski, Kraftanlagen AG, Heidelberg, Federal Republic of Germany

Radiation Protection for Backfitting and Dismantling Operations in Controlled Zones of Nuclear Installations

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

CONF-7910255; Radioactive Waste, Proceedings of the 7th IRPA Regional Conference and 13th Annual Meeting of the Fachverband fuer Strahlenschutz e.V., Koeln, Federal Republic of Germany, October 16-19, 1979 (1979)

Backfitting measures or dismantling activities within a controlled area put special requirements on radiological protection. This is shown in the following cases: sanitation of the general decontamination services of the Karlsruhe Nuclear Research Center, which is a waste water, equipment decontamination, and an incineration and packaging facility; dismantling and disposal of high-radiation components, including decontamination of buildings of the Eurochemic reprocessing plant at Mol; and reconstruction of the HDR plant for safety experiments together with waste management for components and systems, e.g., presure vessel internals, pipes, etc. (EDB)(JMF)

217

Beitel, G.A., Atlantic Richfield Hanford Company, Richland, WA

Remote Disassembly of Radioactively Contaminated Vessels by Means of an Arc Saw

CONF-771102; Proceedings of the 70th Annual AICHE Meeting, New York, NY, November 13-17, 1977; (27 pp.) (1977)

The arc saw is a toothless circular saw that cuts by means of an electric arc. Cutting speeds between 20 to 30 sq cm/s and depths of up to 45 cm are possible. There is no mechanical contact between blade and work piece, no binding, and no blade breakage. Use of the arc saw will enable the rapid and remote disassembly of multiple ton, contaminated stainless steel vessels. (GRA)(JMF)

218

Cluchet, J., J. Desroches, and J.C. Leburn, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France

Dismantling of Nuclear Installations: Problems Arising from the Work and Processing of the Waste and Effluents Produced

CONF-7703138; CEA-CONF-5068; Decommissioning of Nuclear Installations, Proceedings of an Information Session, Paris, France, March 31, 1977; (9 pp.) (1977)

Various dismantling stages are discussed in detail. The fact that work carried out has to comply with general safety rules with respect to both the personnel and the environment is stressed. (EDB)(NPK)

219

Daedalean Associates, Inc., Woodbine, MD

Development of a High Pressure Water Jet for the Rapid Removal of Concrete

MGB-8027-001-FR; FHWA-TS-83-206; 76 pp. (1983, February)

The objective of this program was to design, build, and demonstrate a prototype concrete removal unit that utilized water cavitation erosion technology to accomplish the work. This final report presents an in-depth discussion of the significant elements of the program, specifically: the design considerations, the fabrication and laboratory testing, and finally the field demonstration. In addition, there are separate sections that include a cost analysis and system comparison and the conclusion and recommendations that resulted from this program. (GRA)

220

Dismantling the Niederaichbach Power Plant

Energiewirtschaftliche Tagesfragen 28(8):518 (1978, August)

The Niederaichbach power plant near Landshut, which has proved a failure, will be pulled down this year. Early next year, the radioactive parts of the reactor containment will be removed and stored in the former Asse II salt mine near Wolfenbuettel. (EDB)

221

Cannon Blasts Rock with High Velocity Slug of Water

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Engineering News-Record 192(5):16 (1974, January 31)

The U.S. Department of Transportation's (DOT) Federal Railroad Administration recently introduced a 10-ft-long cannon that fires a 1-quart slug of water at solid rock and produces a 6-in.-deep crater, 2 ft in diameter. The water package is fired at the rock through a special 5-ft-long nozzle at velocities up to 9800 ft/s and jet pressures up to 650,000 psi. The water cannon fires the water in a 0.33-in. diameter stream. The high-velocity water jet fractures the rock much as an ice pick breaks ice. (EDB)

222

Faccini, E.C., and T.E. Wergen, U.S. Department of the Navy, Washington, DC

Cutting Torch and Method

U.S. Patent 4,371,771; 5 pp. (1983, February 1)

This cutting torch and method for cutting or removing a material utilizes a high-velocity reactive gas stream to promote combustion of the material and a hollow, elongated structure, with an adequate supply of aluminum for producing unstable aluminum oxides. (GRA)(Auth)

223

Fetrow, L.K., R.P. Allen, and M.W. McCoy, Pacific Northwest Laboratory, Richland, WA

Sectioning Techniques for Plutonium-Contaminated Glove Boxes

CONF-820424; The Treatment and Handling of Radioactive Wastes, Proceedings of an American Nuclear Society Topical Meeting, Richland, WA, April 19, 1982. Battelle Press, Columbus, OH; (pp. 109-114) (1982)

The size reduction of plutonium-contaminated glove boxes can substantially reduce storage and disposal volumes and is essential to prepare material for decontamination by advanced techniques such as vibratory finishing or electropolishing. Several industrial sectioning techniques have been evaluated at Pacific Northwest Laboratory under U.S. Department of Energy sponsorship for the size reduction of plutonium-contaminated glove boxes. The techniques evaluated include plasma arc torch cutting, mechanical sawing and nibbling, abrasive cutting, and hydraulic shearing and punching. These demonstration studies show that plutonium-contaminated glove boxes can be sectioned safely, efficiently, and with minimal secondary waste generation for size reduction or decontamination purposes using an appropriate combination of available industrial metal cutting techniques. (EDB)

224

Foerster, H., and P. Wiese, Forschungsinstitut Manfred von Ardenne, Dresden, German Democratic Republic

State of the Art of Plasma Cutting in the German Democratic Republic (GDR)

Elektrie 37(3):143-154 (1983, March)

In the German Democratic Republic, plasma cutting equipment has been developed for the power range of 3 to 100 kW. Metallic materials can be cut by machine or by hand up to a thickness of 150 mm. The great cutting velocities are of advantage because they allow coupling with the most modern directing machines. Possibilities of reducing detrimental effects of light, noise, and toxic materials by protective measures are discussed on the basis of examples. (EDB)

225

Gaiser, H., Kunz (A.) and Company, Muenchen, Federal Republic of Germany

Dismantling Procedure for Decommissioned Nuclear Power Plants

German (FRG) Patent 2,854,330/A/ (1980, June 26)

A pit is excavated under the ground plate of the noncontaminated component part of the reactor or nuclear power station to be dismantled. The component part is then separated from the ground plate and lowered into the pit. A supporting construction can be used to lower the component part into the pit. (EDB)(CAJ)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

226

Gini, K.E., Y.D. Elizarov, Y.Y. Kiselev, F.P. Stanchu, S.V. Tebenchuk, and V.M. Yampol'skii

An Air-Plasma Cutter for Thin Materials

Izvestiya Vysshikh Uchebnykh Zavedenii, Mashinostroenie (USSR) 9:115-118 (1982)

The partitioning of metal sheet, less than 8 mm thick, can be accomplished conveniently using an air plasma-arc low-current cutter. The width of the cut is narrow and the edge is well defined. In order to preserve optimum energy balance for the arc, the cutting must be performed at high arc voltage. The optimum voltage is achieved using a source of supply with steeply falling internal static characteristics and a high open-load voltage. The results reported are for an air plasma-arc cutter, rated up to 100 A, for metal sheets and alloys up to 10 mm thick, with the cut width not exceeding 1.3 mm. (INSPEC)

227

Hamasaki, M., Government Industrial Research Institute, Shikoku, Japan

Underwater Cutting of Nuclear Reactor

Koon Gakkaishi 8(1):24-32 (1982, January)

Among energy sour es, a go d substitute for petroleum is nuclear power, in view of power generation costs. Japan has made efforts to increase nuclear power generation, but securing new sites for nuclear power is very difficult. When the life of nuclear power stations has ended, they are dismantled immediately, and new nuclear power stations are constructed at those sites. BWRs are used for 40 years and dismantled immediately. PWRs are used for 40 years and dismantled after they are left as they are for 30 years. To establish safe and efficient techniques for dismantling, a considerably long period is required. To safely guard against radioactivity, underwater cutting is applied to the pressure vessels, structures, and other parts of nuclear reactors. Underwater cutting uses the heat of high temperature arc. Electric discharge cutting, plasma cutting, melting electrode type water jet cutting, the combined use of gouging and gas cutting, and arc saw cutting are described. As for underwater cutting, only basic research was started, and the possibility of perfect separation cutting by remote control must be examined. Also the experiments in cutting nearly full-size components are necessary. (EDB)(CAJ)

228

Hamasaki, M., Y. Murao, and F. Tateiwa, Government Industrial Research Institute, Shikoku, Japan

Fundamental Underwater Cutting Method Experiment as a Dismantling Tool for a Commercial Atomic Reactor Vessel

Nuclear Technology 59(1):99-103 (1982, October)

A new underwater cutting technique applying underwater dismantling to commercial atomic reactor vessels has been developed. This technique involves gas cutting the mild steel underwater after removing the stainless steel cladding by arc gouging. The arc gouging is achieved by blowing out metal that is melted by an arc between a mild steel electrode wire and the stainless steel, by jetting water from a rear water nozzle. The fuel gas employed for preheating for the gas cutting was a mixed gas of propane and 30% methylacetylene. The test piece used was made of 300-mm-thick mild steel with 8-mm-thick stainless steel cladding. The fundamental cutting experiment was carried out successfully under a cutting speed condition of 15 cm/min at a water depth of 20 cm. This apparatus is easy to handle, compact, and cheap. (EDB)

229

Hamasaki, M., and F. Tateiwa

Underwater Gouging of Stainless Clad Steel Using Mild Steel Strip

Journal of Japan Welding Society 52(3):277-281 (1983, March)

The dismantling of the pressure vessel in commercial atomic reactors is now being planned throughout the world. For the dismantling, underwater cutting is a good method of shielding the operators and the reactor site from the induced radiation. These pressure vessels are made of 150-250 mm thick carbon steel with 18/8 type stainless steel 6-12 mm thick cladding, and the underwater cutting has to be carried out from the stainless side. The report concerns underwater gouging of the stainless steel clad for underwater gas cutting of the stainless steel used in commercial pressure vessels. Underwater gouging is a process in which the stainless steel clad is melted by the arc heat generated between a mild steel wire or strip electrode and the stainless steel and blown out by jetting water from a rear nozzle. Continuous gouging can be done by means of an automatic travelling carriage. (METADEX)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

230
Hamasaki, M., F. Tateiwa, F. Kanatani, and S. Yamashita, Government Industrial Research Institute, Shikoku, Japan; Kawasaki Heavy Industries Limited, Technical Institute, Akashi, Hyogo, Japan

Underwater Cutting of Stainless Steel Plate and Pipe for Dismantling Reactor Pressure Vessels

Metal Construction 14(8):446-447 (1982, August)

A consumable electrode water jet cutting technique is described. Satisfactory underwater cutting of 80-mm stainless steel plate, using a current of 2000 A and at a water depth of 200 mm, has been demonstrated. The electrical requirements for this arc welding method applied to cutting were found to be approximately one-third those required for conventional plasma arc cutting for the same thickness plate. An application of this technique might be found in the dismantling of atomic reactor pressure vessels and parts of commercial atomic reactors. (EDB)

231
Hashish, M., Flow Industries Inc., Kent, WA

The Application of Abrasive Jets to Concrete Cutting

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 447-464) (1982, April)

A study was undertaken to develop an abrasive jet cutting nozzle for concrete. This paper presents the experimental results on the effects of various abrasive jet cutting parameters. An optimization kerfing scheme is also presented. The investigation showed the great potential of abrasive jet cutting for a wide range of applications. For example, a 37.5 kW abrasive jet stream was shown to be capable of cutting concrete and steel reinforcing rebars to depths up to 380 mm, without adjusting the original standoff distance, at advance rates of up to 5 m/hr. (Auth)

232
Hashish, M., Flow Industries Inc., Kent, WA

Steel Cutting with Abrasive Waterjets

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 465-487) (1982, April)

Steel cutting with high-velocity, abrasive water jets is investigated. The effects of abrasive material, size, and flow rate, jet pressure, standoff distance, traverse rate, number of passes, and hydraulic power on the depth of cut are presented. The investigation shows the great potential of abrasive water jets in various cutting applications. An example of the cutting results is the slicing of a 20 mm thick steel plate at a 3.3 mm/s traverse rate with a 37 kW hydraulic stream. Optimization of cutting parax parameters can further improve cutting results. (Auth)

233
Hiratake, S.

Plasma Torch and a Method of Producing a Plasma

U.S. Patent 4,390,772 (1983, June 28)

A plasma torch includes an annular cathode having an annular peripheral edge from which an arc is discharged. A pair of annular nozzle elements are placed coaxially on the opposite sides of the cathode. Each nozzle element has an annular edge hanging over the annular peripheral edge of the cathode. The annular edges of the nozzle elements an annular outlet opening for the torch. Gas is introduced between the cathode and the nozzle elements and emitted through the annular outlet opening in a plasma jet. A magnetic field is developed across the annular outlet opening to cause the plasma jet to rotate along the annular peripheral edge of the cathode for its uniform emission from the entire perimeter of the annular outlet opening. (EDB)

234
Kaemmerling, M., and U. Borschel, Transnuklear GmbH, Hanau, Federal Republic of Germany

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Process for Dismantling of Activated Containers in Decommissioned Nuclear Facilities

German (FDG) Patent 2,907,738/A/ (1980, September 4)

For shielding purposes, the container is filled to the top with fluid matter such as paraffin, tar, granulates, sand, or barytes. In the course of dismantling the containment closure and wall, the filling material is removed and used for conditioning the dismantled components in the ultimate storage form. Dismantling is carried out by remote-handling. The components and filling materials are removed by means of a channel tube which penetrates the bottom of the containment and then is itself dismantled. (EDB)(EST)

235

Kiyohashi, H., M. Kyo, W. Ishihama, T. Yahiro, and H. Yoshida, University of Tohoku, Tohoku, Japan; Kajima Institute of Construction Technology, Kajima, Japan

The Effect of Concrete Preheating on Water Jet Breaking of Concrete

CONF-8204107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 241-265) (1982, April)

Influences of preheating temperature (theta) on water jet breaking of a preheated concrete (cement mortar) have been experimentally studied as a function of standoff distance (L). Theta was varied from room temperature (no preheating) to 600 deg C. Water jet speed was kept constant at 210 m/s (water pressure, P sub o, = 22.1 MPa) at the nozzle exit [nozzle diameter (D sub o) = 0.5 mm I.D.]. Temperature of the jet water was normal. Dimensionless standoff distance (L/D sub o) was taken as 20, 28.6, 100, 200, 400, and 600. Jet operation time was fixed at 10 s. The experimental results indicated that the breaking pattern and efficiency varied characteristically with theta and L/D sub o. Holes surrounded with eroded area-shaped cavities were macroscopically observed in the surface of the specimen struck by the water jet. To show the effect of concrete preheating, the breaking depth augmentation ratio and the breaking volume augmentation ratio were defined. (Auth)(MFB)

236

Kohler, E.J., K.P. Steward, and J.V. Iacono, Gulf General Atomic Company, San Diego, CA

Peach Bottom HTGR Decommissioning and Component Removal

GA-A-14297; CONF-770822; Proceedings of an American Nuclear Society Meeting, Chattanooga, TN, August 8, 1977; (42 pp.) (1977, August 8)

The prime objective of the Peach Bottom End-of-Life Program was to validate specific HTGR design codes and predictions by comparison of actual and predicted physics, thermal, fission product, and materials behavior in Peach Bottom. Three consecutive phases of the program provide input to the HTGR design methods verifications: (1) Nondestructive fuel and circuit gamma scanning; (2) removal of steam generator and primary circuit components; and (3) Laboratory examinations of removed components. Component removal site work commenced with establishment of restricted access areas and installation of controlled atmosphere tents to retain relative humidity at less than 30%. A mock-up room was established to test and develop the tooling and to train operators under simulated working conditions. Primary circuit ducting samples were removed, and steam generator access was achieved by a combination of arc gouging and grinding. Tubing samples were removed using internal cutters and external grinding. Throughout the component removal phase, strict health physics, safety, and quality assurance programs were implemented. A total of 148 samples of primary circuit ducting and steam generator tubing were removed with no significant health physics or safety incidents. Additionally, component removal served to provide access for determination of cesium plateout distribution by gamma scanning inside the ducts and for macroexamination of the steam generator from both the water and helium sides. Evaluations are continuing and indicate excellent performance of the steam generator and other materials, together with close correlation of observed and predicted fission product plateout distributions. It is concluded that such a program of end-of-life research, when appropriately coordinated with decommissioning activities, can significantly advance nuclear plant and fuel technology development. (EDB)

237

Logan, J.A., C.W. Hultman, and T.J. Lewis, EG&G Idaho, Inc., Idaho Falls, ID

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

TMI-2 Reactor-Vessel Head Removal and Damaged-Core-Removal Planning

EGG-TIO-M-02282; CONF-821103; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 14, 1982 (1982)

A major milestone in the cleanup and recovery effort at TMI-2 will be the removal of the reactor vessel closure head, planum, and damaged core fuel material. The data collected during these operations will provide the nuclear power industry with valuable information on the effects of high-temperature-dissociated coolant on fuel cladding, fuel materials, fuel support structural materials, neutron absorber material, and other materials used in reactor structural support components and drive mechanisms. In addition, examination of these materials will also be used to determine accident time-temperature histories in various regions of the core. Procedures for removing the reactor vessel head and reactor core are presented. (EDB)

238
Maguire, S.A., Ingalls Shipbuilding, Pascagoula, MS

Planning the Total Plasma Arc Cutting System

Welding Journal 61(12):33-37 (1982)

Numerical control plasma arc cutting is now becoming accepted as a feasible alternative to conventional oxygen cutting in the shipbuilding industry. Plasma arc's major advantage over oxygen cutting is the high cutting speed attainable -- roughly five times faster than oxygen cutting for material thicknesses of 0.5 in. (12.7 mm) or less. Conversion to plasma arc cutting can reduce cutting costs by reducing the man hours required to accomplish the cutting. These substantial savings are based, however, on efficient use of the plasma arc cutting. (ISMEC)

239
Nagase, T., Shimizu Construction Company Limited, Tokyo, Japan

Control Blasting of Reinforced Concrete

First Atomic Power Industry Group 98:45-51 (1981, July)

With the increased necessity of decommissioning nuclear power plants, it is urgent that methods and standards be established. Shimizu Construction Company Limited, has conducted feasibility studies on the explosive demolition method (i.e., the controlled blasting of the massive concrete structures peculiar to nuclear power plants), taking special interest in the aspects of radiation exposure, safety and high efficiency. The techniques of line drilling, cushion blasting, pre-splitting and guide hole blasting are described with photographs included. In the selective demolition of activated concrete structures, the series of experiments resulted in clear-cut surfaces. The blasting was properly confined with the scattering of debris being entirely prevented by the use of rubber belts. There was also little gas and dust generated due to the small amount of charge being used. (EDB)(EST)

240
Nemec, J.F., and T. Mooers, Bechtel National, Inc., Oak Ridge, TN

Contaminated Concrete Removal Techniques for Nuclear Plant Decommissioning

CONF-830905; Proceedings of a Joint Power Generation Conference, Indianapolis, IN, September 25, 1983; American Society of Mechanical Engineers 83-JPGC-NE; (7 pp.) (1983)

Removal of contaminated concrete is a particularly troublesome decommissioning activity. Techniques employed in the construction and demolition industries must be adapted to comply with contamination control and exposure management requirements. This is a discussion of available techniques and equipment, their application, and modifications needed for working in a radioactive environment. In addition, new techniques and approaches are suggested which could significantly reduce the problems of contaminated concrete removal. (EDB)

241
Newton, G.J., M.D. Hoover, E.B. Barr, B.A. Wong, and P.D. Ritter, Lovelace Biomedical and Environmental Research Institute, Inhalation Toxicology Research Institute, Albuquerque, NM

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Aerosols from Metal Cutting Techniques Typical of Decommissioning Nuclear Facilities - Experimental System for Collection and Characterization

LMF-102; Inhalation Toxicology Research Research Institute Annual Report, October 1, 1981-September 30, 1982; (pp. 39-46) (1982, December)

Decommissioning of radioactively contaminated sites has the potential for creating radioactive and other potentially toxic aerosols. An experimental system to collect and characterize aerosols from metal cutting activities typical of those used in decommissioning of nuclear facilities is described. A special enclosure was designed for the experiment and consisted of a 5.1 cm by 10.2 cm stud frame with double walls of flame retardant polyethylene film. Large plexiglass windows allowed the cutting operations to be directed and filmed. Ventilation was 8500 l/min (300 cu ft/min) exhausted through HEPA filters. Seven cutting techniques were evaluated: pipe cutter, reciprocating saw, band saw, chop saw, oxy-acetylene torch, electric arc cut rod and plasma torch. Two grinding tools were also evaluated. Materials cut were 5.1 cm, 7.6 cm and 10.2 cm diameter schedule 40, 80 and 180 type 304L stainless steel pipe. (EDB)

242

Onda, T., M. Umeda, A. Iguchi, M. Kawano, T. Kinoshita, and Y. Kasai, Japan Atomic Energy Research Institute, Tokyo, Japan

Dismantling Technology of Nuclear Reactors

JAERI-M-9540; 190 pp. (1981, July)

Nuclear power plant components, which involve both large scale steel and massively reinforced concrete, contain very high radioactive inventories. At the end of the plant lifetime, the radioactivity makes these components difficult to dismantle. To better understand this difficulty, the state-of-the-art dismantling technologies were surveyed and reviewed, and a case study of the dismantling and safe storage of a small scale BWR power station was carried out and discussed. Immediate dismantling and safe storage on a large scale BWR power station was also surveyed and reviewed. In-site entombment as applied to small and large scale BWR power stations was also discussed. The results described in this report were surveyed and discussed as part of the third year activity of the dismantling technology subcommittee of the Committee on the Study of Decommissioning of Nuclear Facilities. (EDB)(EST)

243

Sato, S., Y. Ikezoe, S. Shimizu, H. Nakajima, K. Onuki, S. Takayanagi, M. Suzuki, S. Hasegawa, and K. Naito, Japan Atomic Energy Research Institute, Tokyo, Japan

Dismantling of the Low Temperature Fissiochemical Loop (LTFL)

JAERI-M-82-081; 69 pp. (1982, July)

Construction of the Low Temperature Fissiochemical Loop (LTFL) was completed in March 1969, using a horizontal experimental hole of JRR-3. The loop was used as an in-pile irradiation apparatus for the study of preparative radiation chemistry, particularly the effect of fission fragment irradiation; ceasing operations in October of 1979. The LTFL was dismantled during April and May of 1981. This report describes the planning and execution of the LTFL dismantlement and the subsequent reactor safety examination and discusses the research works related to the loop. (EDB)(EST)

244

Simpson, D.R., Oak Ridge National Laboratory, Oak Ridge, TN

Health-Physics Activities Associated with the Demolition of the Precipitator Unit in the 3039 Area

ORNL/TM-8437; 15 pp. (1983, February)

Oak Ridge National Laboratory (ORNL) has just completed the demolition of a highly-contaminated precipitator unit as the first step in the renovation of the ventilation and off-gas system. The Health Physics Department actively participated in this project from the planning stages through actual demolition to ensure that all work was done safely and with the minimum radiation exposure reasonably achievable. Lessons learned in this project should be applicable to future decommissioning projects at both ORNL and other facilities. (EDB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

245
Summers, D.A., and R.J. Raether, University of Missouri at Rolla, Rolla, MO

Comparative Use of Intermediate Pressure Water Jets for Slotting and Removing Concrete

CONF-82404107; Jet Cutting Technology, Proceedings of the Sixth International Symposium, Surrey, United Kingdom, April 6-8, 1982, 501 pp.; (pp. 387-395) (1982, April)

The U.S. Army Corps of Engineers has engaged two competing organizations to demonstrate the effectiveness of intermediate-pressure (less than 130 MPa) water jets for cutting concrete. This paper describes the trial that was carried out and the equipment used therein. Potential improvements in performance as a function of the parameters of the test are incorporated in the discussion of the results. (Auth)

246
Tikhomirov, A.V., A.Y. Mikheev, N.V. Evdokushkin, F.K. Kosyrev, and S.F. Moryashchev

Metals Cut with CO2-Lasers

Automatic Welding 35(3):49-51 (1982)

The conditions under which metal alloys and nonmetallic materials can be cut using CO2 lasers [1 to 4.9 kW(t) power range] have been determined by calculation and experiment. The rational fields of use for laser cutting are recommended. An example of the industrial use of the process is given, and machines with digital program control for cutting stainless steel sheet are named. (INSPEC)

247
U.S. Nuclear Regulatory Commission, Washington, DC

NRC Terminates Facility License No. R-60, Stanford University for the Stanford University Pool Reactor, As Licensee Has Successfully Dismantled the Facility

Federal Register 48(127):30227; DOCKET 50-141 (1983, June 30)

By application dated September 20, 1973, as supplemented by other letters, Stanford University requested authorization for the Nuclear Regulatory Commission (NRC) to dismantle the Stanford Pool Reactor, a research reactor located on the University's campus near Palo Alto, California, and to terminate facility License No. R-60. The authorization is in conformance with 40 CFR Part 1500, Council on Environmental Policy Act of 1969 as amended; and 49 CFR Part 622, Federal Highway Administration and Urban Mass Transportation Administration Environmental Impact and related procedures. (Auth)(LFG)(EST)

248
Wobser, J.K., Savannah River Laboratory, Aiken, SC

Nonradioactive Demonstration of the Alpha D and D Pilot Facility

DP-MS-83-42; CONF-830650; Size Reduction and Decontamination Facilities, Proceedings of a Federal Republic of Germany/United States Workshop, Karlsruhe, Federal Republic of Germany, January 27, 1983; (26 pp.) (1983)

The Alpha-Contained Decontamination and Disassembly (D and D) pilot facility was designed to demonstrate the process flowsheet under conditions typical to those expected in a production facility. To achieve this, nonradioactive waste items similar to those in retrievable storage at the Savannah River Plant burial ground (e.g. gloveboxes), were chemically sprayed and size reduced. During process runs, parameters such as feed rate, oxide removal, etching rate, and secondary waste generation were determined. The exhaust system was monitored during operation to ensure that exhaust from the facility was sufficiently filtered before release to the atmosphere. The strategy for decontamination techniques required development during the nonradioactive testing period. During process runs both once-through and recirculating washes were investigated, and their correlation to oxide removal and etching rates on the stainless steel feed items noted. Wash products of the decontamination process were analyzed for concentration of Ni, Cr, Fe, Mn, and Si, which are major components of stainless steel. Size reduction techniques were also developed during the nonradioactive testing period. An array of conventional power and pneumatic tools were tested and evaluated. Plasma arc torch operating parameters, standoff distance, ampere setting, and cutting angle were determined. (EDB)(CAJ)

249

Yada, T., U. Nakamura, S. Tomidokoro, and M. Fukuzawa, Ishikawajima-Harima Heavy Industries Company Limited, Tokyo, Japan

Plasma Cutting Equipment Used in Water

Haikan Gijutsu 23(9):110-114, 131-132 (1981, August)

The method of decommissioning a nuclear power station is roughly classified into sealing and controlling, shielding and isolation, and disassembling and removal. To facilitate reuse of the sites, the disassembling and removal method is preferred in Japan. The dismantlement of highly radioactive parts is done by using a remotely controlled submerged cutting method to guard against radiation exposure. The submerged plasma cutting equipment reported in this paper is manufactured for the purpose of remotely cutting and dismantling radioactive Zr-2.5% Nb tubular materials in water depths up to 4 meters. This equipment is designed on the basis of results obtained during three years of basic experiments and mock-up tests sponsored by the Power Reactor and Nuclear Fuel Development Corporation. The principle features of the submerged plasma arc cutting method are explained. Nonferrous metals can be cut easily. The cutting torches are light, the automation and remote operation of this method are easy, the thermal efficiency is good and the quantity of fumes generated during cutting is very small. The parameters of cutting conditions and protection from the fine particles that are generated by cutting were examined. The disassembly and removal operation of the Elk River Reactor in the U.S. is reported. (EDB)(EST)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING SITE STABILIZATION AND RECLAMATION

250

Tawil, J.J., Pacific Northwest Laboratory, Richland, WA

Decontamination Analysis of the NUWAX-83 Accident Site Using DECON

PNL-4902; 38 pp. (1983, November)

This report presents an analysis of the site restoration options for the NUWAX-83 site, at which an exercise was conducted involving a simulated nuclear weapons accident. This analysis was performed using a computer program developed by Pacific Northwest Laboratory. The computer program, called DECON, was designed to assist personnel engaged in the planning of decontamination activities. The many features of DECON that are used in this report demonstrate its potential usefulness as a site restoration planning tool. Strategies that are analyzed with DECON include: (1) employing a Quick-Vac option, under which selected surfaces are vacuumed before they can be rained on; (2) protecting surfaces against precipitation; (3) prohibiting specific operations on selected surfaces; (4) requiring specific methods to be used on selected surfaces; (5) evaluating the trade-off between cleanup standards and decontamination costs; and (6) varying of the cleanup standards according to expected exposure to surface. (EDB)

251

Tawil, J.J., and D.L. Strenge, Pacific Northwest Laboratory, Richland, WA

Decontamination Analysis of a Radiologically Contaminated Site

PNL-SA-11548; 21 pp.; CONF-840202; Proceedings of the 17th Midyear Topical Meeting of the Health Physics Society, Pasco, WA, February 5, 1984; (21 pp.) (1984, February)

This paper presents an analysis of decontamination options at the NUWAZX-83 exercise site. Held in May 1983, the purpose of the exercise was to evaluate the ability of federal, state and local officials to respond to a radiological accident involving nuclear weapons. A computer program developed by Pacific Northwest Laboratory was used to conduct the decontamination analysis. The program, DECON, was designed to assist personnel engaged in the planning of decontamination activities. The many features of DECON that are demonstrated in this paper contribute to its potential usefulness as a planning tool for site restoration. Strategies that are analyzed with DECON include: (1) using a Quick-Vac option, under which exterior surfaces are vacuumed before it rains; (2) protecting surfaces against precipitation; (3) prohibiting specific operations on selected surfaces; (4) requiring that specific methods be used on selected surfaces; (5) evaluating the trade-off between cleanup standards and decontamination costs; and (6) varying clean-up standards according to expected human exposure to the surface. (EDB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

252

Clark, J.H., and B.J. Sneed, EG&G Idaho, Inc., Idaho Falls, ID

Low-level Waste Volumes from Decommissioning of Commercial Nuclear Power Plants

EGG-M-15983; CONF-831047; Proceedings of an American Nuclear Society Winter Meeting. San Francisco, CA, October 30, 1983; (5 pp.) (1983)

The decommissioning of commercial nuclear power reactors will begin about the year 2000 and is expected to continue beyond 2045. This decommissioning will generate significant volumes of low-level radioactive waste. Seventy-seven such facilities are now operating or have operated in the U.S., and 70 more are expected to be operating by the year 2000. The low-level wastes from decommissioning these facilities must be accommodated in emerging state and regional low-level waste disposal sites. Accurate projections of the annual decommissioning waste volumes must be available for developing disposal site plans. A method for estimating low-level waste volumes from decommissioning of individual power plants is described which utilizes several existing information sources. (EDB)

253

Deichman, J.L., D.E. Large, R.S. Lowrie, L.E. Stratton, and D.G. Jacobs, Rockwell Hanford Operations, Richland, WA

Contaminated Metallic Melt Volume Reduction Testing

CONF-811130; ORNL/NFW-81/34; DOE Participants Information Meeting on Low-Level Waste Management, Proceedings of the Third Annual Meeting, New Orleans, LA, November 4, 1981; (pp. 191-94) (1981, December)

Laboratory scale metallic melts (stainless steel) were accomplished in support of Decontamination and Decommissioning's (D&D) contaminated equipment volume reduction and Low-Level Lead Site Waste programs. Six laboratory scale melts made with contaminated stainless steel provided data that radionuclide distribution can be predicted when proper temperature rates and ranges are employed, and that major decontamination occurs with the use of designed slagging materials. Stainless steel bars were contaminated with plutonium, cobalt, cesium and europium. Although this study was limited to stainless steel, further study is desirable to establish data for other metals and alloys. This study represents a positive beginning in defining the feasibility of economical volume reduction or conversion from TRU waste forms to LLW forms for a large portion of approximately 50 thousand tons of contaminated metal waste now being stored underground or in deactivated facilities at Hanford. (EDB)

254

Hume, C., M.J. Herz, T.C. Jackson, and C. Roosevelt, Carleton College, Northfield, MN

Oceanic Society Briefing Report on Ocean Disposal of Obsolete Nuclear Submarines as Proposed by the United States Navy

Oceanic Society Report; 20 pp. (1983)

Early in 1982, the U.S. Navy revealed plans to dispose of up to 100 defueled, decommissioned nuclear submarines in the oceans over the next 30 years. Safety concerns over the radioactivity contained in the vessels' nuclear reactors and supporting structures are discussed. The Navy has presented plans to remove the submarines' radioactive parts and discard them on land. A second plan details the entire ocean disposal of the vessels. The Navy's submarine scuttling program would result in the release of an unprecedented amount of radioactivity to the oceans. The biological and health effects of such actions are discussed. (ENVIR)(NPK)

255

Petrasch, P., Nuklear-Ingenieur Service GmbH, Frankfurt, Federal Republic of Germany

Waste Amounts and Waste Treatment at the Decommissioning of Nuclear Power Plants

CONF-811056; Management of Radioactive Waste from Nuclear Power Plants, Proceedings of a Seminar, Karlsruhe, Federal Republic of Germany, October 5-9, 1981; (pp. 187-197) (1983, January)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

In the Federal Republic of Germany, 12 nuclear power plants will probably be decommissioned between the years 2000 and 2020. The radioactive waste produced by decommissioning these power plants could amount to as much as 75,000 Mg. The main objective is to dispose of this radioactive waste and, at present, ultimate storage deep inside suitable geologic formations is regarded as the preferential method of disposal in West Germany. This method entails packing the waste into casks and using the resultant solid, compact product as the final storage unit. Up to now only the Asse-System of storage casks has been used for ultimate storage trials in the Federal Republic of Germany, although more advanced types of casks are under development for future use, e.g. cast iron casks or small containers (20 Mg). If the Asse packing concept is taken as an example, the projected amount of decommissioning waste will require about 300, 000 drums whereas the packing system under development calls for only about 12,000 containers. This reduction in the number of disposal casks would simplify the handling aspect and the final storage volume would be about 60,000 to 100,000 cubic meters. The Asse salt mine, with a useable volume of about 3.6 X 10(E+6) cubic meters, would be sufficient for the disposal of radioactive decommissioning waste from 35 to 60 nuclear power plants. (EDB)

256

Talbert, D.M., Sandia National Laboratories, Albuquerque, NM

Oceanographic Studies to Support the Assessment of Submarine Disposal at Sea - Volume 1: Summary and Preliminary Evaluation

SAND-82-1005/1; 47 pp. (1982, September)

Oceanographic studies have been undertaken to provide a data base and generic site characterization to support an assessment of the environmental consequences of possible deep ocean disposal of defueled, decommissioned nuclear submarines. Potentially suitable site selection guidelines are established for these studies. Based on research to date, study areas in the Pacific and Atlantic Oceans are identified which potentially satisfy the guidelines. The data base and general characterization for each of these study areas are discussed. (EDB)

257

U.S. Department of Energy, Office of Defense Waste and Byproducts Management, Washington, DC

Department of Energy Plan for Recovery and Utilization of Nuclear By-products from Defense Wastes

DOE/DP-0013 (Vol. 2); 159 pp. (1983, August)

Nuclear wastes from the defense production cycle contain many uniquely useful, intrinsically valuable, and strategically important materials. These materials have a wide range of known and potential applications in food technology, agriculture, energy, public health, medicine, industrial technology, and national security. Their removal from the nuclear waste stream can facilitate waste management and yield economic, safety, and environmental advantages in the management and disposal of the residual nuclear wastes that otherwise have no redemptive value. Program policy, goals, strategy, implementation tasks, schedule, and funding are detailed. Also included is background information to support these tasks. (BDC)

258

U.S. Department of the Navy, Washington, DC

Permanent Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants - Public Hearings and the Availability of Draft Environmental Impact Statement

Federal Register 47(246):57085-57087 (1982, December)

The Department of the Navy has prepared a draft environmental impact statement (EIS) to assess the environmental implications of alternatives that could be used to permanently dispose of decommissioned, defueled naval submarine reactor plants. The proposed action is to evaluate the two basic alternatives, land or sea, for the permanent disposal of the plants. The Navy has made no decision to dispose of any nuclear-powered ships at this time. However, with over 100 nuclear-powered submarines in operation, the Navy is faced with eventual decommissioning of these at a future rate of possibly 3 or 4 per yr over the next 30 yr, and a permanent means of disposal must be developed that is

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

environmentally acceptable. Impacts assessed for each disposal alternative include expected commitment of resources, land use, transportation requirements, and environmental consequences, including occupational radiation exposure due to disposal activities and possible radiation exposure to the public during transportation and disposal. The impact of radioactivity releases due to unexpected occurrences is also assessed. For each alternative considered, an assessment is made of the impact on the environment in the vicinity of disposal sites. The draft EIS also includes a cost analysis of the disposal alteratives. (Auth)(MFB)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

259
Bjeldanes, M.N., Northern States Power Company, Minneapolis, MN

Pathfinder Conversion

Transactions of the American Nuclear Society 12(Suppl.):52-53 (1969)

On September 1, 1968, Northern States Power Company announced its intention to convert the Pathfinder Atomic Power Plant from nuclear to fossil fuel operation. The decontamination of the turbine and associated equipment was done by a contractor in conjunction with a turbine overhaul. The radioactive contamination encountered was more then 99% Zn-65 with trace amounts of Cobalt-60. The original conservative estimate of the inventory was 33 Ci. The final estimate after decontamination and equipment removal is less than 2.5 Ci. The replaced heaters and the associated piping were shipped and buried as radioactive solid waste. The highest personnel exposures were received by plant personnel trained in radiation work procedures. There were no overexposures or internal exposures. The reactor building is presently defueled. The irradiated reactor fuel was transferred to the storage pool and then shipped to the reprocessors. The unirradiated fuel was returned to the manufacturer to be dismantled. The reactor building is being maintained to comply with Part 20 regulations for personnel exposure and contamination control. Penetrations such as the main steam line and feedwater line were closed with welded pipe caps. Ventilation control and radiation monitoring are being maintained. (MFB)

260
Buclin, J.P., S.A. l'Energie de l'Ouest-Suisse, Lausanne, Switzerland

Decommissioning of Lucens

CONF-821005; International Decommissioning Symposium - 1982, Proceedings of the U.S. Department of Energy's Remedial Action Program/OECD Nuclear Energy Agency Conference, Seattle, WA, October 10-14, 1982; (pp. IV.106-IV.122) (1982)

After a short presentation of the LUCENS Experimental Nuclear Station project, a description of the plant and of the severe incident it experienced on January 21, 1969, is given. The procedures, methods, and tools utilized for dismantling the reactor, and simultaneously investigating the causes and consequences of the accident, are described in chronological sequences. A brief review of some problems that might arise at underground nuclear plants follows. Main figures are given for the costs spent, the time used, the doses accumulated, and the wastes handled. In closing some recommendations are given. (EDB)(CAJ)

261
Denero, J.V., R.A. Lange, M.L. Ray, J.L. Shoulders, and H.C. Woodsum, Westinghouse Electric Corporation, Nuclear Energy Systems, Pittsburgh, PA

Decontamination and Decommissioning of the Westinghouse Nuclear Fuel Facility at Cheswick, Pennsylvania, for the United States Department of Energy, Volume 1

WCAP-10574 (Vol. 1); 254 pp. (1984, June)

In the period 1980 through 1983, the Westinghouse Electric Corporation's Nuclear Fuel Division decontaminated and decommissioned a pilot plant facility that had been used for development and fabrication of mixed plutonium-uranium (mixed oxide) fuels. This facility, the Plutonium Fuels Development Laboratory (PFDL), had been in operation for 10 years, producing light water and fast breeder reactor fuels on a development and pilot-plant scale. Operations within the facility were conducted by two Westinghouse divisions, the Nuclear Fuel Division (NFD) and the Advanced Reactors Division (ARD). The NFD was responsible for the operation of the facility. This report describes the decontamination and decommissioning effort for the NFD portion of the operations, and for the structure and grounds. The ARD's decontamination and decommissioning experiences have been reported in detail in another report and are discussed only where the information is relevant to the NFD operations. (Auth)(NPK)

262
Denero, J.V., R.A. Lange, M.L. Ray, J.L. Shoulders, and H.C. Woodsum, Westinghouse Electric Corporation, Nuclear Energy Systems, Pittsburgh, PA

Decontamination and Decommissioning of the Westinghouse Nuclear Fuel Facility at Cheswick, Pennsylvania, for the United States Department of Energy, Volume 2

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

WCAP-10574 (Vol. 2); 135 pp. (1984, June)

In the period 1980 through 1983, the Westinghouse Electric Corporation's Nuclear Fuel Division decontaminated and decommissioned a pilot plant facility that had been used for development and fabrication of mixed plutonium-uranium (mixed oxide) fuels. This facility, the Plutonium Fuels Development Laboratory (PFDL), had been in operation for 10 years, producing light-water and fast breeder reactor fuels on a development and pilot-plant scale. Operations within the facility were conducted by two Westinghouse divisions, the Nuclear Fuel Division (NFD) and the Advanced Reactors Division (ARD). The NFD was responsible for the operation of the facility. This report describes the decontamination and decommissioning effort for the NFD portion of the operations and for the structure and grounds. Volume 2 of this report contains the following appendices: (1) Appendix C - Requests for approval and drawings for galvanized drums, epoxy coated corrugated steel boxes, fiberglass-reinforced polyester-coated plywood boxes, and non-TRU waste containers; (2) Appendix D - Certificates of compliance for overpacks; (3) Appendix E - Training program on use of full-face respirators; (4) Appendix F - Radiological survey measurement equipment; (5) Appendix G - Heath physics checks on decontaminated areas identified in ORAU/NRC survey; and (6) Appendix H - Tooling, equipment and supplies. (NPK)

263
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium

Experience Gained in the Management of Radioactive Waste from Maintenance, Decontamination and Partial Decommissioning of a Reprocessing Plant and Conclusions Resulting for the Management of Radioactive Wastes from Nuclear Power Plants

IAEA-TECDOC-276; CONF-811056; Management of Radioactive Waste from Nuclear Power Plants, Proceedings of a Seminar, Karlsruhe, Federal Republic of Germany, October 5-9, 1981; (pp. 165-186) (1983, January)

After a short description of the historical background of Eurochemic, its main tasks and the various operational phases, a detailed description of the waste management principles applied is presented. The practical experience in waste treatment is reported for both the operational phase of the reprocessing plant and its decontamination and partial decommissioning after shutdown. Based on this experience and the presented data, an assessment of the practical operations is made and conclusions are drawn. Finally, recommendations are formulated both for the general waste management policy and the practical waste treatment processes in nuclear power reactors. (EDB)

264
Henning, K.

Radiation Protection Aspects in Permanent Decommissioning of the N.S. Otto Hahn

Atomwirtschaft Atomtechnik 28(9):467-469 (1983, September)

After more than ten years of operation, the nuclear research vessel, N.S. "Otto Hahn," was decommissioned in the period 1980 to 1982, i.e., dismantled and decontaminated to such an extent as to now contain only "free areas" in the sense of the Radiation Protection Ordinance, which allows continued operation without a permit under the Atomic Energy Act of the vessel as a diesel operated commercial vessel. The case of the N.S. "Otto Hahn" for the first time demonstrates for a nuclear plant complete nuclear waste management to the point of commercial re-use. (EDB)

265
Hild, W., European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium

Decontamination, Decommissioning and Waste Management at Eurochemic

ETR-318; Eurochemic Experience, W. Drent and E. Delande (Eds.), Proceeding of a Seminar, Mol, Belgium, June 9-11, 1983, 229 pp.; (pp. 107-119) (1982)

After the shutdown of an Eurochemic plant, a decontamination and decommissioning (D&D) program was carried out, comprising a remote rinsing phase to remove and recover most of the fissile material that was still dis-

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

tributed in the equipment of the plant. This phase was followed by a remote chemical decontamination, mainly aiming at the removal and washing out of fission products, to obtain a drastic decrease of the radiation and contamination to levels that would allow direct access to the process cells and their equipment in the third phase of the program. In this phase, cells and equipment were inspected and surveyed for residual radiation and contamination; hot spots were then removed from the equipment by direct decontamination, using special decontamination loops, different high-pressure water jets, and manual operation. In the same phase, some obsolete equipment was decontaminated. During the main D&D work, roughly 170 cu m of intermediate-level liquid waste concentrate was produced; it was solidified onsite by homogeneous incorporation into bitumen. Roughly 700 cu m of low-level combustible solid waste and about 450 cu m of low-level non-combustible wastes were shipped to the SCK/CEN for conditioning in view of sea dumping. Only a small volume of intermediate level solid waste was produced in the D&D work because stainless steel equipment of reprocessing plants can effectively be decontaminated, provided the surfaces are smooth and easily accessible. Contrary to the waste management of the liquid wastes, practically no treatment or storage provisions were made for the intermediate- and high-level solid wastes. Due to the application of the chemical decladding, these waste categories were not supposed to arise. When active operation showed that this was not the case, the solid waste pond was constructed for the underwater storage of the high-level solid wastes, of which 25 cu m is still stored after repacking into cylindrical stainless steel canisters. The intermediate-level solid wastes were collected for interim storage into different prefabricated shielded concrete and metal containers. Ten different types of containers, with varying geometry and construction and containing some 75 cu m of such wastes are presently stored. (Auth)(NPK)(CAJ)

266

Lettnin, H.K.J.

Is the Know-How of NS Otto Hahn Getting Lost

Technik Heute 36(3):19-25 (1983, March)

The nuclear decommissioning work on the nuclear ship (NS) Otto Hahn, the first nuclear merchant ship of Germany and Europe, has been completed and the licensing authority has freed the ship from provisions governing controlled areas. Thus a mission has come to an end which, after successful construction and operation of the NS Otto Hahn, led to shutdown and complete dismantling of the nuclear plant aboard. Now the ship is free for conventional use without the restrictions due to nuclear operation. The termination of the Otto Hahn's phase of operation as a nuclear ship is used as an opportunity to review the ship's history to date, including a summary of the 5 1/2 years of construction, the 10.5 years of operation and, finally, the three-year period of shutdown and reactor decommissioning. The extensive experience and results gained from practical operation and the performance of research and development projects form the heart of the review. (EDB)(NPK)(CAJ)

267

Link, B.W., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects, Summary Report, North Carolina State University Research and Training Reactor

NUREG/CR-3370; 32 pp. (1983, August)

This document summarizes information from the decommissioning of the NCSUR-3 (R-3), a 10-kW(t) university research and training reactor. The decommissioning data were placed in a computerized information retrieval/manipulation system which permits their future utilization in predecommissioning activities for university reactors of similar design. The information is presented in some detail as computer output and also as a manually assembled summarization which highlights the more significant aspects of the decommissioning project. Data from a generic study and from the decommissioning of the Ames Laboratory Research Reactor are included for comparison. (Auth)(BDC)

268

McQueen, S.

Gundremmingen Decommissioning Proving Out Salvage Possibilities

Nucleonics Week 24(35):5-6 (1983, September 1)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

At the 250-MW Gundremmingen A station whose boiling water reactor (BWR) unit is being decommissioned after almost 11 years of operation, it is being shown that nuclear power station equipment with relatively low levels of radioactivity can be decontaminated and salvaged for unrestricted reuse. The reactor and auxiliary building are earmarked for safe enclosure for 25 years, while the turbine hall will probably be prepared for intermediate storage of low-level wastes from the two 1300-MW BWR's under construction. The chosen decontamination method is electropolishing. At the present rate, dismantling and decontamination are expected to take about five years. (BDC)(NPK)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

269

American Nuclear Society, La Grange Park, IL

Decommissioning of Nuclear Generating Stations: A Policy Statement of the American Nuclear Society

American Nuclear Society News 1(7):6 (1983, July)

Regulations have been promulgated and alternatives for decommissioning commercial nuclear electric generating facilities have been identified. Conventional and safe processes and techniques exist and have been demonstrated. Mechanisms for financing decommissioning through the ratemaking processes are available and are used by some utilities. The radioactivity in wastes from decommissioning represents only a small fraction of that in the radioactive wastes generated during operation of the facility. Experience has shown that public health and safety have been adequately addressed during the decommissioning phases. The viability of alternatives for decommissioning and site restoration is well established. The option for continued use of the site is becoming more important since sites for new power stations are becoming more limited. (Auth)(NPK)

270

Anderson, J., D. Aquilina, and D. Rodbourne, University of Minnesota, Center for Urban and Regional Affairs, Minneapolis, MN

Decommissioning Commercial Nuclear Power Plants

CURA 80-6; 103 pp. (1980)

Decommissioning is approached not as a strictly technological problem but as a policy issue. Technical aspects of decommissioning are dealt with to the extent necessary to present the basic technological options and to highlight important policy questions. Several steps involved in the decommissioning process which are discussed include determining the preferred method of decommissioning; estimating the future costs associated with that method; devising an equitable mechanism for collecting sufficient funds to meet decommissioning costs; providing means for adjusting the funding mechanism to accommodate changing estimates and economic circumstances; and incorporating adequate guarantees that the task of decommissioning will be carried out. This report includes appendices containing information on nuclear waste inventories, spent fuel accumulations, decommissioning timetables, total commercial low-level wastes, nuclear waste management cost estimates to the year 2000, U.S. Atomic Energy Commission Regulatory Guide 1.86, decommissioning cost estimates, radiation exposures, and state action on decommissioning financing. (BDC)

271

Operational Experience with Nuclear Power Installations in the Federal Republic of Germany: Annual Report for 1975 of the ABE-Committee of Working Party I 'Engineering and Industry' of the German Atom Forum

Atom und Strom 22(3):57-80 (1976, May)

In this report a comprehensive review is given of operational results achieved with the nuclear power stations functioning in the Federal Republic of Germany during 1975. (EDB)

272

Operational Experience with Nuclear Power Installations in the Federal Republic of Germany: Annual Report for 1976 of the ABE-Committee of Working Party I 'Engineering and Industry' of the German Atom Forum

Atom und Strom 23(2):21-48 (1977, March)

In this report a comprehensive review is given of operational results achieved with the nuclear power stations functioning in the Federal Republic of Germany during 1976. The individual plants are discussed in separate chapters. The annual performance curve (availability) for each reactor is presented in a diagram. (EDB)

273

Operational Experience with Nuclear Power Plants in the Federal Republic of Germany

Atom und Strom 24(2):21-54 (1978)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

The paper reports on operational experiences in 1977; all nuclear power plants of the Federal Republic of Germany are discussed in separate chapters. Special occurrences in this year are presented in an operating diagram. (EDB)

274

Operational Experience with Nuclear Power Installations in the Federal Republic of Germany: Annual Report for 1979 of the ABE-Committee of Working Party I 'Engineering and Industry' of the German Atom Forum

Atom und Strom 26(2):29-31 (1980)

In this report a comprehensive review is given of operational results achieved with the nuclear power stations functioning in the Federal Republic of Germany during 1979. (EDB)

275

Operating Results of German Nuclear Power Plants in 1979 - Part 2: Demonstration and Experimental Plants

Atomwirtschaft Atomtechnik 25(11):550-555 (1980, November)

With an 18 percent increase in 1979, nuclear power had the highest growth rate of all energy sources in the Federal Republic of Germany. Nevertheless, its contribution to the supply of primary energy continues to be only 3.4 percent. According to the Annual Report by the ABE Committee of the Deutsches Atomforum, German nuclear power plants were able to achieve a satisfactory operating result in 1979 with 41.3 TW-hr of electricity generated and a contribution to the total electricity generation of approximately 11.2 percent. However, the two KWL and KRB-A demonstration nuclear power plants and the N.S. Otto Hahn had to be decommissioned in 1979, chiefly for economic reasons. The releases of radioactivity from nuclear power plants continue to be far below the licensed levels also in 1979. The report contains detailed information about the operation in 1979 of each nuclear power plant on the basis of plant operations diagrams plus data about the radiological burdens to personnel, releases of radioactivity into the environment, etc. (EDB)

276

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

Gaining Confidence in Decommissioning

Nuclear Engineering International 27(335):31-32 (1982, December)

A report is given of the International Symposium on Decommissioning, held in Seattle, 11-14 October 1982. Research and development work on decommissioning, waste management, and past decommissioning experience was discussed. (EDB)

277

Birkhold, U., J. Obst, W. Stasch, H.K.J. Lettnin, W. Zimmermann, and R. Stang, GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude, Federal Republic of Germany

Total Decommissioning of Nuclear Facilities

GKSS-81/E/50; 13 pp. (1981)

The following nuclear facilities in the Federal Republic of Germany are now ready for total decommissioning: Niederaichbach Power Plant(KKN); nuclear ship, Otto Hahn; and the research reactor FR-2. Planning work on KKN commenced in 1979, and the approval procedure was begun in early 1980 when the approval contract was submitted. At the beginning of 1980, the contract for decommissioning the nuclear facilities on the Otto Hahn was awarded. Approval was received in December 1980, and work was begun on decommissioning the plant. FR-2 is still in operation and will be shut down at the end of 1981. Planning work for decommissioning the nuclear part began at the end of 1980. The planning and the methods that are intended to be used for the three plants are described. (EDB)

278

Boing, L.E., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Evaluation of the Nuclear Facility Decommissioning Projects Program, Project Summary Report: A Reference Pressurized Water Reactor

UNI-2462; 142 pp. (1983, August)

This document summarizes generic conceptual information relevant to the decommissioning of a reference pressurized water reactor power station. All of the data presented were extracted from NUREG/CR-0130 and arranged in a form that will provide a basis for future comparison studies for the Evaluation of Nuclear Facility Decommissioning Projects program. During the data extraction process, no attempt was made to challenge any of the assumptions of the original studies nor was any attempt made to update assumed methods or processes to state-of-the-art decommissioning techniques. In a few instances, obvious errors were corrected after consultation with the study author. (Auth)(NPK)

279
Boing, L.E., and R.L. Miller, UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

Evaluation of the Nuclear Facility Decommissioning Projects Program, Project Summary Report: A Reference Test Reactor

UNI-2463; 145 pp. (1983, October)

This document summarizes generic conceptual information relevant to decommissioning a reference test reactor. All of the data presented were extracted from NUREG/CR-1756 and arranged in a form that will provide a basis for future comparison studies for the Evaluation of Nuclear Facility Decommissioning Projects program. During the data extraction process no attempt was made to challenge any of the assumptions of the original studies nor was any attempt made to update assumed methods or processes to state-of-the-art decommissioning techniques. In a few instances, obvious errors were corrected after consultation with the study author. (Auth) (NPK)

280
Bonhote, P.A., Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Reactor Decommissioning

Radiation Protection in Australia 1(82):118-127 (1982, March)

Options for decommissioning, together with associated costs and exposures, are outlined. The amount and type of radioactive material, both neutron activation and fission products, have a direct effect on all decommissioning considerations. Major activation products are Co-60, Fe-55, Ni-63, Ni-59, and C-14. (EDB)

281
Denys, C.J., Illinois Legislative Council, Springfield, IL

Decommissioning Nuclear Power Plants

M-FILE-9-367; NSF/ISP-83026; 49 pp. (1983, October)

Three approaches to decommissioning are considered: permanent entombment, safe storage, and dismantlement. The cost of decommissioning is addressed, and it is noted that approximately 33% of the cost is for shipment and disposal of radioactive materials while only about 19% is for demolition of the remaining contaminated structure. Financing options are summarized, including deposit methods, unfunded reserve, and general tax revenues. It is concluded that because Illinois has the largest nuclear power capacity of any state and because it has the oldest privately built commercial nuclear power plant in the country, its state government should act to get the federal government to expedite promulgation of the desired standards, regulations, and guidelines for decommissioning. (GRA)

282
Essmann, J., Preussische Elektrizitaets AG, Hannover, Federal Republic of Germany

Decommissioning of Nuclear Power Plants: Status in the Federal Republic of Germany

INIS-mf-7352; CONF-8110236; Modern Power Stations, Proceedings of an International Study Meeting, Liege, Belgium, October 26, 1981; (12 pp.) (1981)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Because German utilities operating nuclear power plants have long concerned themselves with aspects of decommissioning, an engineering company was given a contract to study the entire spectrum of decommissioning. The results of this study became available in autumn 1980 and made possible the discussion of all aspects of decommissioning on a new basis. No change in the design concept of LWR nuclear power plants currently in operation or under construction is necessary because the techniques necessary for decommissioning are fully available today. The technical feasibility of decommissioning the power plants Biblis A and KRB type has been shown in detail. Calculations of the quantity of waste produced during removal of a nuclear power plant could be confirmed. The radiation dose to decommissioning personnel is within the ranges of radiation protection regulations and radiation dose to personnel involved in a yearly in-service inspection. (EDB)(AF)(CAJ)

283
Federal Energy Regulatory Commission, Washington, DC

Decommissioning: Another Facet of Nuclear Power

Monitor III(26):1,8 (1983, December)

The complexity and interest of the decommissioning issue have become evident by the large number of rulemaking, research, and litigatory activities underway at the Nuclear Regulatory Commission, the Energy Information Administration, Internal Revenue Service, the Environmental Protection Agency, and the Federal Energy Regulatory Commission (FERC). Of the available options (diamantlement, mothballing, and entombment); immediate dismantlement is the least expensive. It then remains to be decided how the cost of decommissioning will be borne. Although there is general agreement that the costs should be borne by the ratepayer, there is gross uncertainty as to what those costs will be. In a case pending before the FERC, Vermont Yankee Nuclear Power Corporation filed a proposal to begin collecting the estimated cost of decommissioning. They estimate the cost to dismantle the facility in the year 2007 will be $422.6 million. (MFB)

284
Holter, G.M., and E.S. Murphy, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, Effects on Decommissioning of Interim Inability to Dispose of Wastes Offsite

NUREG/CR-0130 (Addendum 2); 28 pp. (1983, July)

The impacts on the previously reported technology, safety, and costs of decommissioning a reference pressurized water reactor power station that would result from an inability to dispose of decommissioning wastes offsite at the time of decommissioning are examined in this addendum. Three onsite waste storage alternatives are evaluated: (1) interim onsite storage of low-level waste (LLW); (2) interim onsite storage of spent fuel with offsite disposal of LLW; and (3) interim onsite storage of both LLW and spent fuel. Storage periods of up to 100 years are considered, after which the wastes are postulated to be disposed of offsite, and decommissioning of the facility and site to unrestricted release conditions will have been completed. Estimates of costs and occupational radiation dose are made for each of the alternatives studied. (Auth)

285
Holter, G.M., and E.S. Murphy, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station, Effects on Decommissioning of Interim Inability to Dispose of Wastes Offsite

NUREG/CR-0672 (Addendum 1); 25 pp. (1983, July)

The impacts on the previously reported technology, safety, and costs of decommissioning a reference boiling water reactor power station that would result from an inability to dispose of decommissioning wastes offsite at the time of decommissioning are examined in this addendum. Three onsite waste storage alternatives are evaluated: (1) interim onsite storage of low-level waste (LLW); (2) interim onsite storage of spent fuel with offsite disposal of LLW; and (3) interim onsite storage of both LLW and spent fuel. Storage periods of up to 100 years are considered, after which the wastes are postulated to be disposed of offsite, and decommissioning of the facility and site to unrestricted release conditions will have been completed. Estimates of costs and occupational radiation dose are made for each of the alternatives studied. (Auth)

286

Huber, B., and S. Orlowski, Commission of the European Communities, Luxembourg, Luxembourg

Community's Research and Development Programme on Decommissioning of Nuclear Power Plants - Second Annual Progress Report (Year 1981)

EUR-8343-EN; 69 pp. (1982)

This is the second progress report of the European Community's program of research on the decommissioning of nuclear power plants. It covers the year 1981. The program seeks to promote a number of research and development projects as well as the identification of guiding principles. The projects concern the following subjects: long-term integrity of buildings and systems; decontamination for decommissioning purposes; dismantling techniques; treatment of specific waste materials (steel, concrete and graphite); large transport containers for radioactive waste produced in the dismantling of nuclear power plants; estimation of the quantities of radioactive waste arising from decommissioning of nuclear power plants in the Community; and the influence of nuclear power plant design features on decommissioning. The research is carried out by public organizations and private firms in the Community under cost-sharing contracts with the Commission of the European Communities. The Commission budget planned for this five-year program amounts to 4.7 million ECU. (Auth)(MFB)

287

International Atomic Energy Agency, Vienna, Austria

Waste Management Research Abstracts, Volume 12

IAEA/HSW/12; 84 pp. (1978, December)

This publication includes abstracts of recently completed research as well as work in progress dealing with radioactive waste management. Topics include: gaseous, liquid, and solid waste treatments; storage and disposal studies; decontamination and decommissioning; environmental studies; and economic studies. The abstracts are printed in the language of submittal. (BDC)(ARE)

288

International Atomic Energy Agency, Vienna, Austria

Waste Management Research Abstracts, Volume 13

IAEA/WMRA/13; 177 pp. (1982)

This publication includes abstracts of research in progress dealing with radioactive waste management. Topics included are gaseous, liquid and solid waste treatments; storage and disposal studies; decontamination and decommissioning; environmental studies; and economic studies. The abstracts are printed in the language of submittal. (BDC)(ARE)

289

International Atomic Energy Agency, Vienna, Austria

Waste Management Research Abstracts, Volume 14

IAEA/WMRA/14; 288 pp. (1983)

This publication includes abstracts of research in progress dealing with radioactive waste management. Topics included are gaseous, liquid and solid waste treatments; storage and disposal studies; decontamination and decommissioning; environmental studies; and economic studies. The abstracts are printed in the language of submittal. (BDC)(ARE)

290

Kiselev, G.V.

Foreign NPP Decommissioning

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Energeticheskoe Stroitel'stvo za Rubezhon 6:16-20 (1980)

Different methods of nuclear power plant decommissioning are discussed. Dismantling technology as well as devices for decontaminating and cutting equipment and concrete structures are described. Data on the number of shutdown and dismantled nuclear power plants are given. It is noted that to perform successful dismantling it is necessary to: chooze a nuclear power plant decommissioning version, calculate radioactivity levels, substantiate the necessity of decontamination, develop the plan of removal of radioactive equipment, radioactive concrete, and structures, transport and bury solid, liquid, and gaseous radioactive and chemical wastes, evaluate the accepted solutions of dismantling from the point of view of the effect on the environment, and determine costs. It is shown that the optimal period of complete or partial dismantling after the nuclear power plant decommissioning is 15 years. Nuclear power plant dismantling expenditures can reach 10-15% of expenditures for their construction. (EDB)(EBL)

291

Konzek, G.J., Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors, Sensitivity of Decommissioning Radiation Exposure and Costs to Selected Parameters

NUREG/CR-1756 (Addendum); 169 pp. (1983, July)

Additional analyses of decommissioning at the reference research and test (R&T) reactors and analyses of five recent reactor decommissionings are made that examine some parameters not covered in the initial study report (NUREG/CR-1756). The parameters examined for decommissioning are: (1) the effect on costs and radiation exposure of plant size and/or type, (2) the effects on costs of increasing disposal charges and of unavailability of waste disposal capacity at licensed waste disposal facilities, and (3) the costs of and the available alternatives for the disposal of nuclear R&T reactor fuel assemblies. The volumes of radwaste and the total decommissioning costs from the five recent research reactor decommissioning projects are seen to exhibit some correlation with overall reactor power rating for that class of facility. However, until more data are available from decommissioning of specific reactor types, it will be difficult to establish the effect of reactor type on costs or to correlate radiation with reactor facility size and/or type with any degree of confidence. The effect on decommissioning costs of increasing disposal charges at waste disposal facilities is examined. In the case of the reference test reactor conceptually decommissioned in NUREG/CR-1756, it is concluded that a doubling of the burial ground charges would result in an increase of about 13% in the overall cost of DECON. In addition, the effect on decommissioning of interim inability to dispose of radwastes offsite for the reference R&T reactors is examined. In each case, if offsite waste disposal were not available, the technology, safety, and costs of decommissioning would be altered, most likely resulting in selection of a different preferred alternative for completing the decommissioning. The impact on decommissioning costs of disposing of R&T reactor fuel hinges on whether the fuel is privately owned or is owned by the U.S. Department of Energy (DOE). Licensees who own their own fuel must bear all costs associated with fuel disposal, including cask rental and shipment of fuel. At those universities where DOE retains ownership of the fuel, the universities can frequently borrow DOE-owned casks free of charge to transport this fuel after irradiation; however, they still must pay for the shipment of the fuel. (Auth)

292

Ludwick, J.D., and E.B. Moore, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning Reference Independent Spent Fuel Storage Installations

NUREG/CR-2210; 468 pp. (1984, January)

Safety and cost information is developed for the conceptual decommissioning of five different types of reference independent spent fuel storage installations (ISFSIs), each of which is being given consideration for interim storage of spent nuclear fuel in the United States. These include one water basin-type ISFSI (wet) and four dry ISFSIs (drywell, silo, vault, and cask). The reference ISFSIs include all component parts necessary for the receipt, handling, and storage of spent fuel in a safe and efficient manner. Three decommissioning alternatives are studied to obtain comparisons among costs (in 1981

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

dollars), occupational radiation doses, and potential radiation doses to the public. The alternatives considered are: DECON (immediate decontamination), SAFSTOR (safe storage followed by deferred decontamination), and ENTOMB (entombment followed by long-term surveillance). (Auth)

293

Lunning, W.H., International Atomic Energy Agency, Vienna, Austria

Decommissioning of Nuclear Facilities

IAEA-CN-36/71; CONF-770505; Nuclear Power and Its Fuel Cycles, Proceedings of the International Conference, Salzburg, Austria, May 2-13, 1977; (9 pp.) (1977)

Collaborative studies are in progress in the United Kingdom between the United Kingdom Atomic Energy Authority (UKAEA), the generating boards, and other outside bodies, to identify development issues and practical aspects of decommissioning excess nuclear facilities. The currently operating commercial 26 Magnox reactors at 11 stations, totalling approximately 5 GW, and a number of DFR, WAGR, and SGHWR experimental reactors supporting the UKAEA nuclear power program will be retired before the end of the century. Attention is focused on these reactors. The actual timing of withdrawal from service will be dictated by development program requirements for experimental reactors and by commercial and technical considerations for electricity-producing reactors. Decommissioning studies have so far been confined to technical appraisals including the sequence logic of achieving specific objectives and are based on the generally accepted three-stage progression. Stage 1, which is essentially a defuelling and coolant removal operation, is an interim phase. Stage 2 is a storage situation, the duration of which will be influenced by environmental pressures or economic factors including reuse of existing sites. Stage 3, which implies removal of all active and nonactive waste material and returning the site to general use, must be the ultimate objective. The engineering features and the radioactive inventory of the system must be assessed in detail to avoid personnel or environmental hazards during stage 2. These factors will also influence decisions on the degree of stage 2 decommissioning and its duration, bearing in mind that for stage 3, activation may govern the waste disposal route and the associated radiation man-rem exposure during dismantlement. Ideally, planning of decommissioning should be considered at the design stage of the facility. An objective of present studies is to identify features which would assist decommissioning of future systems. (EDB)(JMF)

294

MacLachlan, A.

Europeans Told Economics May Favor Immediate Decommissioning

Nucleonics Week 25(22):4-5 (1984, May 31)

Deferring mothballing and dismantling of power reactors for 50 years or more may turn out to be more expensive in the long run than immediate removal of reactors and release of sites for redevelopment. A. Gregory, head of the decommissioning project at Britain's Central Electric Generating Board (CEGB), told a conference sponsored by the European Commission that immediate dismantling could be "very attractive," providing a utility used discounted cash-flow accounting without inflation, because it would remove the need to maintain services and site security over decades until the plant could be dismantled. Nevertheless most utilities seem to be leaning toward a strategy that defers mothballing and dismantling for lower near-term cost and a crack at the more difficult tasks later, using better techniques and equipment now under study and development. Decommissioning is receiving heightened attention in the European Community. The Luxembourg meeting marks the end of the Community's first five-year plan for R&D on decommissioning, under which 51 contracts totaling about $4.7 million were carried out to identify potential problems and foster new techniques, and to identify plant design features that could facilitate decommissioning. (NPK)

295

Maestas, E., and O. Ilari, Nuclear Energy Agency, Organization for Economic Cooperation and Development, Paris, France

Overview of Decommissioning Policy, Standards and Practices in NEA Member Countries

CONF-821005; International Decommissioning Symposium - 1982, Proceedings of the U.S. Department of Energy's Remedial Action Program/OECD Nuclear Energy Agency Conference, Seattle, WA, October 10-14, 1982; (pp. II.3-II.8) (1982)

Decommissioning refers to the orderly disposition of nuclear facilities after their retirement from service, taking into account environmental, radiation protection, waste management, and safety considerations. The activities involved in such an exercise can vary from simple closure of the facility with a minimum removal of radioactive materials, to complete plant disassembly and restoration of the site for unrestricted release for other uses. As the nuclear industry matures, an increasing number of facilities have reached, or are approaching, the time when they will have to be withdrawn from active service and disposed of. Authorities in countries around the world must direct some effort in anticipation of the problems of decommissioning associated with nuclear power and nuclear research programs. (EDB)(EST)

296
Marshall, W.

Nuclear Power Technology: Volume 2 - Fuel Cycle

Clarendon Press, Oxford, England, 456 pp. (1983)

The book deals with the nuclear fuel cycle, from raw, freshly mined matter through enrichment techniques, fuel packaging processes and reprocessing. The problems of waste management and the decommissioning of nuclear facilities are also covered. The uranium cycle is covered in detail while the possible alternatives posed by the thorium cycle are also considered. A comprehensive glossary and index are provided. (INSPEC)(NPK)

297
McLaren, L.H., U.S. Department of Energy, Technical Information Center, Oak Ridge, TN

Decontamination and Decommissioning: A Bibliography

DOE/TIC-3391; 123 pp. (1982, November)

This bibliography contains 468 abstracts on decontamination and decommissioning included in the Department of Energy's Data Base from January 1981 through October 1982. The abstracts are grouped by subject category. Within each category the arrangement is by report number for reports, followed by nonreports in reverse chronological order. Five indexes, each preceded by a brief description, are provided: corporate author, personal author, subject, contract number, and report number. (EDB)(NPK)

298
Miller, R.L., UNC Nuclear Industries, Inc., Decommissioning Programs Department, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects Program, Project Summary Report: A Reference Boiling Water Reactor

UNI-2461; 161 pp. (1983, July)

This document summarizes generic conceptual information relevant to the decommissioning of a large boiling water reactor power station in DECON, SAFSTOR, and ENTOMB modes. All data presented were extracted from NUREG/CR-0672 and arranged in a form that will provide a basis for future comparison studies for the evaluation of nuclear facility decommissioning projects. (Auth)(BDC)

299
The Engineering Test Reactor at INEL is being Inactivated

Nucleonics Week 23(27):9 (1982, July 8)

The engineering test reactor (ETR) at Idaho National Engineering Laboratory is being inactivated prior to eventual decommissioning and decontamination. Work completed to date includes removal of fuel, shipment of fuel to a reprocessing plant, draining of water from the reactor, and dismantling and removal of the sodium support system. The characterization phase, which lies ahead, will involve a detailed listing and identification of the ETR, accompanied by estimates of waste volumes and their radioactivity. Characterization will involve about one-third of the inactivation program's budget but will make final decommissioning of the facility easier. The work done for the characterization phase will be available for future inactivations of research and commercial reactors. (BDC)(ARE)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

300
Steinkilberg, W., Kernforschungszentrum Karlsruhe GmbH, Schule fuer Kerntechnik, Karlsruhe, Federal Republic of Germany

Methods of Decommissioning of Nuclear Facilities

INIS-mf-8551; CONF-8209134; Waste Management in Nuclear Facilities, Proceedings of an International Atomic Energy Agency Interregional Training Course, Karlsruhe, Federal Republic of Germany, September 6, 1982; (10 pp.) (1982)

The different steps of dismantlement of nuclear facilities are presented. The principles for planning decommissioning projects are discussed and specific planning of the dismantlement of the FR2 research reactor core is described. (EDB)(RW)(PTO)

301
Torikai, K., and T. Kinoshita, Japan Atomic Energy Research Institute, Tokai Research Center, Experimental Power Reactor Division, Tokai, Japan; Japan Atomic Energy Research Institute, Oarai Research Center, Materials and Experimental Reactor Division, Oarai, Japan

Decommissioning of Light Water Reactors

Genshiryoku Kogyo 22(4):29-35; OLS-80-259; 13 pp. (1980)

This paper discusses the case of the Elk River Reactor (ERR) as a rare example of the complete dismantling of a nuclear reactor. The successful dismantling of this reactor may have elevated technological confidence in the feasibility of dismantling nuclear power stations as well. The paper also reports on the partial dismantling operation of the Japan Power Demonstration Reactor (JPDR). (Auth)(BDC)

302
U.S. Department of Energy, Technical Information Center, Oak Ridge, TN

Nuclear Reactors Built, Being Built, or Planned in the United States

DOE/TIC-8200-R-47; 45 pp. (1983, August)

This report contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of December 31, 1982, which are capable of sustaining a nuclear chain reaction. The U.S. Department of Energy's (DOE's) Technical Information Center gathers this information semiannually from: DOE headquarters; DOE field offices, U.S. Nuclear Regulatory Commission, and U.S. reactor manufacturers who are the principal nuclear contractors for foreign countries. Information is presented in five parts, each of which is categorized by primary function or purpose: civilian, military, production, export, and critical assembly facilities. Various classes of reactors within these categories are designed as follows: (1) central-station nuclear power plants, (2) dual-purpose plants, (3) experimental power reactors, (4) general irradiation test reactors, (5) high-power research and test reactors, (6) safety research and test reactors, and (7) research reactors. These facilities are listed by type, location, principal nuclear contractor and/or operator, power rating, start up, and shut down (where appropriate). This document contains a comprehensive list of decommissioned nuclear facilities in the U.S. (Auth)(MFB)

303
United Kingdom Atomic Energy Authority, Risley Nuclear Power Development Establishment, Risley, United Kingdom

Incidents in German Nuclear Power Stations

RISLEY-Trans-4186; A Publication of the Confidential Incident Reports of the West German Government by the Federal Association of Citizens' Action Groups for Environmental Protection (BBU); 196 pp. (1979, September)

In this document, BBU presents a complete list of all the incidents in German nuclear power plants from 1965 to autumn 1977. The incident list covers Stade, Lingen, Wuergassen, AVR, Biblis A, Obrigheim, MZFR, KNK I, VAK, and Gundremmingen KRB. (EDB)(DLC)

304
United Kingdom Atomic Energy Authority, Windscale Nuclear Power Development Laboratories, Seascale, United Kingdom

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Windscale AGR Decommissioning

Newsletter; 8 pp. (1983, September)

Reactor decommissioning is now recognized as an important new phase of development work in the nuclear industry world-wide. The British plans to "learn the trade" with the Windscale Advanced Gas-cooled Reactor (WAGR) are therefore of wide interest, both within the United Kingdom (UK) and abroad. Following the Seattle Conference on the subject in October 1982, a number of discussions have taken place between the UK and other nations with broadly similar plans. These include the United States, France, Canada, and Japan. It is likely that bilateral agreements will be signed with some of these countries. In addition, the EEC has set up an Advisory Committee to examine the subject and this body visited Windscale for a presentation of our plans in May of this year. This committee is able to fund development work in return for access the results, and our project may benefit from this. Because much of the project will involve the handling of radioactive material in novel circumstances there is strong interest and frequent intervention by several Government ministries. The Nuclear Installations Inspectorate (NII) are scrutinizing our plans closely; the Department of Environment wishes to be satisfied on our strategy for waste management; and our plans on the latter have to be closely coordinated with NIREX. An Advisory Committee for the project has been established with representatives from the various sectors of the nuclear industry plus a nominee representing the demolition industry. (Auth) (PTO)

305
Watzel, G.V.P., and I. Auler, Rheinisch-Westfalisches Elektrizitaetswerk AG, Essen, Federal Republic of Germany

Decommissioning of Large Nuclear-Power Plants with LWRs in the Federal Republic of Germany

Nuclear Technology 63(1):90-101 (1983, October)

A short review of the essential results of a German decommissioning study is given. The study treats the total dismantling of the reference plants Biblis A, a 1204-MW pressurized water reactor, and Brunsbuttel, a 805-MW boiling water reactor. The necessary decommissioning techniques are available today, and the resulting costs and structures can be determined. A detailed evaluation of the working procedures and sequences is carried out, and the given boundary conditions and assumptions (licensing requirements, activity release criteria, repository concepts, etc.) are explained. Data on activity inventory, masses, and wastes are given. (INSPEC)

Chapter 3

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

306

Bair, W.J., Pacific Northwest Laboratory, Richland, WA

Former Nuclear Site Risk Estimation

PNL-4600 (Part 5); Pacific Northwest Laboratory Annual Report for 1982 to the DOE Office of the Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness - Part 5: Environmental and Occupational Protection, Assessment, and Engineering; (p. 13) (1983, February)

During FY 1982, the project was initiated to estimate health effects at formerly utilized MED/AEC nuclear sites or inactive uranium mill tailing sites. This activity complements radiological survey programs that are also sponsored by the Office of Operational Safety. During FY 1982, the general outlines of the methodology to be used in health effects estimation were developed, and initial estimates were calculated for twelve vicinity properties in the Salt Lake City area. (EDB)

307

Bechtel National, Inc., Advanced Technology Division, Oak Ridge, TN

Geologic Report - Middlesex Municipal Landfill Site, Middlesex, New Jersey

DOE/OR/20722-9; 117 pp. (1984, March)

This is a report on geologic and hydrologic investigations of the former Municipal Landfill, Middlesex, New Jersey, conducted during 1982 and 1983. The investigations were designed to assess the feasibility of stabilizing the radioactive contamination present on the site. The investigations were conducted in two phases: (1) permeability tests, and (2) tests to ascertain the extent of hydraulic interconnection between various stratigraphic units. The investigations revealed that a complete seperation of bedrock and overburden did not exist and that the clay present could not be relied upon to confine vertical migration of contaminants over the long term. (Auth) (BDC)

308

Berven, B.A., M.S. Blair, R.W. Doane, C.A. Little, and P.T. Perdue, Oak Ridge National Laboratory, Oak Ridge, TN

Application of Computers in a Radiological Survey Program

CONF-840202; Proceedings of the 17th Midyear Topical Meeting of the Health Physics Society, Pasco, WA, February 5, 1984; (8 pp.) (1984)

A brief description of some of the applications of computers in a radiological survey program is presented. It has been our experience that computers and computer software have allowed our staff personnel to more productively use their time by using computers to perform the mechanical acquisition, analyses, and storage of data. It is hoped that other organizations may similarly profit from this experience. This effort will ultimately minimize errors and reduce program costs. (EDB)

309

Berven, B.A., W.A. Goldsmith, F.F. Haywood, and K.J. Schiager, Oak Ridge National Laboratory, Oak Ridge, TN

Proposed Training Program for Construction Personnel Involved in Remedial Action Work at Sites Contaminated by Naturally Occurring Radionuclides

CONF-791203; Proceedings of the Health Physics Society Meeting, Honolulu, HI, December 10-14, 1979; (p. 11) (1979)

Many sites used during the early days of the atomic energy program in the United States are contaminated with radionuclides of the primordial decay chains (uranium, thorium, and actinium series). The 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, the need exists 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. (EDB)(JMF)

310

Clark, C., and B.A. Berven, Oak Ridge National Laboratory, Oak Ridge, TN

Results of the Groundwater Monitoring Program Performed at the Former St. Louis Airport Storage Site for the Period of January 1981 through January 1983

ORNL/TM-8879; 82 pp. (1983)

Results of a two-year groundwater monitoring program performed at the former St. Louis Airport Storage Site, January 1981 - January 1983, are presented. Data indicate that radionuclides stored onsite are leaching into the groundwater at above background levels but that potential health effects are very small. The only radionuclide detected in measurable amounts in area wells was U-238. Maximum concentration at one of these wells was 2230 pCi/l which exceeded background concentrations throughout the state by a factor of 50. The drinking water for the metropolitan St. Louis area is acquired from two municipal water purification plants. The uranium concentration measured in these treated waters was 0.34 and 0.68 pCi/l. Considering the average uranium concentration measured in municipal water, a typical resident of the area would ingest four times less than the national mean. (Auth)(BDC)

311

Clark, C., B.A. Berven, W.D. Cottrell, and W.A. Goldsmith, Oak Ridge National Laboratory, Oak Ridge, TN

Results of the Post Remedial Action Survey of Areas 4 through 10 at the Former Kellex Site in Jersey City, New Jersey

DOE/EV-0005/29 (Suppl.); ORNL/TM-8941 (Suppl.); 78 pp. (1982)

A post remedial action survey was conducted at the former Kellex Corporation Research Facility in Jersey City, New Jersey. The Kellex facility was involved in the Manhattan Project, particularly in the area of engineering research in gaseous diffusion for uranium enrichment. As a result of those operations, this site was included by the U.S. Department of Energy (DOE) in their Formerly Utilized Sites Remedial Action Program (FUSRAP). During comprehensive radiological surveys conducted by Oak Ridge National Laboratory in the summer of 1979, ten areas were located with levels of radionuclides in the soil in excess of DOE criteria. This report describes the results of radiological surveys conducted in seven of these locations (Areas 4 to 10) following remedial action. Results of these surveys indicate that remedial action was successful in reducing radioactive contamination in these areas to criteria values established by DOE. (EDB)

312

Clark, C. B.A. Berven, and W.A. Goldsmith, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Summary of a Two-Year Groundwater Monitoring Program at the Former St Louis Airport Storage Site, St Louis, Missouri

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983 (1983, June 2)

The Department of Energy (DOE) is conducting a program to identify and remedy potentially unacceptable radiological conditions at sites utilized by the Manhattan Engineer District (MED) and later the Atomic Energy Commission (AEC), during the early development of nuclear energy in the United States. One such site, acquired by the MED in 1947, was the St. Louis Airport Storage Site, which was used for storing waste residues generated during uranium processing operations. The waste materials stored at the site were removed between 1966 and 1969. However, a comprehensive radiological survey performed by Oak Ridge National Laboratory (ORNL) in 1976 indicated that although the bulk of the stored wastes had been removed, some residual materials were found at surface and subsurface depths. At the request of DOE, the Remedial Action Survey and Certifi-

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

cation Activities group at ORNL initiated, in January 1981, a groundwater monitoring program at the former St. Louis Airport Storage Site. This program, which involved the monitoring or six wells, was initiated to provide an information base for developing remedial action protocols for the safe and cost-effective management of contaminated material. Radionuclide concentrations during the monitoring period were found to be the highest for uranium-238 and ranged from 3 to 2000 pCi/l. Concentrations of radium-226, thorium-230, lead-210, and actinium-227 were well within background levels. There was no correlation between radionuclide concentrations and well-water depth. The data also show contamination of groundwater occurs at a very low rate (if at all) with the possible exception of the elevated uranium-238 concentration measured in one well. (Auth) (JMF)

313

Flynn, K.F., W.H. Smith, and R.A. Wynveen, Argonne National Laboratory, Argonne, IL

Project Management Plan for the Decontamination of Jones Laboratory, Ryerson Physical Laboratory, and Eckhart Hall, The University of Chicago, Chicago, Illinois

ANL-OHS/HP-84-105; 32 pp. (1984, January)

The Department of Energy (DOE) has in place a plan for the decontamination and decommissioning of contaminated sites that were formerly utilized by the Manhattan Engineering District (MED) and/or the Atomic Energy Commission (AEC). This plan is referred to as the Formerly Utilized Sites Remedial Action Program (FUSRAP). Among these sites are Jones Laboratory, Ryerson Physical Laboratory, and Eckhart Hall of The University of Chicago at Chicago, Illinois. This document represents the Project Management Plan for the decontamination of these facilities. (EDB)

314

George, A.C., and J. Eng, U.S. Department of Energy, Environmental Measurements Laboratory, New York, NY

Indoor Radon Measurements in New Jersey, New York and Pennsylvania

Health Physics 45(2):397-400 (1983, August)

The distribution of Rn-222 concentrations in 33 buildings near Canonsburg, Pennsylvania, Lewiston, New York, and Middlesex, New Jersey, was investigated over a 2-yr period. One or two week-long time-integrated measurements of radon concentrations, repeated several times during the study period, were obtained in the living and working areas of the buildings. Average air concentrations of radon, measured over the study period, varied from 0.32 to 4.5 pCi/l. In only one building did the annual radon concentration exceed the U.S. Nuclear Regulatory Commission's limit of 3 pCi/l, for continuous exposure in uncontrolled areas. (INSPEC)(EST)

315

Gilbert, T.L., J.M. Peterson, R.W. Vocke, and J.K. Alexander, Argonne National Laboratory, Argonne, IL; U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN

Alternatives for Management of Wastes Generated by the Formerly Utilized Sites Remedial Action Program and Supplement

ANL/EIS-20; 39 pp. (1983, March)

Alternatives for disposal or stabilization of the wastes generated by the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP) are identified and compared, with emphasis on the long-term aspects. These wastes consist of soil material and rubble containing trace amounts of radionuclides. A detailed pathway analysis for the dose to the maximally exposed individual is carried out using an adaptation of the natural analogue method. Comparisons of the different alternatives, based on the results of the pathway analysis and qualitative cost considerations, indicate that, if the hazard is such that the wastes must be removed and disposed of rather than stabilized in place, disposal by immediate dispersal is preferable to containment, and containment followed by slow planned dispersal is preferable to containment without dispersal. The Supplement presents refinements of work that was reported at the 1982 International Decommissioning Symposium. The new material consists of revisions of the estimates of the predicted potential dose to the maximally exposed individual and a more detailed comparative assessment of the radiological impacts of alternatives for management of wastes generated by the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). (EDB)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

316

Gilbert, T.L., and C.J. Roberts, Argonne National Laboratory, Argonne, IL

Long-Term Health Risks from Waste Contaminated with Radioactive Ore and Processing Residues: A New Approach to the Pathway Analysis Problem

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983; (17 pp.) (1983)

Estimates of the relation between the long-term (100 to 10,000 years) health risks (H) to the maximally exposed individual and the source terms (S) from the long-lived radionuclides at sites contaminated by ore and processing residues are needed for developing appropriate waste-management guidelines and strategies. This relation may be expressed as a sum of products of source-to-exposure (E/S), exposure-to-dose (D/E), and dose-to-health-effects (H/D) conversion factors for individual pathways: H/S=(E/S)(D/E)(H/D). The E/S factors present unusual problems and a major source of uncertainty because of the complexity of the many environmental pathways, uncertainties in the environmental models and parameters, and uncertainties in the scenarios that determine individual exposure. A new analysis of the E/S factors for all major pathways has been carried out and combined with current estimates of D/E and H/D factors to obtain generic estimates of the D/S and H/S factors for a model site. A key feature is a natural analogue analysis that permits incorporation of data on average soil concentration, dietary intakes, and body burdens of naturally occurring radionuclides in order to supplement and modify estimates from individual pathway models, thereby obtaining more reliable conversion factors. The H/S factors are used to derive radionuclide concentration limits for contaminated sites that correspond to limits imposed by current radiation protection guidelines. (Auth)

317

Gunderson, T., T. Buhl, R. Romero, and J. Salazar, Los Alamos National Laboratory, Los Alamos, NM

Radiological Survey Following Decontamination Activities Near the TA-45 Site

LA-9831-MS; 15 pp. (1983, July)

Three areas at the site of a former radioactive liquid waste treatment plant at Los Alamos National Laboratory were decontaminated during 1982 by Bechtel Corporation, with health physics support provided by Eberline Instrument Corporation, under the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program. Before decontamination, there were above-background concentrations of gross alpha, gross beta, Pu-238, Pu-239, Am-241, Sr-90 and Cs-137 in the surface soils. These combined concentrations were above operational decontamination guidelines for surface soil contamination. After cleanup operations, radionuclide concentrations in surface soils at all three sites were within decontamination guidelines. (Auth)

318

Hagee, G.R., and P.H. Jenkins, Monsanto Research Corporation, Mound Facility, Miamisburg, OH

Monitoring of Radon in the Environment around Former MED/AEC and Mill Tailings Sites

DOE/EML-416; CONF-8211115; Environmental Measurements Laboratory Indoor Radon Workshop, Proceedings of a Conference, New York, NY, November 30-December 1, 1982, 114 pp.; (p. 77) (1983, June)

Radon monitoring was conducted in the environment around formerly utilized MED/AEC sites and abandoned mill tailings sites to: (1) determine the effect of radon emanating from the site in its present condition on the ambient radon concentrations in the surrounding environment; (2) monitor potential perturbances in radon concentrations during remedial action activities; and (3) determine the effectiveness of the remedial action in restoring radon concentrations to levels which are in compliance with EPA standards. Monitoring will continue until remedial actions are completed and sufficient data are obtained to determine the effectiveness of the remedial actions. (Auth)(BDC)(ARE)

319

Hayes, K.A., Argonne National Laboratory, Argonne, IL

Radiological Survey of the Low-Level Radioactive Waste Burial Site at the Palos Forest Preserve, Illinois

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

CONF-8205107; Proceedings of the Ninth Annual Meeting of the National Black Chemists and Chemical Engineers, New York, NY, May 6, 1982; (18 pp.) (1982)

Two landfill sites containing low-level radioactive waste material, Site A and Plot M, are located 14 miles southwest of Chicago, Illinois, in the Palos Forest Preserve. Site A is the former location of the Argonne National Laboratory. Buried at Site A in 1956, were the dismantled reactor shells, building walls, and cooling towers from three of the world's first nuclear reactors. Plot M was used from 1943 to 1949, for burial of low-level radioactive wastes derived from Site A operations and from the University of Chicago Metallurgical Laboratory. Tritiated water was detected in 1973 in some of the Forest Preserve picnic wells located 500 to 1000 yd north of Plot M. An extensive surveillance program was initiated in 1976, to: (1) study the elevated tritium content of some picnic wells and its observed seasonal fluctuations, (2) establish if other radionuclides buried in Plot M or remaining at Site A have migrated, (3) establish the rate of groundwater movement in the glacial till and underlying dolomite aquifer, (4) determine the tritium content of the till and aquifer, and (5) predict future tritium levels in the well water. Several test wells were installed in the soil and dolomite bedrock to monitor radioactivity in groundwater, measure water levels, and provide other geohydrological information. Tritium has migrated from the Plot M burial trenches into the surrounding drift. The tritium plume, the contaminated zone in the drift in which tritium concentrations exceed 10 nCi/l of water, has migrated at least 165 ft horizontally northward and 130 ft vertically downward to the bedrock surface. Small amounts of other radionuclides -- uranium, plutonium, and strontium-90 -- have been found in boreholes beneath the concrete cap covering Plot M but not in the subsoil outside of the Plot. The radionuclide concentrations found to date are too low to result in any measurable radiation exposure to the public. (EDB)

320

Haywood, F.F., and J.G. Phillips, Eberline Instrument Corporation, Oak Ridge, TN

Determination of In-Homogeneities in Ra-226 Contaminated Soils

Health Physics 43(1):161-162 (1982)

This study investigated a method to determine the uniformity of Ra-226 distributions in soil which had become contaminated with residual natural radioactivity from an ore sampling and storage site. It was assumed that the principal contamination pathway was erosion by wind and water. A specific objective of the study was to determine the distribution of radium between the concentrations of 5 and 15 pCi/g, or the depths at which these concentrations would be encountered during soil excavation. Four study areas were selected on the basis of data from a published radiological survey report. Each area was laid out in a 5 m by 5 m grid, and holes were drilled on 2.5 m centers within the area (total of 9 holes each area). A NaI probe was used to monitor gamma-ray intensities at 5 cm intervals to a depth of at least 60 cm. Upon completion of gamma-ray logging, narrow trenches were dug along the 2.5 cm grid line and a small soil sample was collected from each hole location at 5 cm intervals (0-5, 5-10, 10-15 cm, etc). The samples for a given layer were used to form a composite sample. An analysis of the Ra-226 concentration was made using a gamma-ray spectrometer, and the result for each composite sample was assumed to represent the concentration in each 5 m by 5 m by 5 cm thick layer from the surface to 60 cm. Comparisons were then made between these Ra-226 concentrations and the weighted average of gamma-ray logs for holes in each area. Data will be presented to show the thicknesses of soil between 5 and 10 pCi/g and 10 and 15 pCi/g. Also to be shown is the effect on total quantities for soil removal based on the establishment of a soil cleanup criterion between 5 and 15 pCi/g. (Auth)

321

Hewlett, R.G., and O.E. Anderson, Jr.

The New World, 1939/1946, Volume 1 - A History of the United States Atomic Energy Commission

Pennsylvania State University Press, University Park, PA (1962)

Volume 1 of this history of the Atomic Energy Commission covers the development of the early nuclear program of the United States from 1939 to 1946. The book provides background for the Manhattan Project and the events leading to the development of the U.S. Atomic Energy Commission. (BDC)(PTO)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

322

Hewlett, R.G., and F. Duncan

Atomic Shield, 1947/1952, Volume 2 - A History of the United States Atomic Energy Commission

Pennsylvania State University Press, University Park, PA (1969)

This second volume of a history of the Atomic Energy Commission covers the period from the Commission's assumption of responsibility for the program to the detonation of the first thermonuclear device. In a political sense this covers most of the Truman administration and, in the international realm, the years of the Marshall Plan, the Berlin Block and the Korean War. (BDC)

323

Knight, M.J., Argonne National Laboratory, Argonne, IL

Effect of Soil Erosion on the Long-Term Stability of FUSRAP Near-Surface Waste-Burial Sites

ANL/EIS-18; 33 pp. (1983, April)

Decontamination of FUSRAP sites could result in the generation of large volumes (in excess of 400,000 cu m) of low-activity radioactive wastes (primarily contaminated soil and building materials) requiring subsequent disposal. It is likely that near-surface burial will be seriously considered as an option for disposal of these materials. A number of factors, including soil erosion, could adversely affect the long term stability of a near-surface waste-burial site. The majority of FUSRAP sites are located in the humid eastern United States, where the principal cause of erosion is the action of water. This report examines the effect of soil erosion by water on burial-site stability based on analysis of four hypothetical near-surface burial sites. The Universal Soil Loss Equation was employed to estimate average annual soil loss from burial sites and the 1000-year effects of soil loss on the soil barrier (burial trench cap) placed over low-activity wastes. Results suggest that the land use of the burial site and the slope gradient of the burial trench cap significantly affect the rate of soil erosion. The development of measures limiting the potential land use of a burial site (e.g., mixing large rocks into the burial trench cap) may be required to preserve the integrity of a burial trench for long periods of time. (EDB)

324

Knight, M.J., Argonne National Laboratory, Argonne, IL

Uptake by Plants of Radionuclides from FUSRAP Waste Materials

ANL/EIS-19; 22 pp. (1983, April)

Radionuclides from FUSRAP wastes potentially may be taken up by plants during remedial action activities and permanent near-surface burial of contaminated materials. In order to better understand the propensity of radionuclides to accumulate in plant tissue, soil and plant factors influencing the uptake and accumulation of radionuclides by plants are reviewed. In addition, data describing the uptake of the principal radionuclides present in FUSRAP wastes (uranium-238, thorium-230, radium-226, lead-210, and polonium-210) are summarized. All five radionuclides can accumulate in plant root tissue to some extent, and there is potential for the translocation and accumulation of these radionuclides in plant shoot tissue. Of these five radionuclides, radium-226 appears to have the greatest potential for translocation and accumulation in plant shoot tissue. (EDB)

325

Kupferman, S.L., D.R. Anderson, L.H. Brush, L.S. Gomez, and L.E. Shephard, Sandia National Laboratories, Albuquerque, NM

Ocean Disposal Feasibility Study: Candidate DOE (FUSRAP) Soil Characterization

SAND-82-1839C; CONF-821103; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 14, 1982; (5 pp.) (1982)

The purpose of the Formerly Utilized Sites Remedial Action Program (FUSRAP) is to evaluate the radiological conditions at former MED-US AEC sites. The purpose of the Ocean FUSRAP program is to assess the feasibility of ocean disposal of FUSRAP waste which contains trace natural radioactive materials. This paper presents soil characterization information on the Middlesex, NJ, Sampling Plant site, and reports preliminary ocean dispersion calculations. (EDB)(EST)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

326

Merry-Libby. P., Argonne National Laboratory, Argonne, IL

Model Environmental Assessment for a Property-Cleanup/Interim-Storage Remedial Action at a Formerly Utilized Site

DOE/NBM-3001480; 34 pp. (1982, July)

This document has been prepared as a model for the preparation of an Environmental Assessment (EA) for a property-cleanup/interim-storage type of remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP) of the U.S. Department of Energy (DOE). For major federal actions significantly affecting the quality of the human environment, an Environmental Impact Statement (EIS) must be prepared to aid DOE in making its decision. However, when it is not clear that an action is major and the impacts are significant, an EA may be prepared to determine whether to prepare an EIS or a finding of no significant impact (FONSI). If it is likely that an action may be major and the impacts significant, it is usually more cost-effective and timely to directly prepare an EIS. If it is likely that a FONSI can be reached after some environmental assessment, as DOE believes may be the case for most property-cleanup/interim-storage remedial actions, preparation of site-specific EAs is an effective means of compliance with NEPA. (EDB)

327

Moe, H.J., M.J. Robinet, V.R. Veluri, and R.A. Wynveen, Argonne National Laboratory, Argonne, IL

Operational Experience: Problems in the On-Site Assay and Management of New Brunswick Laboratory Decommissioning Wastes

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983 (1983)

The New Brunswick Laboratory, situated on 2.3 ha with 12 buildings, was decommissioned during 1981. The laboratory had been operated for the Atomic Energy Commission as a general nuclear chemistry facility and was involved in the preparation of assay standards for nuclear materials used in the reactor and weapons program, in pilot-plant thorium extraction, and in UF4 production. In addition, during 1960, about 500 cu m of soil contaminated with Belgian-Congo pitchblende was transferred to the site and used as a fill. To meet the requirement for identification and quantification of the contaminated wastes, radionuclide assays were performed using a high purity Ge spectrometer in a low background environment. The significant problems encountered during the assays and with the disposal management of the wastes can be categorized as follows: (1) identification and quantification of surface radionuclide contaminants on structural material and methods of disposition for these materials; (2) identification and quantification of radionuclides in the soil under buildings and on the site for hazard assessment; (3) estimation of total radioactivity to be sent to the burial facility, based on the limited analysis of small representative samples; and (4) delineation of contaminated from uncontaminated objects so as to allow salvage. Some onsite approaches to the solution of these problems and the difficulties involved in quantification of contaminants are discussed. (Auth)

328

Myrick, T.E., B.A. Berven, and F.F. Haywood, Oak Ridge National Laboratory, Oak Ridge, TN

Determination of Concentrations of Selected Radionuclides in Surface Soil in the United States

Health Physics 45(3):631-642 (1983, September)

Background radionuclide concentrations in surface soil across the U.S. have been measured by the Remedial Action Survey and Certification Activities (RASA) Group of the Health and Safety Research Division at Oak Ridge National Laboratory (ORNL). These measurements have been made as part of the ORNL program of radiological surveillance of active uranium mills and sites formerly utilized during Manhattan Engineer District and early Atomic Energy Commission projects. The background soil sampling program involved determination of Ra-226, Th-232 and U-238 concentrations in surface soil samples for comparative purposes to determine the extent of contamination present at the survey sites and surrounding off-site areas. The sampling to date has provided background information at 356 locations in 33 states. The nationwide average concentrations of Ra-

226, Th-232 and U-238 in surface soil were determined to be 1.1, 0.98 and 1.0 pCi/g, respectively. This paper summarizes the results of these background measurements and provides a brief analysis of regional differences and similarities in data values. (EDB)

329

Myrick, T.E., M.S. Blair, R.W. Doane, and W.A. Goldsmith, Oak Ridge National Laboratory, Oak Ridge, TN

A Mobile Gamma Scanning System for Detecting Radiation Anomalies

Nuclear Technology 62(3):364-370 (1983, September)

A mobile gamma-ray scanning system has been developed by Oak Ridge National Laboratory for use in the U.S. Department of Energy's remedial action survey programs. The unit consists of NaI(Tl) detectors housed in a specially equipped van. The system is operator controlled through an on-board minicomputer with data output provided on the computer video screen, strip chart recorders, and an on-line printer. Data storage is provided on floppy disk. Multichannel analysis capabilities are included for qualitative radionuclide identification. A Ra-226 specific algorithm is currently employed to identify locations containing residual radium-bearing materials. (EDB)

330

Three University of Chicago Buildings Used During the Manhattan Project

Nucleonics Week 24(34):1 (1983, August 25)

The U.S. Department of Energy has announced that three University of Chicago buildings used during the Manhattan Project will be decontaminated. The cleanup will be carried out by staff from Argonne National Laboratory. The project is due to start in December, 1983 and should be completed by September, 1984. (BDC)

331

Oak Ridge National Laboratory, Oak Ridge, TN

Procedures Manual for the ORNL Remedial Action Survey and Certification Activities (RASCA) Program

ORNL/TM-8600; 35 pp. (1982, September)

This manual describes the functions and procedures used at Oak Ridge National Laboratory (ORNL) in support of the Remedial Action Survey and Certification Activities (RASCA) program as implemented for the Department of Energy. The format and arrangement of the manual was selected to facilitate its use and to enable revisions to be incorporated simply and easily. The manual is intended to be utilized as a reference for all operations related to the ORNL-RASCA Program and may also, from time to time, serve as a training manual. The ORNL-RASCA Procedures Manual consists of some 21 major sections, each of which contains one or more subsections or procedures. The introduction is descriptive in nature, defining the purpose, scope and utilization of the manual, as well as including a policy statement on quality assurance. A glossary of terms, as used in this manual, is included. Other sections include background information on the functions and administration of the ORNL-RASCA Program and planning sections. (Auth)(MFB) (BDC)

332

Olsen, K.B., J.A. Young, and V.W. Thomas, Pacific Northwest Laboratory, Richland, WA

Review of Well-Logging Techniques For Use in Remedial Action Programs

NUREG/CR-3186; PNL-4634; 29 pp. (1983, April)

A literature review has been conducted to determine whether suitable borehole-logging techniques exist for the measurement of gamma-ray-emitting elements using downhole detectors. Most of the methods that have been used for the last 30 years by the uranium-exploration industry involve passive gamma-ray measurement techniques utilizing NaI(Tl) and, occasionally, intrinsic germanium detectors. Parameters the industry has had to consider in calibrating these detectors are variations in: (1) casing material and thickness; (2) water in the borehole; (3) hole diameter; (4) disequilibrium between uranium and its daughters in the ore zone; (5) spatial distribution of the radioactive material; and (6) dead time of the analyzer. The methods they have used to address

these variable parameters appear to be applicable to remedial action programs. The techniques that have been used for the measurement of subsurface radium concentration by DOE during the engineering assessment of UMTRAP/FUSRAP sites and by NRC at one remedial action site are described in this report. (EDB)

333
Phelps, A.K., and M.G. White, Bechtel National, Inc., Oak Ridge, TN; U.S. Department of Energy, Washington, DC

Conceptual Facility Designed for Remedial Action Wastes

NUREG/CP-0028 (Vol. 1); CONF-820911; Low-Level Waste Disposal: Facility Design, Construction, and Operating Practices, Proceedings of a Symposium, Washington, DC, September 29, 1982; (pp. 45-65) (1983, March)

Two conceptual designs are presented for below-grade land disposal in the Northeastern United States of remedial action wastes from the DOE Formerly Utilized Sites Remedial Action Program (FUSRAP). The wastes were generated by programs of the Manhattan Engineer District/Atomic Energy Commission (MED/AEC), and consist largely of trace-contaminated soils, sediments, and rubble resulting from a variety of activities, including research, processing, and storage of uranium and thorium ores and concentrates. The principal isotope of interest from a hazards control standpoint is Ra-226. Conceptual designs are presented for disposal facilities for the states of New York and New Jersey. Each design is based on the estimated volume of FUSRAP waste in each state. Since no specific sites have been identified for the disposal facilities, the geologic, hydrologic, topographic, and meteorological conditions chosen for the conceptual design are representative of conditions in New York and New Jersey. The principal difference in the two sites is an assumed soil permeability factor which requires an engineered clay liner surrounding the waste for the New York facility, but not for the New Jersey facility. The conceptual designs are intended to be conservative and were developed to be compatible with 10 CFR 40, proposed 10 CFR 61, and proposed 40 CFR 192. The designs are developed in sufficient detail to verify the feasibility of the design concepts and to provide a basis for developing capital cost estimates for below-grade land disposal facilities. (EDB)(EST)

334
Reiman, R.T., EG&G Energy Measurements Group, Las Vegas, NV

In Situ Gamma Analysis Support for Phase 1 Middlesex Cleanup Project

EGG-10282-1003; 23 pp. (1983, July)

An analysis was conducted of the radiological character of the soil at the former Middlesex Sampling Plant and associated properties in Middlesex, New Jersey in the Phase 1 cleanup before, during, and after decontamination. The method used for the analysis was in situ gamma spectroscopy employing a high-purity germanium detector. This report describes the in situ system and displays the results of the in situ measurements before and after decontamination of the properties. (Auth)(BDC)

335
Robinson, J.E., and T.L. Gilbert, Argonne National Laboratory, Argonne, IL

Scoping Survey of Perceived Concerns, Issues, and Problems for Near-Surface Disposal of FUSRAP Waste

ANL/EIS-17; 138 pp. (1982, December)

This report is a scoping summary of concerns, issues, and perceived problems for near-surface disposal of radioactive waste, based on a survey of the current literature. Near-surface disposal means land burial in or within 15 to 20 m of the earth's surface. It includes shallow land burial (burial in trenches, typically about 6 m deep with a 2-m cap and cover) and some intermediate-depth land burial (e.g., trenches and cap similar to shallow land burial, but placed below 10 to 15 m of clean soil). Proposed solutions to anticipated problems also are discussed. The purpose of the report is to provide a better basis for identifying and evaluating the environmental impacts and related factors that must be analyzed and compared in assessing candidate near-surface disposal sites for FUSRAP waste. FUSRAP wastes are of diverse types, and their classification for regulatory purposes is not yet fixed. Most of it may be characterized as low-activity bulk solid waste, and is similar to mill tailings, but with somewhat lower average specific activity. It may also qualify as Class A segregated waste under the proposed 10 CFR 61 rules, but the parent radionuclides of concern in FUSRAP (primarily U-238 and Th-232) have longer half-lives than do the radionuclides of concern in most low-level waste. Most of the references reviewed deal with low-level waste or mill tailings since there is as yet very little literature in the public domain on FUSRAP. (EDB)

336
Tsai, S.Y.H., and W.H. Smith, Argonne National Laboratory, Argonne, IL

Hydrogeological Characterization of Back Forty Area, Albany Research Center, Albany, Oregon

ANL/ER-TM-83-4; 22 pp. (1983, December)

Radiological surveys were conducted to determine the potential migration of radionuclides from the waste area to the area commonly referred to as the Back Forty, located in the southern portion of the ARC site. The survey results indicated that parts of the Back Forty contain soils contaminated with uranium, thorium, and their associated decay products. A hydrogeologic characterization study was conducted at the Back Forty as part of an effort to more thoroughly assess radionuclide migration in the area. The objectives of the study were: (1) to define the soil characteristics and stratigraphy at the site; (2) to describe the general conditions of each geologic unit; and (3) to determine the direction and hydraulic gradient of areal groundwater flow. The site investigation activities included literature reviews of existing hydrogeological data for the Albany area, onsite borehole drilling, and measurement of groundwater levels. (EDB)

337
U.S. Department of Energy, Office of Inspections, Washington, DC

The Follow-up Inspection of the Formerly Utilized Sites Remedial Action Program

DOE/IG-0199; 10 pp. (1983, September 30)

In a follow-up inspection of the Formerly Utilized Sites Remedial Action Program (FUSRAP), it was found that four of the six areas of concern identified in the initial inspection had been adequately addressed by FUSRAP managers. First, the Assistant Secretary for Nuclear Energy was given sole responsibility for managing FUSRAP. Improved coordination among the various program elements and more efficient decontamination procedures at the sites were found. Second, DOE has opted to use U.S. Environmental Protection Agency (EPA) cleanup standards for uranium mill tailings in its remedial actions at FUSRAP sites. Third, while these standards will increase cleanup costs vis-a-vis more relaxed standards, costs can be tempered somewhat by the use of health effects assessments and cost benefit analyses that are now being performed during the preliminary engineering phase of the remedial action process. Finally, it was concluded from the follow-up inspection that FUSRAP managers are making their best efforts to estimate likely costs for completing the program. However, major uncertainties continue to exist in the program that preclude the development of a reliable cost estimate at this time. Two issues continue to be of concern: FUSRAP sites are not being certified as being decontaminated in a timely manner; and permanent waste repositories have not yet been planned or developed for the disposal of FUSRAP residues. (Auth)(NPK)

338
U.S. Department of Energy, Washington, DC

DOE Office of Terminal Waste Disposal and Remedial Action has Completed Radiological Survey and Taken Remedial Actions to Decontaminate Properties Found to Contain Low-Level, Naturally Occurring Residual Radioactive Material Resulting from R&D Projects at the Former Kellex Laboratory While It Operated Under Contract to the Manhattan Engineer District and the Atomic Energy Commission in Jersey City, New Jersey

Federal Register 48(193):45281 (1983, October 4)

The Department of Energy (DOE) has completed radiological surveys and taken remedial actions to decontaminate properties found to contain low-level, naturally occurring residual radioactive material resulting from research and development projects at the former Kellex Laboratory. The Office of Terminal Waste Disposal and Remedial Action has reviewed and analyzed the radiological data obtained following remedial action on the site once occupied by the former Kellex Laboratory in Jersey City, New Jersey. (Auth)(LFG)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

339
Vierzba, E.A., and A. Wallo, Aerospace Corporation, Washington, DC

Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works, Final Report

ATR-82(7963-04); 81 pp. (1982, November)

The objective of this study was to use available documentary evidence to present a comprehensive overview of the site's operating history and land use, describe the recent radiological monitoring performed at the site, discuss remedial actions performed at the site, summarize the site's present condition, and suggest priorities for conduct of comprehensive radiological surveys in specific areas of the former ordnance works. Recommended priorities for the radiological survey of areas of the site are based on the likelihood of radiological contamination and potential health effects from ionizing radiation associated with the contamination. (GRA)

340
Weston (Roy F.), Inc., West Chester, PA

Engineering Feasibility Analysis for In-Situ Stabilization of Burrell Township Site Residues

UMTRA-DOE/ALO-187; 136 pp. (1982, November)

An engineering study of the Burrell Township site was conducted to determine the feasibility of stabilizing the site in accordance with the U.S. Environmental Protection Agency's interim and proposed standards. The scope of the study was limited to alternatives that could be implemented on the site. Alternatives which were considered and evaluated included: site stabilization and closure; waste control and containment; waste excavation and encapsulation; and waste excavation, incineration, and encapsulation. Site stabilization and closure was recommended as meeting environmental, technical, and cost-effectiveness criteria. (Auth)(BDC)

341
Whitman, M., Colorado Office of the Governor, Denver, CO

The Feasibility of Co-Disposing Low-Level Radioactive Waste with Uranium Mill Tailings and/or FUSRAP Waste

DOE/ID/12371-4; 25 pp. (1983, September)

Optimal arrangements for the disposal of low-level waste in the Rocky Mountain region was studied. The Rocky Mountain states share the problem of safe disposal and maintenance of uranium mill tailings. In addition, three officially designated FUSRAP sites are located in New Mexico. This study to assess the acceptability of co-siting low-level wastes with uranium mill tailings at separate but neighboring disposal areas addresses economics, technical issues, and institutional issues. Analysis of economic and technical feasibility indicated that a co-facility would be preferable to specialized disposal facilities. Institutional factors indicated less adaptability to a co-facility, with major concerns involving liability in the event of site failure and licensing and legal obstacles. (BDC)

342
Wyman, D.J., Argonne National Laboratory, Argonne, IL

Methods for Assessing Environmental Impacts of a FUSRAP Property-Cleanup/Interim-Storage Remedial Action

ANL/EIS-16; 237 pp. (1982, December)

This document provides a description of a property-cleanup/interim-storage action, explanation of how environmental impacts might occur, comprehensive treatment of most potential impacts that might occur as a result of this type of action, discussion of existing methodologies for estimating and assessing impacts, justification of the choice of specific methodologies for use in FUSRAP environmental reviews, assessments of representative impacts (or expected ranges of impacts where possible), suggested mitigation measures, and some key sources of information. The major topical areas covered are physical and biological impacts, radiological impacts, and socioeconomic impacts. Some project-related issues were beyond the scope of this document, including dollar costs, specific accident scenarios, project funding and changes in Congressional mandates, and project management (contracts, labor relations, quality assurance, liability, emergency preparedness, etc.). These issues will be covered in other documents supporting the decision-making process. Although the scope of this document covers property-cleanup and interim-storage actions, it is applicable to other similar remedial actions. For example, the analyses discussed herein for cleanup activities are applicable to any FUSRAP action that includes site cleanup. (EDB)

343

Wynveen, R.A., W.H. Smith, C.B. Mayes, and A.L. Justus, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of Chemicals Group, Olin Corporation, Joliet, Illinois, March 27 - November 28, 1978

DOE/EV-0005/35; ANL-OHS/HP-83-103; 99 pp. (1983, May)

A comprehensive radiological survey was conducted at Building 55 of the Chemicals Group, Olin Corporation, Joliet, Illinois. The survey included measurements of alpha and beta-gamma contamination, both fixed and removable; beta-gamma exposure readings at contact and at 1 m above the floor or ground level; estimates of radon-daughter concentrations in the air as airborne contaminants; and determinations of concentrations of Cs-137, the Th-232 decay chain, the Ra-226 decay chain, and uranium in the soil on the site. Thirty-three spots or localized areas and three larger general areas within the building exceeded allowable limits for uranium, the general roof area exceeded acceptable limits for radium-226, with two spots or localized areas on the roof substantially exceeding those limits. In fifteen instances, the contamination was found to be removable from surfaces and readily available for transfer to other locations. Concentrations of radon daughters in the air of the building were below the limit of 0.01 WL above background. Analyses of soil samples from the site indicated significantly elevated concentrations of uranium and radium at two sampling locations near the building. In order to reduce the potential for radiation exposure, remedial measures such as stabilization of the contamination in place would be applicable as a short-term measure. The long-term solution would involve decontamination by removal of the radioactive residues from the areas where it was detected. (Auth)(BDC)

344

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Argonne, IL

Radiological Survey of the Former Watertown Arsenal Property, Site 34 and Site 41, Watertown, Massachusetts

DOE/EV-0005/37; ANL-OHS/HP-83-106; 75 pp. (1983, October)

Radiological surveys of several areas within the Watertown Arsenal Complex were conducted to determine current radiological conditions. Results of surveys of Building Site 34 and Building Site 41 are presented in this report. Building 34 housed a uranium machine shop, and a portion of Building 41 contained a foundry that was used for uranium work. Both buildings have been razed with concrete floor slabs, access drives, and underground utility service trenches still in place. Radiological surveys showed significant levels of contamination at 33 locations on the pad of Site 34 and in 5 out of 15 soil corings from the perimeter of the pad. No contamination was found on the pad of Site 41; however, two-thirds of this pad was covered with soil up to 4 ft thick. One of the 14 soil corings taken adjacent to the pad of Site 41 had elevated levels of uranium. Levels of contamination found at this site were in excess of criteria as identified in ANSI 13.12 and NRC Guidelines. (BDC)

345

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of the Former Watertown Arsenal Property, GSA Site, Watertown, Massachusetts

DOE/EV-0005/38; ANL-OHS/HP-83-108; 104 pp. (1983, October)

This is one in a series of reports resulting from a program initiated by the Atomic Energy Commission (AEC) in 1974 to determine the condition of sites formerly utilized by the Manhattan Engineer District (MED) and the AEC since the 1940s for work involving the handling of radioactive materials. During the period from July 13 through September 4, 1981, the Argonne National Laboratory (ANL) conducted a comprehensive radiological survey at the GSA property. The GSA property includes an area that had been used for packaging and storing of radioactive waste, burning of uranium scrap, and staging of radioactive-waste shipments during the MED/AEC period. Although the buildings at the GSA property were free from contamination, significant levels of radioactive contamination were found on the site grounds, particularly in the area where radioactive uranium wastes had been burned. About 65 sq ft of surface area exhibited elevated radiation levels. Soil borings indicated that the contamination extends to a depth of 6 ft at some locations and is in contact with groundwater. The levels of contamination found at the GSA property are in excess of accepted guidelines. (Auth)(NPK)

346

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of the Albany Metallurgical Research Center, United States Bureau of Mines Biomass Facility and the "Back Forty" Area, Albany, Oregon

DOE/EV-0005/39; ANL-OHS/HP-83-101; 97 pp. (1983, June)

This report contains survey results identifying the current radiological condition of two areas located at the site of the U.S. Bureau of Mines' Albany Metallurgical Research Center. These areas are the "Biomass Facility" and the "Back Forty". The Biomass Facility was a pilot plant for the production of oil from wood waste and consists of five structures on a 2-acre site. The Back Forty is a vacant area of about 14 acres south of the Biomass Facility. Both areas were reportedly used as dump sites. From 1954 to 1956 and from 1960 to 1971, the research center was engaged in metallurgical operations that included melting, machining, welding, and alloying thorium, as well as research on alloys of uranium and thorium. At the time the contract was terminated, the buildings and surrounding areas were decontaminated in accordance with the general guidelines provided by the Atomic Energy Commission. Those guidelines were not as specific as current guidelines, and details of the final decontamination were not documented. A radiological assessment of the entire site was initiated in June 1978. No contamination was found to be associated with the structures, equipment, or material in the Biomass Facility, but four relatively small areas of contamination were found in the exterior grounds. The structures, equipment, and material associated with the Biomass Facility were released for unrestricted use, but some restrictions were recommended for use of the exterior grounds. A relatively large area in the Back Forty showed radiation levels as high as 100 uR/hr at 3 ft above ground. Restrictions were placed on use of this area. (Auth)(BDC)

347

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of the Albany Metallurgical Research Center, United States Bureau of Mines, Albany, Oregon

DOE/EV-0005/40; ANL-OHS/HP-83-102; 164 pp. (1983, June)

From 1954 to 1956 and 1960 to 1971, the Albany Metallurgical Research Center was engaged in metallurgical operations that included melting, machining, welding, and alloying thorium, as well as research on alloys of uranium and thorium. At the time the original Atomic Energy Commission (AEC) contract was terminated, buildings and surrounding areas were decontaminated according to the general guidelines provided by the AEC. Because those guidelines were not as specific as current guidelines and detailed records of the final decontamination were not made, radiological assessment of the site was initiated in June 1978. Significant levels of contamination were found in 10 of 33 buildings surveyed and about 60 contaminated areas were found outside the buildings. Subsurface contamination was primarily within the main site and restricted to depths of 1 to 2 ft. Although contamination levels did not pose an immediate health hazard, it was concluded that decontamination and cleanup would be appropriate to reduce radiation exposure to as "low as reasonably achievable" levels. (Auth)(BDC)

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

348

Wynveen, R.A., W.H. Smith, C.M. Sholeen, A.L. Justus, and K.F. Flynn, Argonne National Laboratory, Argonne, IL

Post-Remedial Action Radiological Survey of Kent Chemical Laboratory, The University of Chicago, Chicago, Illinois, May 1983

DOE/EV-0005/43; ANL-OHS/HP-83-107; 77 pp. (1983, December)

In the early 1970s, it was found that documentation was insufficient to determine if the decontamination work carried out at the Kent Chemical Laboratory when nuclear activities ceased was adequate by current guidelines. Consequently, a comprehensive radiological assessment of Kent Laboratory was conducted during September 1977. Results of the assessment indicated the need for remedial action. Since that time, the university has decontaminated the building. In May 1983, a post-remedial-action survey was conducted. Contamination remained in six of the rooms in the building. Further decontamination was conducted and these areas are now free of contamination. However, a contaminated clay pipe in the attic remained which has since been removed and disposed of as solid radioactive waste. The building is now free of radioactive contamination in excess of background levels; however, the sewers do contain radioactive material above background levels. (BDC)(ARE)

Chapter 4

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

- Design, Planning, and Regulations
- Environmental Studies and Site Surveys
- Decontamination Studies
- Site Stabilization and Reclamation
- Waste Disposal
- Remedial Action Experience
- General Studies

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

349
Dillon, T.A., U.S. Department of Energy, Washington, DC

National Environmental Policy Act - Record of Decision for Remedial Actions at the Former Vitro Rare Metals Plant Site, Canonsburg, Pennsylvania

Federal Register 48(196):45820-45823 (1983, October 7)

Pursuant to the Council on Environmental Quality Regulations implementing the procedural provisions of the National Environmental Policy Act (NEPA) and the Department of Energy's (DOE) guidelines for compliance with NEPA, the Office of the Assistant Secretary for Nuclear Energy (ASNE) of DOE issued a Record of Decision on the environmental impact statement prepared for remedial actions at the former Vitro Rare Metals Plant Site. DOE also issued concurrently a floodplain statement of findings for the proposed actions pursuant to Executive Order 11988 and 10 CFR Part 1022.18. (Auth)

350
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

UMTRAP Salt Lake Off-Site Properties, Health Physics and Safety Plan

UMTRAP Report; 12 pp. (1981, June)

The purpose of this Health Physics and Safety plan is to ensure that contractor employees are provided with safe and healthful working conditions; to reduce injuries, illnesses and exposures to toxic and radioactive materials; to protect the environment and the health and safety of the general public; and to establish programs for periodic inspection, instruction, and monitoring. (BDC)

351
Logsdon, M.J., T.R. Verma, and D.E. Martin, U.S. Nuclear Regulatory Commission, Division of Waste Management, Washington, DC

Information Needs for Demonstration Compliance with Groundwater Aspects of 40 CFR Part 192 for Uranium Mill Tailings Remedial Action Programs

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 3-7) (1984, February)

An interpretation is presented of Subpart C of the U.S. Environmental Protection Agency's radiological and nonradiological standards (40 CFR Part 192) for remedial actions at inactive uranium mill sites. Subpart C deals with pollutants in groundwater at these sites. U.S. Nuclear Regulatory Commission experience shows that reports concerning groundwater aspects of UMTRA documents should (1) identify the physical and chemical nature of the present groundwater flow system; (2) identify actions which might alter the existing groundwater flow system and the effects of such changes on the definition of the protected zone; (3) identify current groundwater use within the protected zone; and (4) identify site-specific models, boundary conditions, and representative values of system parameters, to predict that proposed actions will protect groundwater and surface water resources for the design period of 200 to 1000 years. It was suggested that DOE develop and document an analysis which would demonstrate that the remedial action plan is consistent with 40 CFR Part 192. (Auth) (BDC)(ARE)

352
MITRE Corporation, McLean, VA

Uranium Mill Tailings Remedial Action Project (UMTRAP) Public Participation Plan

UMTRA-DOE/ALO-10; 24 pp. (1982, February)

The Public Participation Plan explains the Department of Energy's plan for involving the public in the decision-making process related to the Uranium Mill Tailings Remedial Action (UMTRA) Project. The congressional action that authorized the project provides for a cooperative effort among affected states and Indian tribes for the eventual cleanup of abandoned or inactive uranium mill tailings sites located in nine western states and Pennsylvania. DOE plans not only to comply with the legal requirements for public participation, but also to expand the role of the citizens who live in affected communities. (BDC)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

353

Utah Wins Role in Tailings Cleanup and Colorado Plans Similar Proposal

Nuclear Fuel 9(6):12-13 (1984, March 12)

Utah and the Department of Energy (DOE) have reached agreement on the joint management of the mill tailings cleanup in Salt Lake City. The state government will control the remedial action contract, but a decision has not been made as to how much remedial work the Utah state government will do itself and how much it will contract out. A key feature of the agreement is Utah's offer to pay 25% of the cost of removing the tailings from the site in addition to 10% of the overall remedial action work. DOE said the remedial action at Salt Lake City will cost $60 million and Utah estimates the cost at $54 million. DOE officials have said they will consider Colorado's proposal to take over the cleanup of inactive uranium mill sites in that state. (BDC)

354

Nussbaumer, D.A., and D.A. Harmcn, U.S. Atomic Energy Commission, Washington, DC

The United States Atomic Energy Commission's Regulatory Control Program for Uranium Milling

CONF-104; Radiological Health and Safety in Mining and Milling of Nuclear Materials, Proceedings of a Symposium, Vienna, Austria, August 26-30, 1963; (pp. 519-533) (1964)

The Atomic Energy Commission has been vested by the Atomic Energy Act of 1954, as amended, with the authority and responsibility for regulatory control of radiological health and safety in the United States uranium milling industry. The Commission has promulgated regulations, established standards, developed guides and criteria, and instituted a licensing and inspection program to discharge this responsibility. A brief history of the milling industry is presented with particular emphasis on the development of the Commission's regulatory control program. Information on the Commission's present licensing program is described and discussed. Topics covered include: applicable regulations; licensing guides; requirements for the issuance of licenses including a summary of the information which applicants must submit in support of applications for licenses; considerations in technical evaluation of applications; the Commission's inspections and enforcement program; limits for external radiation exposures and concentrations of airborne uranium and its daughter products in air and water; and procedures and bases for granting certain exemptions and special authorizations pursuant to applicable regulations. The paper also includes an identification and discussion of those phases of milling operations which require special consideration from a radiation safety standpoint. Among the items discussed are control of airborne radioactivity resulting from dust-producing operations such as crushing and grinding, sample preparation, and final product packaging; criteria for use of respirators in controlling exposure of workers to airborne radioactivity; treatment and control of liquid effluents; retention of liquid and solid tailings; criteria for construction and maintenance of earth dam retention systems; and requirements for shutdown and abandonment of uranium mills. (Auth)

355

Tennessee Valley Authority, Knoxville, TN

TVA Makes Available Record of Decision to Decommission the Edgemont, South Dakota Uranium Mill and Related EIS

Federal Register 48(185):43253 (1983, September 22)

In accordance with Tennessee Valley Authority (TVA) procedures implementing the National Environmental Policy Act (NEPA), Federal Register (1983), and consistent with 40 CFR 1506.3 (1982), TVA adopted the final environmental impact statement related to decommissioning of the Edgemont uranium mill on March 16, 1983. The statement was prepared by the Officer of Nuclear Material Safety and Safeguards of the Nuclear Regulatory Commission (NRC). TVA has determined that the statement adequately assesses the decommissioning of the Edgemont mill and that the adopted statement is still available to the public. TVA will implement the preferred alternative identified in NRC's "Final Environmental Statement Related to the Decommissioning of the Edgemont Uranium Mill". TVA has decided to: (1) decommission the inactive mill including building removal and decontamination; and (2) conduct the decommissioning operation using a disposal site remote to the mill and city of Edgemont. (Auth)(LFG)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

356
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting

DOE News (June 14, 1984):1 (1984, June 14)

The U.S. Department of Energy (DOE) will conduct a public information meeting regarding the Canonsburg uranium mill tailings site Thursday, June 28, 1984, at 7:00 PM in the North Strabane Town Hall. Area residents are invited to attend. The meeting is being held so that the DOE and the contractors can bring the public up to date on all remedial construction activities going on in the Canonsburg area. Project officials will be present from the DOE's Uranium Mill Tailings Remedial Action (UMTRA) project office, Albuquerque, New Mexico. Jacobs Engineering Group, Incorporated, the technical assistance contractor, and Morrison-Knudsen Company, the remedial action contractor also will have representatives on hand to answer questions. The Canonsburg mill tailings site is one of 24 sites nationwide designated for cleanup under DOE's UMTRA program. (Auth)(PTO)

357
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Action Plan for Stabilization of the Inactive Uranium Mill Tailings Site at Canonsburg, Pennsylvania

UMTRA-DOE/AL-140; 354 pp. (1983, October)

This Remedial Action Plan (RAP) has been developed to serve a twofold purpose. It presents the series of activities which are proposed by the U.S. Department of Energy to effect permanent control of radioactive materials at the inactive uranium processing site in Canonsburg, Pennsylvania and it also serves to document the agreement of the Commonwealth of Pennsylvania and the concurrence of the U.S. Nuclear Regulatory Commission in the remedial action. This document has been structured to provide a comprehensive understanding of the remedial action proposed for the Canonsburg site. Detailed supporting information can be found in appendices and referenced documents. (Auth)(BDC)

358
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

UMTRA Project Quality Assurance Plan

UMTRA-DOE/AL-185 (Issue B); 14 pp. (1983, June)

The Quality Assurance Plan (QAP) of the Uranium Mill Tailings Remedial Action (UMTRA) Project is described in the report. The program has been established to be applicable to all activities affecting functions that prevent or mitigate the consequences of events that could cause unreasonable risk to the health and safety of the public or that could compromise project success. This QAP describes the general quality assurance plan for the overall UMTRA Project under which the quality assurance programs of the individual participating organizations, project contractors, and task contractors are to operate. It is the purpose of this plan to show the commonality of quality assurance programs in effect within the project and to define how each element fits into the entire picture to give total quality assurance coverage for the UMTRA Project. (Auth)(MFB)

359
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

UMTRA Project Quality Assurance Plan

UMTRA-DOE/AL-185; 14 pp. (1983, June)

The Quality Assurance Plan (QAP) of the Uranium Mill Tailings Remedial Action (UMTRA) Project is described in the report. The program has been established to be applicable to all activities affecting functions that prevent or mitigate the consequences of events that could cause unreasonable risk to the health and safety of the public or that could compromise project success. This QAP describes the general quality assurance plan for the overall UMTRA Project under which the quality assurance programs of the individual participating organizations, project contractors, and task contractors are to operate. It is the purpose of this plan to show the commonality of quality assurance programs in effect within the project and to define how each element fits into the entire picture to give total quality assurance coverage for the UMTRA Project. (Auth)(MFB)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

360
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Action Concept Paper for the Uranium Mill Tailings at the Vitro Site, Salt Lake City, Utah

UMTRA-DOE/AL-33 (Draft); 21 pp. (1982, October)

The mission of the UMTRA Project at Salt Lake City is to carry out a clean up program according to U.S. Environmental Protection Agency (EPA) standards for the disposal of tailings and for the cleanup of open lands and structures. Interim and proposed standards are summarized and discussed. The project's objective is to combine the radioactive materials from the site and the vicinity properties at one location. The final disposal site will be owned by the federal government and licensed by the Nuclear Regulatory Commission. By combining and stabilizing all tailings and contaminated materials at one disposal site, potential health effects caused by exposure to the tailings will be minimized, and all other presently contaminated areas will be cleaned up sufficiently to be released for unrestricted use. (Auth)(MFB)(ARE)

361
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Action Concept Paper for the Uranium Mill Tailings at the Vitro Site, South Salt Lake, Utah

UMTRA-DOE/AL-33; 21 pp. (1982, November)

The mission of the UMTRA Project at Salt Lake City is to carry out a cleanup program according to U.S. Environmental Protection Agency standards for the disposal of tailings and for the cleanup of open lands and structures. The interim and proposed standards are summarized and discussed. The objective of the project is to combine at one location the radioactive materials from the site and the vicinity properties. The final disposal site will be owned by the federal government and licensed by the Nuclear Regulatory Commission. By combining and stabilizing all tailings and contaminated materials at one disposal site, potential health effects caused by exposure to the tailings will be minimized, and all other presently contaminated areas will be cleaned up sufficiently to be released for unrestricted use. (Auth)(MFB)

362
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Project Plan, Uranium Mill Tailings Remedial Actions (UMTRA) Project

UMTRA-DOE/ALO-167; 37 pp. (1982, January)

The Uranium Mill Tailings Remedial Actions (UMTRA) Project is directed to undertake remedial action at designated inactive uranium mill sites and associated vicinity properties containing residual radioactive materials from such sites. The purpose of such action would be to stabilize and control uranium mill tailings and associated material in a safe and environmentally sound manner, to minimize radiation health hazards. The project plan presented in this report deals with problems of performance standards, risk assessment, management, scheduling, and costs. (BDC)

363
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Action Concept Paper for the Uranium Mill Tailings Site at Canonsburg, Pennsylvania

UMTRA-DOE/ALO-31 (1982, February)

The purpose of this Remedial Action Concept Paper (RACP) is to provide a written description of the conceptual framework within which the specific course of remedial action to be followed at the Canonsburg site will be ultimately decided. The conceptual framework set forth in the RACP includes an identification of the reasonable alternatives, a discussion of the significant factors affecting the remedial action decision, and a description of the remedial action concept that appears to be the most feasible at this time. (Auth)(ARE)

364
U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Action Concept Paper for the Uranium Mill Tailings Site at Durango, Colorado

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

UMTRA-DOE/ALO-32; 21 pp. (1982, August)

The purpose of this Remedial Action Concept Paper (RACP) is to identify the reasonable alternatives, discuss the significant factors affecting the remedial action decision, and describe the remedial action options that appear to be the most feasible at this time. The mission of the UMTRA project at Durango is to carry out a cleanup program according to EPA standards for the disposal of tailings and the cleanup of open lands and structures. Interim and proposed standards are discussed. The objective is to combine at one location the radioactive materials, the contaminated soils, and the other contaminated materials from the site and vicinity properties. Combining and stabilizing all tailings and contaminated materials at one site would minimize potential adverse health effects from exposure. Another aspect of the project which is addressed is the economic and technical feasibility of reprocessing the tailings. A feasibility analysis should be conducted to comply with Public Law 95-604. (Auth)(MFB)(BDC)

365
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE, Wyoming Sign Agreement for Remedial Actions on Two Inactive Uranium Mill Tailings Sites

DOE News (December 29, 1983): 1-2 (1983, December 29)

The state of Wyoming and the Department of Energy's Albuquerque Operations Office have executed a cooperative agreement under which remedial actions on two inactive uranium mill tailings sites in Wyoming will be carried out. The purpose of the agreement is to establish a contractual basis whereby Wyoming will participate in the planning, execution, and funding of remedial actions at these sites to stabilize and control the tailings in a safe and environmentally sound manner. (BDC)

366
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Schedules Second Public Meeting at Shiprock, New Mexico

DOE News (February 24, 1984):1 (1984, February 24)

A second public meeting is planned to discuss cleanup efforts for the inactive uranium mill tailings pile on the the Navajo Reservation at Shiprock, New Mexico. A previous meeting was held to introduce the UMTRA Project and present preliminary plans for the Shiprock Site. The second meeting to be held on March 6, 1984, will discuss potential health risks associated with uranium tailings and demonstrate how remedial action is to be carried out. (BDC)

367
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Plans Clean-up of Edgemont Properties

DOE News (June 5, 1984):1-2 (1984, June 5)

The State of South Dakota and the U.S. Department of Energy (DOE) will begin a joint effort this year to cleanup properties contaminated with residual radioactive materials from the TVA uranium mill site at Edgemont, South Dakota. A total of 216 properties designated on February 2, 1984 could be eligible for remedial action in Edgemont. These locations are referred to as "vicinity properties" under the UMTRA Project, and consist of residences, open land, and commercial structures. Vicinity properties that exceed EPA standards and are included for remedial action will be cleaned up at no cost to the property owner. The State of South Dakota will pay for 10% of the remedial action costs, with the DOE covering the remainder. Current estimates indicate that about $1 million will be expended on Edgemont vicinity properties during the 1984 construction season, and up to $4 million may be required for the entire cleanup effort in Edgemont. The cleanup effort is scheduled to be completed no later than the summer of 1987. The remedial action process for an Edgemont vicinity property involves the following steps: (1) property added to UMTRA site list; (2) site survey conducted to determine boundaries and extent of contamination; (3) radiological engineering assessment made to recommend proposed remedial action; (4) property owner, State of South Dakota, and DOE must sign a remedial action agreement; (5) final design completed and bids accepted; (6) remedial action construction performed; (7) property certification completed according to EPA standards; and (8) remedial action task documented in local land records. (PTO)(Partial Text)

368
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

Canonsburg Construction Firm Selected for Vicinity Property Cleanup Efforts

DOE News (May 16, 1983):1 (1983, May 16)

The Department of Energy has chosen Gregg, Inc., a Canonsburg construction firm, as the major subcontractor to perform remedial actions work on vicinity properties contaminated with radioactive materials from the inactive uranium mill tailings pile at the Vitro site. The work consists of cleanup activities at the site and decontamination of approximately 25 residences, with all vicinity properties to be restored to their original condition. (BDC)

3?.
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Awards Contract to Gerber Concrete Construction

DOE News (May 3, 1983):1 (1983, May 3)

The Department of Energy has awarded a contract to the firm of Gerber Concrete Construction, Inc., of Salt Lake City to decontaminate four vicinity properties in Salt Lake County near the old Vitro Chemical Uranium Processing site. Contamination at the vicinity properties consists mainly of low-level radioactive mill tailings. Approximately 92 locations have been identified as vicinity properties and will undergo remedial actions over the next three years. (BDC)

370
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE to Hold Public Meeting Regarding Vitro Tailings Site

DOE News (November 22, 1983):1 (1983, November 22)

The Department of Energy held a public meeting in Canonsburg, Pennsylvania, to give the public the opportunity to learn of and comment on DOE's plans for remedial action at the Canonsburg site. Discussions included current and future construction activities at the site. (BDC)(NPK)

371
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE, Navajo Tribe Sign Agreement for Remedial Actions on Three Inactive Uranium Mill Tailings Sites

DOE News (September 13, 1983): 1-2 (1983, September 13)

The Department of Energy's Albuquerque Operations Office and the Navajo Tribal Council executed a cooperative agreement under which remedial actions on three of the four inactive uranium mill tailings sites on Indian lands will be carried out. The three sites covered by this agreement are: Shiprock, New Mexico; Mexican Hat, Utah; and Monument Valley, Arizona. A site at Tuba City, Arizona, is within the Navajo-Hopi land dispute area and will be covered by a separate agreement. (BDC)

372
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

Remedial Action to Begin Soon on Canonsburg Tailings Pile

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

DOE News (September 29, 1983):1 (1983, September 29)

The Department of Energy announced that remedial action will begin shortly on the Canonsburg, Pennsylvania, inactive uranium mill tailings site. The Canonsburg site is the first of 24 locations nationwide to be cleaned up under DOE's Uranium Mill Tailings Remedial Action Project. A public information meeting regarding the remedial action was held October 6, 1983. Highlights of the meeting were the proposed remedial action schedule and alternate transportation routes available to the public in the event of street closures. (BDC)(NPK)

373
U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

Design Criteria for Stabilization of Inactive Uranium Mill Tailings Sites - Review Draft

UMTRA-DOE/AL-049; 64 pp. (1984, January)

The purpose of this report is to provide a basis or guideline for the remedial action contractor (RAC) to prepare the final design documentation for the Uranium Mill Tailings Remedial Action (UMTRA) Project sites. This report was prepared to provide a set of operating procedures, formats for drawings, specifications, calculations, schedules and cost estimates, and minimum design constraints. This site design criteria is intended to be used in conjunction with each site conceptual design. This report provides the major portion of the criteria necessary for the reader to understand the constraints, procedures, codes, and standards to be used during the design and performance of the remedial actions at the UMTRA project sites. For those design criteria that are specific to only a few sites, the reader is referred to the site design criteria contained in each site conceptual design. (Auth)(PTO)

374
U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

Public Information Plan for Uranium Mill Tailings Remedial Actions Project

UMTRA-DOE/ALO-184; 29 pp. (1982, May)

The objective of the public information program discussed herein is the timely dissemination of factual information sufficient to promote understanding of the project by federal, state, and local officials; the media; special interest groups; and the general public and thereby encourage informed participation in the project by citizens and government officials. The purpose of this document is to describe public information activities and to establish procedures and methods that will ensure capabilities for providing information on all of the UMTRA project, including scientific, technical, environmental, socioeconomic, and project status. (Auth)(NPK)

375
U.S. Department of Energy, Washington, DC

DOE to Hold Informational Meeting on Shiprock Uranium Mill Tailings Pile

DOE News (January 17, 1984):1 (1984, January 17)

A public meeting was scheduled on January 24, 1984, in Shiprock, New Mexico. The purpose of the meeting was to discuss remedial action plans and activities leading toward stabilization of the inactive uranium mill tailings pile at Shiprock. (BDC)

376
Zimmerman, L.L., and M.H. McCloskey, Radian Corporation, Austin, TX

Regulatory Gaps, Conflicts, and Overlaps in the Regulation of Environmental Releases from Nuclear Facilities - Task Assignment 6: Final Report

DOE/EP/12086-T3; 117 pp. (1983, December)

Regulation of the nuclear fuel cycle is a highly balkanized process, divided primarily among the Nuclear Regulatory Commission, the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the Department of Transportation (DOT). The nuclear fuel cycle for a typical light-water reactor consists of five discrete stages: (1) material mining and milling; (2) fuel conversion, enrichment, and fabrication; (3) power production; (4) spent fuel reprocessing; and (5) radioactive

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

waste disposal. The major federal acts regulating facilities in the nuclear fuel cycle include: (1) the Atomic Energy Act of 1954 (AEA), as amended; (2) the Uranium Mill Tailings Radiation Control Act of 1978; (3) the Low-Level Radioactive Waste Policy Act of 1980; (4) the Nuclear Waste Policy Act of 1982; and (5) the Hazardous Materials Transportation Act of 1974. Because two or more federal agencies play a role in almost every stage of the cycle, there is considerable potential for regulatory overlaps and conflicts in the regulation of routine (federally permitted) releases from nuclear facilities. Surprisingly, there are also gaps in the regulatory process. These gaps, overlaps, and conflicts are discussed. (EDB)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

377
Baker, K.R., D.E. Mohr, and R.L. Hillman, Weston (Roy F.), Inc., Albuquerque, NM

Radiological Aspects - Canonsburg, Pennsylvania UMTRA Site

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 463-472) (1984, February)

The extensive radiological data necessary to characterize the Canonsburg site are described along with the complexities brought about by the heterogeneity of the contamination and the disequilibrium between Th-230 and Ra-226. Automatic data processing methods are described that were used in delineating which material is to be removed and encapsulated and which material is to be removed to meet U.S. Environmental Protection Agency standards. Preliminary radon barrier thickness calculations and post remedial action flux estimates for the site are presented. (Auth)

378
Beedlow, P.A., and M.C. McShane, Pacific Northwest Laboratory, Richland, WA

Suitability of Vegetation for Erosion Control on Uranium Mill Tailings: A Regional Analysis

PNL-SA-11805; 23 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 521-530) (1983, November)

Inactive uranium mill tailings (UMTRAP sites) in the West were grouped into three major climatic regions to evaluate the adequacy of vegetation for long-term stabilization: the Colorado Plateau, the West Slope of the Rocky Mountains, and the Northern Great Plains. Four general vegetation types were found at western sites: grasslands, shrub-steppe, saltshrub, and woodland. Soil-loss rates, calculated using the Universal Soil Loss Equation, were variable within regions and vegetation types, but trends were apparent. Calculations indicated that vegetation or vegetation plus a layer of surface rock provided adequate stabilization against long-term average soil loss for slopes less than 10% at the UMTRAP sites evaluated. However, detailed analyses of erosion due to severe storm events, gully formation, and channel cutting are necessary for designing protective covers at each site. (EDB)

379
Bendix Field Engineering Corporation, Grand Junction, CO; Western Geophysical Company of America, Houston, TX

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango Quadrangle, Colorado - Final Report

GJBX-143(79) (Vol. 1); 121 pp. (1979, July)

Results from the airborne gamma-ray spectrometer and magnetometer survey of Durango Quadrangle in Colorado are presented in the form of radiometric multiple-parameter stacked profiles, histograms, flight path map, and magnetic and ancillary stacked profile data. (GRA)

380
Bloomster, C.H., D.R. Brown, G.A. Bruno, S.N. Craig, J.A. Dirks, E.A. Griffin, J.W. Reis, and J.K. Young, Pacific Northwest Laboratory, Richland, WA

Estimated Population Near Uranium Tailings

PNL-4959; 83 pp. (1984, January)

Population studies, which took place during the months of April, May, and June 1983, were performed for 27 active and 25 inactive mill sites. For each mill site, a table showing population by radius (0.5, 1, 2, 3, 4, and 5 km) in 16 compass directions was generated. (EDB)

381
Bone, M.J., and T.J. Schruben, Jacobs Engineering Group, Inc., Albuquerque, NM

Long-Term Stability - Canonsburg, Pennsylvania UMTRA Site

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 453-461) (1984, February)

The remedial action at the Canonsburg site has been planned to provide for the long-term stability of the site. In order to ensure that the integrity of the remedial action will remain intact, several methods of natural erosive destruction and other threats to long-term stability have been investigated and mitigating measures proposed. Aspects of the design approach and consideration in implementing certain design features are presented in this paper. (Auth)

382

Brinkman, J.E., Sergent, Hauskins and Beckwith Engineers, Albuquerque, NM

Ground Water - Canonsburg, Pennsylvania UMTRA Site

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 443-451) (1984, February)

At the Canonsburg site, shallow groundwater is present in an unconfined unit composed of variable fill material and in a semiconfined unit composed of fractured gray shale. The unconfined unit is recharged from the south and has a groundwater mound near the center of the site. Discharge is to Chartiers Creek to the east, north, and west. In the semiconfined unit, groundwater appears to flow in the direction of the dip of the underlying red shale, southwest to northwest. Communication between the semiconfined unit and Chartiers Creek is evident, but most of the water in the unit probably flows beneath the creek. Groundwater analyses show elevated concentrations of uranium at various onsite areas in the unconfined unit, at one area in the semiconfined area, and not at all in the Chartiers Creek. Also, some onsite groundwater samples show elevated levels of Ar, Se, Pb, N, and Cu. Modeling of the hydrogeochemistry of the site and adjacent areas, includes: (1) calibration of the hydrodynamic flow model for the steady-state unconfined unit against measured static water levels; (2) calculation of post remedial action, steady-state water table elevations; and (3) calculation of post remedial action rates and concentrations of contaminant migration. (Auth)(NPK)

383

Brinkman, J.E., W.A. Ericson, J.B. Price, and D.R. Lewis, Sergent, Hauskins and Beckwith Engineers, Albuquerque, NM; Jacobs Engineering Group, Inc., Albuquerque, NM

Hydrologic Setting and Ground Water Chemistry Characterization of the Vitro Uranium Mill Tailings Site, South Salt Lake, Utah

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 473-482) (1984, February)

The abandoned uranium mill tailings pile located in the vicinity of Jordan River Valley, Salt Lake City, Utah, has contributed contaminants associated with uranium processing to the near-surface unconfined aquifer system beneath the pile. The groundwater regime in the area consists of two distinct but interconnected aquifers: a shallow, brackish, unconfined aquifer with water levels within 3 ft of the ground surface and a deeper, confined aquifer with head levels above the ground surface and measurable artesian flow. The current hydrodynamics prevent the brackish waters of the unconfined system from reaching the deeper system unless stressed by large production wells. Detailed field investigations, laboratory studies, and hydrodynamic computer modeling have been used to evaluate the existing conditions. (Auth)

384

Bush, K.J., and G. Markos, GECR, Inc., Rapid City, SD

Investigation of Contamination of Earthen Covers on Inactive Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 145-154) (1984, February)

The upward migration of contaminants into earthen covers on uranium mill tailings was evaluated from chemical and isotopic analysis of 5- to 10-cm-sample intervals

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

through the cover and into the tailings at three locations on the Riverton pile. From 3% to 20% of the cover consisted of tailings as estimated from isotope ratios in solid samples from tailings, cover, and uncontaminated soil. The migration behavior of Th-230 was consistent at the three locations and varied from 2 to 23 pCi/g. Mobility appeared to be controlled by the solubility of thorium oxides and hydroxides. U-238, Ra-226, Mo, As, and Se showed significant chemical migration at one sampling location. The mobility of these elements appeared to be controlled by precipitation and adsorption on iron hydroxides and amorphous aluminosilicate components. Other contaminants, Al, Cr, Ni, and Co, were immobilized at the interface between the cover and tailings. (Auth)(PTO)

385

Butz, T.R., N.E. Dean, C.S. Bard, R.N. Helgerson, and J.G. Grimes, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, TN

Hydrogeochemical and Stream Sediment Detailed Geochemical Survey for Edgemont, South Dakota and Wyoming

GJBX-133(80); K/UR-38; 385 pp. (1980, May 31)

Results of the Edgemont detailed geochemical survey are reported. Field and laboratory data are presented for 109 groundwater and 419 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the survey area is provided, and pertinent geologic factors that may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwaters containing greater than or equal to 7.35 ppb uranium are presented in scattered clusters throughout the area sampled. Most of these groundwaters are from wells drilled where the Inyan Kara Group is exposed at the surface. The exceptions are a group of samples in the northwestern part of the area sampled and south of the Dewey Terrace. These groundwaters are also produced from the Inyan Kara Group where it is overlain by the Graneros Group and alluvium. The high uranium groundwaters along and to the south of the terrace are characterized by high molybdenum, uranium/specific conductance, and uranium/sulfate values. Many of the groundwaters sampled along the outcrop of the Inyan Kara Group are near uranium mines. Groundwaters have high amounts of uranium and molybdenum. Samples taken downdip are sulfide waters with low values of uranium and high values of arsenic, molybdenum, selenium, and vanadium. Stream sediments containing greater than or equal to 5.50 ppm soluble uranium are concentrated in basins draining the Graneros and Inyan Kara Groups. These values are associated with high values for arsenic, selenium, and vanadium in samples from both groups. Anomalous values for these elements in the Graneros Group may be caused by bentonite beds contained in the rock units. As shown on the geochemical distribution plot, high uranium values that are located in the Inyan Kara Group are almost exclusively draining open-pit uranium mines. (GRA)

386

Church, H.W., Sandia National Laboratories, Albuquerque, NM

Meteorological Tower Data: Grand Junction Tailings Site, Colorado, Final Report, January - August 1982

SAND-83-0434; 7 pp. (1983, March)

The 10 m tower system installed in 1981 at the Grand Junction abandoned uranium-mill-tailings pile continued to measure and record data through August 1982. This report presents these final data for calendar year 1982 along with some comments about the systems performance. (EDB)

387

Doane, R.W., and P.T. Perdue, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Radon and Radon Daughter Measurements in the ORNL Remedial Action Survey and Certification Activities (RASCA) Program

DOE/EML-416; CONF-8211115; Environmental Measurements Laboratory Indoor Radon Workshop, Proceedings of a Conference, New York, NY, November 30-December 1, 1982, 114 pp.; (p. 42) (1983, July)

The Remedial Action Survey and Certification Activities (RASCA) program at Oak Ridge National Laboratory (ORNL) uses a variety of methods to measure radon and radon daughter concentrations in air. These measurements are made in conjunction with comprehensive radiological surveys of vicinity properties in the Uranium Mill Tailings Remedial Action Program. Based on the results of these surveys, the U.S. Department of Energy can determine the potential for long-term health effects to the occupants and prioritize the need for remedial action. (BDC)(ARE)

388

Doty, B.P., and R.E. Versaw, Golder Associates, Inc., Denver, CO

Groundwater Conditions at the Grand Junction Uranium Mill Tailings Pile

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 329-338) (1984, February)

A detailed groundwater hydrology investigation was conducted at the Grand Junction uranium tailings pile, which is located immediately adjacent to the Colorado River. The pile is founded upon Colorado River alluvium underlain by Mancos Shale. Earlier studies have shown the bedrock units to have artesian heads greater than the ground surface. Seven new wells or clusters of wells were installed through and in the vicinity of the pile. These were hydraulically tested and sampled for water quality. Results indicated that alluvial groundwater flowing through saturated tailings at the base of the pile is reacting with the tailings to produce a chemically distinct water, more dominated by sodium and more saline than the upgradient water. There is a tendency for the more sodic groundwater to remain in the upper portions of the alluvial acquifer, at least near the pile. Although Co, Fe, Mn, Mo, Se, V, and Zn appear to be leached out of the tailings, elevated levels of these constituents do not extend for appreciable distances down-gradient. There appears to be a very minor increase in uranium concentration, due to leaching of the pile that extends unabated beyond the down-gradient extent of the investigation. The leaching of the pile is not thought to be a health hazard because the up-gradient groundwater is too saline for most uses, and the uranium content is not high enough for either toxic or radiometric hazard. (Auth)(BDC)

389

Edgar, T.V., J.D. Nelson, and D.B. McWhorter, University of Wyoming, Laramie, WY; Colorado State University, Fort Collins, CO

Modeling Equilibrium Water Contents and Deformation in UMTRAP Inactive Uranium Mill Tailings Impoundments

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 549-558) (1984, February)

Water movement in tailings and covers has a significant influence on the soil deformation which will take place. Water may move both in liquid and vapor phases. The phase change which takes place during evaporation within the pores and at the surface can alter the temperature of the profile and affect the flow. Therefore, a model which determines the deformation of a soil in a partially saturated state should consider heat as well as liquid and vapor flow. A model was developed which considers these effects in a deforming soil. A set of governing equations was derived using a coordinate system related to the soil particles. This coordinate system was used because the flow of water and heat are functions of their locations relative to the soil particles and not to a location fixed in space. The governing equations were approximated by a finite difference model which can be solved for various boundary conditions. By assuming reasonable values for the environmental boundary conditions and several soil parameters, the long-term effects of the placement of covers on tailings piles was investigated. Several example solutions are presented to demonstrate the effect of different parameters on long-term water contents and deformation of tailings surfaces. (Auth)

390

Flynn, K.F., A.L. Justus, C.M. Sholeen, W.H. Smith, and R.A. Wynveen, Argonne National Laboratory, *Occupational Health and Safety Division*, Argonne, IL

Radiological Survey of Shiprock Vicinity Property SH01, Shiprock, New Mexico, August-November 1982

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

DOE/NE-SH01; ANL-OHS/HP-84-SH01; 66 pp. (1984, April)

At the request of the U.S. Department of Energy, a detailed radiological assessment of the vicinity properties of Shiprock was conducted by Argonne National Laboratory. As part of that assessment, a comprehensive survey of the vicinity property designated as "SH01" was conducted on an intermittent basis from August 23 to November 11, 1982. At the time of the survey, three structures were located on the property - two residential structures and a residential trailier. In addition to the three residences, the frame from a former truck scale was still on the property. The lands surrounding the structure and former truck scale were sparsely covered with vegetation. The assessment activities included determination of indoor and outdoor surface radiation levels through direct instrument surveys and analysis of air and soil samples. No evidence of radioactive contamination was found inside the structures, although elevated levels of radioactivity resulting from proximity to, or shine from, contaminated soils were indicated within all. Short-term radon daughter measurements did not exceed the 0.02 WL limit for average annual concentrations including background as specified in the EPA standard 40 CFR 192.12. The assessment indicated elevated levels of radioactivity in the outdoor environs, encompassing about 32,000 sq ft of land surrounding, and north of, the former truck scale. Analysis of a surface soil sample collected from the environs indicated a radium concentration considerably in excess of the limit of 5 pCi/g above background as specified in the EPA standard. Subsurface soil sampling was not conducted, thus the vertical extent of the radiological contamination is not known. Because the surface soil contamination levels exceeded the limits specified in the EPA standard, remedial action for this vicinity property should be considered. (Auth)(PTO)

391

Flynn, K.F., A.L. Justus, C.M. Sholeen, W.H. Smith, and R.A. Wynveen, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Radiological Survey of Shiprock Vicinity Property SH03, Shiprock, New Mexico, July-November 1982

DOE/NE-SH03; ANL-OHS/HP-84-SH03; 72 pp. (1984, April)

At the request of the U.S. Department of Energy, a detailed radiological assessment of the vicinity properties of Shiprock was conducted by Argonne National Laboratory. As part of that assessment, a comprehensive survey of the vicinity property designated as "SH03" was conducted on an intermittent basis from July 26 to November 11, 1982. At the time of the survey, three structures were located on the property: a residential trailer; the main structures (a wooden building housing a thrift shop); and an old gas pump housing. The lands surrounding the structures were either sparsely covered with arid vegetation or paved. The assessment activities included determination of indoor and outdoor surface radiation levels, for both fixed and removable contamination, through direct instrument and smear survey; measurement of ambient external penetrating radiation levels at 1-meter heights; and analyses of air, soil, and other material samples. No evidence of radioactive contamination was found inside the trailer. However, the results of the radiological assessment did indicate the occurrence of elevated levels of gamma, surface alpha, and radon daughter radioactivity within the main structure. Short-term radon daughter measurements within the structures exceeded the 0.02 WL limit for average annual concentrations including background as specified in the EPA standard 40 CFR 192.12. The elevated radiation levels are believed to be caused by the presence of material containing radium-226 underneath, or directly adjacent to, the concrete foundation, encompassing generally the southern half of the structure, an area of about 1900 sq ft. The assessment also indicated elevated levels of radioactivity in the outdoor environs, encompassing about 32,000 sq ft of the grounds adjacent to and surrounding the main structure on the east, south, and west sides. The contamination appeared to result from unprocessed uranium ore. Analysis of surface soil samples collected from the environs indicated radium concentrations in excess of the limit of 5 pCi/g above background specified in the EPA standard. Subsurface soil sampling was not conducted, and thus the vertical extent of the radiological contamination is not known. Because the surface soil contamination levels exceeded the limits specified in the EPA standard, remedial action for this vicinity property should be considered. (Auth)(PTO)

392

Flynn, K.F., A.L. Justus, C.M. Sholeen, W.H. Smith, and R.A. Wynveen, Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

Radiological Survey of Shiprock Vicinity Property SH12, Shiprock, New Mexico, October-November 1982

DOE/NE-SH12; ANL-OHS/HP-84-SH12; 74 pp. (1984, April)

At the request of the U.S. Department of Energy, a detailed radiological assessment of the vicinity properties of Shiprock was conducted by Argonne National Laboratory. As part of that assessment, a comprehensive survey of the vicinity property designated as "SH12" was conducted on an intermittent basis from October 27 to November 22, 1982. At the time of the survey, several exhibition halls and concession stands, an auction yard, a race track and rodeo area with associated stands, shutes, and corrals; and a hogan were located on the property. The surrounding environs were either sparsely covered with arid vegetation or covered with gravel. The assessment activities included: determination of indoor and outdoor surface radiation levels, for both fixed and removable contamination, through direct instrument and smear survey; measurement of ambient external penetrating radiation levels at 1-meter heights; and analyses of air, soil, and other material samples. The radiological assessment indicated elevated levels of radioactivity within only one of the structures. This involved an area of about 480 sq ft at the rear of the Arts and Crafts Hall. Gamma radiation exposure rates there reached 5 uR/hr above background, less than the 20 uR/hr above background limit specified in the EPA standard (40 CFR 192.12). Background levels of radioactivity were indicated within all other structures. Short-term radon daughter measurements within the structures did not exceed the 0.02 WL limit for average annual concentrations including background as specified in the EPA standard 40 CFR 192.12. The assessment indicated elevated levels of radioactivity at the rodeo arena and nearby shutes and corrals, encompassing about 49,000 sq ft of land. Radiochemical analysis of the soil sample collected from this general area indicated 23 plus or minus 2 pCi/g for radium, which is in excess of the limit of 5 pCi/g above background, averaged over the top 15 cm of soil below the surface, as specified in Section 192.12 of the EPA standard. Elevated levels of radioactivity were also found at the southern end of the west parking lot, encompassing about 7500 sq ft of land, and at several areas in the southern section of the property, encompassing about 160,000 sq ft of land. Radiochemical analyses of two of the soil samples collected from the southern section indicated radium concentrations of 43 plus or minus 5 pCi/g, and 42 plus or minus 5 pCi/g of soil, in excess of the limit of 5 pCi/g above background as specified in the EPA standard. Subsurface soil sampling was not conducted, and thus the vertical extent of the radiological contamination is not known. Because the surface soil contamination levels exceeded the limits specified in the EPA standard, remedial action for this vicinity property should be considered. (Auth)(PTO)

393
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, Grand Junction Site, Grand Junction, Colorado

DOE/UMT-0105; FBDU 360-09; 180 pp. (1981, July)

The Grand Junction, Colorado, 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. This assessment included preparation of topographic maps, performance of core drillings and radiometric measurements to determine areas and volumes of tailings and radiation, investigation of site hydrology and meteorology, and evaluation and costing of alternative corrective actions. Radon gas released from the tailings constitutes the most significant environmental impact, but windblown tailings and external gamma radiation are also factors. Alternative actions presented include millsite and offsite decontamination, with the addition of 3 m of stabilization cover material, and removal of the tailings to remote disposal sites with decontamination of the tailings site. Cost estimates for the options range from about \$10,200,000 for stabilization in-place to about \$39,500,000 for disposal in the DeBeque area, using rail transportation. Heap leaching, treatment at an existing mill and reprocessing at a new conventional mill constructed for that purpose were examined as alternatives for the reprocessing of the tailings. Cost of recovered uranium would be about \$200/lb by heap leach and \$150/lb by conventional plant processes. In 1981, the spot market price for uranium was \$25/lb. (Auth)(BDC)

394
Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Grand Junction Site, Grand Junction, Colorado

DOE/UMT-0105S; FBDU 360-09S; 36 pp. (1981, July)

The Grand Junction Site was reevaluated to revise the October 1977 engineering assessment of problems resulting from the existence of radioactive uranium mill tailings. This current engineering 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. Radon gas released from the 1.9 million tons of tailings at the site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation are also factors. The eight alternative actions presented range from millsite and off-site decontamination with the addition of 3 m of stabilization cover material, to removal of the tailings to remote disposal sites and decontamination of the tailings. Cost estimates for the eight options range from about $10,200,000 for stabilization in-place to about $39,500,000 for disposal in the DeBeque area, at a distance of about 35 miles, using transportation by rail. Cost for transportation by truck to the area would be about $41,900,000. Three alternatives for reprocessing of the tailings were examined: heap leaching; treatment at an existing mill; and reprocessing at a new conventional mill constructed for tailings reprocessing. Cost of the uranium recovered would be about $200/lb by heap leach and $150/lb by conventional plant processes. The spot market price for uranium was $25/lb in early 1981 making reprocessing not economically feasible. (Auth)(MFB)(BDC)

395

Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Inactive Uranium Mill Tailings, New and Old Rifle Sites, Rifle, Colorado

DOE/UMT-0108; FBDU 360-10; 209 pp. (1981, August)

The New and Old Rifle, Colorado, 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. Evaluation has included the preparation of topographic maps, the performance of core drillings and radiometric measurements to determine areas and volumes of tailings and radioactivity, the investigation of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. Radon gas released from the tailings constitutes the most significant environmental impact, but windblown tailings and external gamma radiation are also factors. Alternative actions presented include stabilization of the sites in their present locations with the addition of 3 m of stabilization cover material, and the removal of the tailings to disposal sites with decontamination of the sites. Cost estimates range from about $14,700,000 for stabilization in-place to about $39,800,000 for disposal in the DeBeque area, using rail transportation. Reprocessing alternatives of the tailings include heap leaching, treatment at an existing mill, or reprocessing at a new conventional mill constructed for that purpose. Cost of recovered uranium would be about $52/lb by heap leach and $35/lb by conventional plant processes. In early 1981, the spot market price for uranium was $25/lb. Reprocessing would be economically feasible only if the market price rose or if the rate of recovery could be improved. (Auth)(BDC)

396

Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings - New and Old Rifle Sites, Rifle, Colorado

DOE/UMT-0108S; FBDU 360-10S; 65 pp. (1981, August)

The New and Old Rifle sites were reevaluated to revise the October 1977 engineering assessment of problems resulting from the existence of radioactive uranium mill tailings at the sites. The evaluation included the preparation of topographic maps, the performance of core drillings and radiometric measurements to determine areas and volumes of tailings and radiation exposures to individual and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative remedial actions. Radon gas released from the tailings and contaminated wastes at

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

the sites constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. Alternative actions presented in this assessment range from stabilization in place with the addition of cover materials to removal of the tailings to disposal sites along with decontamination of the sites. Three alternatives for reprocessing of the tailings are examined: heap leaching; treatment at an existing mill; and reprocessing at a new conventional mill constructed for tailings reprocessing. Studies showed that reprocessing is not economically feasible. (Auth) (BDC)

397

Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Engineering Assessment of Radioactive Sands and Residues, Lowman Site, Lowman, Idaho

DOE/UMT-0118; FBDU 360-17; 137 pp. (1981, September)

The Lowman, Idaho, site was reevaluated in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive sands and residues. The assessment included the preparation of topographic maps, the performance of core drillings and radiometric measurements, the investigation of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from sands, residues, and contaminated soils constitutes the most significant environmental impact, although windblown sands and external gamma radiation are also factors. Alternative actions presented ranged from millsite and offsite decontamination, with the addition of 3 m of stabilization cover material, to removal of the radioactive sands to remote sites and decontamination of the former site. Cost estimates of the options ranged from about $2,500, 000 for stabilization in-place, to about $6,000,000 for disposal at a distance of about 15 miles. Reprocessing the radioactive sands for uranium recovery is not practicable. (Auth)(BDC)

398

Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Reduction of Radon Daughter Concentrations in Structures

UMTRA-DOE/ALO-189; 97 pp. (1982, December)

A structure was identified in Salt Lake City in which uranium mill tailings had been used in the construction and in which unusually high levels of radon daughter concentrations (RDCs) existed. The physical and radiological characteristics of the structure were assessed. Ventilation techniques were investigated to assess their effectiveness in reducing RDCs. A preferred set of equipment was identified, installed in the structure, and operated, to reduce RDCs. Parametric studies were conducted to determine if supplying fresh air or recirculating air through electrostatic precipitators was more effective in reducing RDCs. Fresh air was found to be more effective. RDCs were reduced to levels at or near the target of 0.03 WL under optimal ventilation conditions. Natural gas consumption with the new equipment was found to be about 39% higher than with the original equipment, and electrical energy usage and electrical demand were respectively 50% and 44% higher with the new equipment. (Auth)(BDC)

399

Freeman, H.D., J.N. Hartley, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Radon Barrier Field-Test Monitoring at Grand Junction Tailings Pile

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 277-285) (1984, February)

A development program for conducting three large-scale field tests of radon covers at the uranium mill tailings pile in Grand Junction, Colorado, has been developed. The barrier systems, monitored for radon flux for over two years, include earthen, multilayer, and asphalt emulsion covers. Results of the monitoring have shown that a variety of cover systems can meet the U.S. Environmental Protection Agency standard. The most effective covers tested were asphalt emulsion and earthen (Mancos shale). (Auth)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

400
Ganley, M.

More than 8,000 New Candidates Emerge for DOE's Remedial Mill Tailings Program

Nuclear Fuel 9(5):13-14 (1984, February 27)

The Department of Energy has published a list of 8,156 properties which may be eligible for remedial action under the Uranium Mill Tailings Radiation Control Act of 1978. Upon completion of surveys to determine whether levels of radioactivity exceed EPA radiation standards, it is estimated that between 5,000 to 6,000 properties will be on the final cleanup list. (BDC)(ARE)

401
GeoMetrics, Inc., Sunnyvale, CA

Aerial Gamma-Ray and Magnetic Survey, Raton Basin Project, Volume 2: Shiprock Quadrangle, Arizona/New Mexico - Final Report

GJBX-116(79) (Vol. 2); 294 pp. (1979, June)

The Shiprock 1-deg-by-2-deg sheet covers portions of five major tectonic features: (1) San Juan Basin, (2) De Chelly Uplift, (3) Black Mesa Basin, (4) Defiance Uplift, and (5) Monument Uplift. Mesozoic sedimentary rocks dominate the lithology of the quadrangle. Scattered tertiary volcanics are present. Uranium is being produced from epigenetic deposits in the Triassic Chinle and Jurassic Morrison Formations. A total of 130 statistical anomalies were defined, of which a representative number are discussed. Only a small proportion of the anomalies were associated with known districts. The bulk of the anomalies were not associated with geologic units known to produce uranium elsewhere. The largest number of anomalies occurred in the Menefee Formation of Cretaceous age, although the highest count rate averages were observed in volcanics. The single largest anomaly appears associated with a mine location. Magnetic data, in general, define major structure but only marginally reflect structural features in the overlying sediments. (GRA)

402
Grant, M.W., G.B. Merrell, V.C. Rogers, and K.K. Nielson, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Performance and Cost of Uranium Mill Tailings Containment Systems - The PACUTS Computer Program

UMTRA-DOE/ALO-35; RAE-27; 212 pp. (1983, March)

A systems performance and cost model has been developed for the Inactive Uranium Mill Tailings Remedial Action Program. The major pathways for impacts from a uranium mill tailings containment system are: radon migration, gamma ray exposure, and groundwater contamination. Moisture balance and containment system physical stability calculations are also performed. One of the important features of the model is its explicit consideration of interactions among the major components of the disposal system. The interactive nature of the model allows for estimating the balance among competing requirements for disposal system components and, as such, is useful for analyzing the conceptual design of remedial action alternatives. The design analysis capability is further enhanced by the costing component of the program which includes cost considerations in the conceptual design analyses. Consequently, cost-effectiveness tradeoffs can be readily evaluated for alternative system or component designs. (Auth)

403
Hans, J.M., Jr., and B. Benally, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Whole Body Gamma Ray Exposures to Personnel Decontaminating a Uranium Millsite

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 701-706)()

Decontamination of the former Shiprock uranium millsite and the interim stabilization of its tailings piles began in March 1974, and ended in June 1978. Personnel monitoring for whole body gamma-ray exposure was conducted for selected individuals working at the site during this period. Exposure rates received by workers were divided into the relative exposure rate ranges - high (working with tailings), intermediate (working in mill and ore storage yards), and low (perimeter areas). Adjusted exposure rates for these ranges were 134, 37, and 12 uR/hr, respectively. (BDC)

404
Hans, J.M., Jr., and T.L. Hurst, U.S. Environmental Protection Agency, Las Vegas, NV

Gamma Exposure Rate Reduction and Residual Radium-226 Concentrations Resulting from Decontamination Activities Conducted at the Former Uranium Millsite in Shiprock, New Mexico

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 913-926) (1981)

Gamma radiation surveys and residual radium-226 soil samples were taken as part of the decontamination activities of the former Shiprock uranium mill site in New Mexico. To facilitate the decontamination activities, the mill site and its contaminated environs were divided into six major areas. Extensive data are presented in two appendices of the pre- and post-decontamination gamma-ray exposure rates made on mill site and of radium-226 concentrations in surface soil samples. A training program established on the mill site by the Navajo Engineering and Construction Authority is described. (EDB) (KRM)

405
Harley, N.H., and M. Maiello, New York University, School of Medicine, Institute of Environmental Medicine, New York, NY

An Integrating Radon Monitor Utilizing the Electret

DOE/EML-416; CONF-8211115; Environmental Measurements Laboratory Indoor Radon Workshop, Proceedings of a Conference, New York, NY, November 30-December 1, 1982, 114 pp.; (p. 39) (1983, July)

This investigation was conducted in Uravan, Colorado, for the purpose of studying the distribution of radon daughter exposures in homes typical of the 1935-1966 period. The integrating monitor that was developed is essentially a miniature version of the EML PERM with a few modifications. To fully determine its characteristics, calibration is being conducted in the EML radon calibration facility. (BDC)(EST)

406
Haywood, F.F., G.D. Kerr, and W.A. Goldsmith, Oak Ridge National Laboratory, Oak Ridge, TN

Measurements of Radon Daughter Concentrations in Structures Built on or Near Uranium Mine Tailings

CONF-761071; Personal Dosimetry and Area Monitoring Suitable for Radon and Daughter Products, Proceedings of a Specialist Meeting, Ontario, Canada, October 4-8, 1976; (pp. 219-229) (1977)

A technique is discussed that has been used to measure air concentrations of short-lived daughters of radon-222 in residential and commercial structures built on or near uranium mill tailings in the western part of the United States. In this technique, the concentrations of radon-A, radon-B and radon-C are calculated from one integral count of the radon-A and two integral counts of the radon-C alpha-particle activity collected on a filter with an air sampling device. A computer program, written in BASIC, was used to calculate the concentrations of radon-A, radon-B and radon-C in air and to estimate the accuracy in these calculated concentrations. Alpha-particle spectrometers used to count activity on air filters and the results of radon daughter measurements in Colorado, Utah, and New Mexico are also discussed. Results of these and other measurements are now being used in a comprehensive study of potential radiation exposures to the public from uranium mill tailing piles. (EDB) (JMF)(ARE)

407
High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Monument Valley A and B, Utah, Detail Area - Volume 1, Final Report

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

GJBX-26-83 (Vol. 1); 96 pp. (1983)

Data were collected by a helicopter, equipped with a gamma-ray spectrometer with a large crystal volume, and with a high-sensitivity proton precession magnetometer. The radiometric system was calibrated at the Walker Field Calibration pads and the Lake Mead Dynamic Test Range. Data quality was ensured during the survey by daily test flights and equipment checks. Radiometric data were corrected for live time, aircraft and equipment background, cosmic background, atmospheric radon, Compton scatter, and altitude dependence. The corrected data were statistically evaluated, gridded, and contoured to produce maps of the radiometric variables -- uranium, potassium, and thorium -- their ratios; and the residual magnetic field. These maps have been analyzed to produce a multivariant analysis contour map based on the radiometric response of the individual geological units. A geochemical analysis has been performed, using the radiometric and magnetic contour maps, the multivariant analysis map, and factor analysis techniques, to produce a geochemical analysis map for the area. Volume I contains a description of the systems used in the survey, a discussion of the calibration of the systems, the data collection procedures, the data processing procedures, the data presentation, the interpretation rationale, and the interpretation methodology. Separate Volumes II-A and II-B, for each detail area, contain the data displays and the interpretation results. (EDB)

408
High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Monument Valley A, Utah, Detail Area - Volume 2A, Final Report

GJBX-26-83 (Vol. 2A[MVA]); 540 pp. (1983)

Volume II-A contains appendices for: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data. (EDB)(ATT)

409
High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Monument Valley B, Utah, Detail Area - Volume 2A, Final Report

GJBX-26-83 (Vol. 2A[MVB]); 553 pp. (1983)

Volume II-A contains appendices for: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data. (EDB)(ATT)

410
High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Monument Valley A, Utah, Detail Area - Volume 2B, Final Report

GJBX-26-83 (Vol. 2B[MVA]); 283 pp. (1983)

Volume II-B contains appendices for: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps. (EDB)(ATT)

411
High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Monument Valley B, Utah, Detail Area - Volume 2B, Final Report

GJBX-26-83 (Vol. 2B[MVB]); 307 pp. (1983)

Volume II-B contains appendices for: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, and geochemical factor analysis maps. (ATT)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

412

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango A, B, C, and D, Colorado, Detail Area - Volume 1, Final Report

GJBX-31-83 (Vol. 1); 98 pp. (1983)

An airborne combined radiometric and magnetic survey was performed for the Department of Energy (DOE) over the Durango A, Durango B, Durango C, and Durango D Detail Areas of southwestern Colorado. The Durango A Detail Area is within the coverage of the Needle Mountains and Silverton 15' map sheets, and the Pole Creek Mountain, Rio Grande Pyramid, Emerald Lake, Granite Peak, Vallecito Reservoir, and Lemon Reservoir 7.5' map sheets of the National Topographic Map Series (NTMS). The Durango B Detail Area is within the coverage of the Silverton 15' map sheet and the Wetterhorn Peak, Uncompahgre Peak, Lake City, Redcloud Peak, Lake San Cristobal, Pole Creek Mountain, and Finger Mesa 7.5' map sheets of the NTMS. The Durango C Detail Area is within the coverage of the Platoro and Wolf Creek Pass 15' map sheets of the NTMS. The Durango D Detail Area is within the coverage of the Granite Lake, Cimarrona Peak, Bear Mountain, and Oakbrush Ridge 7.5' map sheets of the NTMS. Radiometric data were corrected for live time, aircraft and equipment background, cosmic background, atmospheric radon, Compton scatter, and altitude dependence. The corrected data were statistically evaluated, gridded, and contoured to produce maps of the radiometric variables, uranium, potassium, and thorium; their ratios; and the residual magnetic field. These maps have been analyzed in order to produce a multi-variant analysis contour map based on the radiometric response of the individual geological units. A geochemical analysis has been performed, using the radiometric and magnetic contour maps, the multi-variant analysis map, and factor analysis techniques, to produce a geochemical analysis map for the area. (EDB)

413

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango A, Colorado, Detail Area - Volume 2A, Final Report

GJBX-31-83 (Vol. 2A-DA); 520 pp. (1983)

This volume contains geology of the Durango A detail area, radioactive mineral occurrences in Colorado, and geophysical data interpretation. Eight appendices provide the following: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data. (EDB)

414

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango B, Colorado, Detail Area - Volume 2A, Final Report

GJBX-31-83 (Vol. 2A-DB); 422 pp. (1983)

The geology of the Durango B detail area, the radioactive mineral occurrences in Colorado, and the geophysical data interpretation are included in this report. Seven appendices contain: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, and test line data. (EDB)

415

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango C, Colorado, Detail Area - Volume 2A, Final Report

GJBX-31-83 (Vol. 2A-DC); 351 pp. (1983)

Geology of Durango C detail area, radioactive mineral occurrences in Colorado, and geophysical data interpretation are included in this report. Eight appendices provide: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, magnetic and ancillary profiles, and test line data. (EDB)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

416

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango D, Colorado, Detail Area - Volume 2A, Final Report

GJBX-31-83 (Vol. 2A-DD); 220 pp. (1983)

This volume contains geology of the Durango D detail area, radioactive mineral occurrences in Colorado, and geophysical data interpretation. Eight appendices provide: stacked profiles, geologic histograms, geochemical histograms, speed and altitude histograms, geologic statistical tables, geochemical statistical tables, magnetic and ancillary profiles, and test line data. (EDB)

417

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango A, Colorado, Detail Area - Volume 2B, Final Report

GJBX-31-83 (Vol. 2B-DA); 316 pp. (1983)

This volume comprises five appendices pertaining to the Durango A detail area: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, and radiometric contour maps. (EDB)

418

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango B, Colorado, Detail Area - Volume 2B, Final Report

GJBX-31-83 (Vol. 2B-DB); 234 pp. (1983)

This volume comprises magnetic and ancillary profiles for the Durango B detail area. (EDB)

419

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango C, Colorado, Detail Area - Volume 2B, Final Report

GJBX-31-83 (Vol. 2B-DC); 161 pp. (1983)

This volume comprises eight appendices containing the following information for the Durango C detail area: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps. (EDB)

420

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango D, Colorado, Detail Area - Volume 2B, Final Report

GJBX-31-83 (Vol. 2B-DD); 291 pp. (1983)

This volume comprises eight appendices containing the following information for the Durango D detail area: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps. (EDB)

421

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango A, Colorado, Detail Area - Volume 2C, Final Report

GJBX-31-83 (Vol. 2C-DA); 115 pp. (1983)

This volume contains three appendices: magnetic contour maps, multi-variant analysis maps, and geochemical factor analysis. These maps are of the Durango A detail area. (EDB)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

422

High Life Helicopters, Inc., Puyallup, WA; QEB, Inc., Lakewood, CO

Airborne Gamma-Ray Spectrometer and Magnetometer Survey: Durango B, Colorado, Detail Area - Volume 2C, Final Report

GJBX-31-83 (Vol. 2C-DB); 222 pp. (1983)

This volume contains eight appendices: flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multi-variant analysis maps, and geochemical factor analysis maps. These appendices pertain to the Durango B detail area.

423

Korte, N.E., and R. Thul, Bendix Field Engineering Corporation, Grand Junction, CO

United States Department of Energy Facilities - Grand Junction, Colorado, and Monticello, Utah: 1982 Environmental Monitoring Report

GJO-113(83); 36 pp. (1983, April)

The shallow gravel aquifer underneath the Grand Junction, Colorado, Department of Energy facility is contaminated by uranium mill tailings. According to Colorado water quality standards, the aquifer is unfit for agricultural use - the lowest-use classification. This report describes 1982 monitoring activities and the location and levels of contamination. The contaminated aquifer's threat to the nearby Gunnison River system is probably negligible, but this cannot be verified without additional testing. Because there were no significant process changes and because no significant air quality impacts were noted in previous years, no air quality data were obtained in 1982. The shallow aquifer underneath the Monticello, Utah, property is also contaminated by uranium mill tailings. The creek flowing through the property is contaminated at levels exceeding Utah water quality standards for several miles downstream. This report describes a portion of a much larger environmental study currently underway at the site. Levels of water contamination and radon emission probably require mitigation to meet State of Utah and federal regulations. (EDB)

424

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Geochemical Investigation of UMTRAP Designated Site at Durango, Colorado

UMTRA-DOE/AL-0227; DOE/UMT-0227; GECR-R-822; 85 pp. (1983, September)

This report is the result of a geochemical investigation of the former uranium mill and tailings site at Durango, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. This is one in a series of site specific geochemical investigations performed on the inactive uranium mill tailings included in the UMTRA Project. The objectives of the investigation are to characterize the geochemistry, to determine the contaminant distribution resulting from the former milling activities and tailings, and to infer chemical pathways and transport mechanisms from the contaminant distribution. The results will be used to model contaminant migration and to develop criteria for long-term containment media such as a cover system that is impermeable to contaminant migration. This report assumes a familiarity with hydrologic conditions of the site and the geochemical concepts underlying the investigation. The results reported are based on a sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples are water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The water extracts and solid samples were analyzed for the major and trace elements. A limited number of samples were analyzed for radiological components. The report includes the methods of sampling, sample processing, analysis, and data interpretation. Three major conclusions are: (1) carbonate salts and low TDS characterize the tailings; (2) the adjacent area and raffinate ponds contain contaminants deposited by a single event of fluid permeation of the soils; and (3) the Animas River adjacent to the site has elevated gross alpha activity, attributed to radium-226 in the sediments derived from the tailings or milling activities. (Auth)

425

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

Data for the Geochemical Investigation of UMTRAP Designated Site at Durango, Colorado

UMTRA-DOE/AL-0228; DOE/UMT-0228; GECR-R-8213; 57 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Durango, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. The methods of data interpretation and results of the investigation are described in the report, "Geochemical Investigation of UMTRAP Designated Site at Durango, Colorado." Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. A few samples were analyzed for radioisotopes. (Auth)

426
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Geochemical Investigation of UMTRAP Designated Site at Riverton, Wyoming

UMTRA-DOE/AL-0229; DOE/UMT-0229; GECR-R-823; 72 pp. (1983, September)

This report is the result of a geochemical investigation of the former uranium mill and tailings site at Riverton, Wyoming, performed under contract from the Department of Energy Uranium Mill Tailings Remedial Action (UMTRA) Project. This is one in a series of site specific geochemical investigations performed on the inactive uranium mill tailings included in the UMTRA Project. The objectives of the investigation are to characterize the geochemistry, to determine the contaminant distribution resulting from the former milling activities and tailings, and to infer chemical pathways and transport mechanisms from the contaminant distribution. The results will be used to model contaminant migration and to develop criteria for long-term containment media, such as a cover system that is impermeable to contaminant migration. This report assumes a familiarity with the hydrologic conditions of the site and the geochemical concepts underlying the investigation. The results reported are based on a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples were water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The water extracts and solid samples were analyzed for the major and trace elements. A limited number of samples were analyzed for radiological components. The report includes the methods of sampling, sample processing, analysis, and data interpretation. Four major conclusions are: (1) salts containing uranium, vanadium, radium, and other contaminants have migrated to the surface and have activities and concentrations nearly as great as those within the tailings; (2) contaminants have migrated about 1 m into the soils below the tailings but were retarded by the precipitation as carbonates, hydroxides, and oxides; (3) the soils off the northeast corner of the tailings are contaminated with uranium, nickel, aluminum, and iron which were deposited by a single event of fluid transport; and (4) the surface and shallow subsurface waters adjacent to the tailings are contaminated, but the source of contamination can not be conclusively related to the tailings. (Auth)

427
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Riverton, Wyoming

UMTRA-DOE/AL-0230; DOE/UMT-0230; GECR-R-8214; 54 pp. (1982)

This report contains the methods of collection and the data used in the geochemical investigation of the former tailings and raffinate pond sites at Riverton, Wyoming, performed under contract from the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. The methods of data interpretation and results of the investigation are described in the report, "Geochemical Investigation of UMTRAP Designated Site at Riverton, Wyoming". Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples are water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solid samples were analyzed for selected major and trace elements. A few samples were analyzed for radioisotopes. (Auth)

428

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Geochemical Investigation of UMTRAP Designated Site at Grand Junction, Colorado

UMTRA-DOE/AL-0231; DOE/UMT-0231; GECR-R-824; 84 pp. (1983, September)

This report is the result of a geochemical investigation of the former uranium mill and tailings site at Grand Junction, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. This is one in a series of site specific geochemical investigations performed on the inactive uranium mill tailings included in the UMTRA Project. The objectives of the investigation are to characterize the geochemistry, to determine the contaminant distribution resulting from the former milling activities and tailings, and to infer chemical pathways and transport mechanisms from the contaminant distribution. The results will be used to model contaminant migration and to develop criteria for long-term containment media such as a cover system that is impermeable to contaminant migration. This report assumes a familiarity with hydrologic conditions of the site and the geochemical concepts underlying the investigation. The results reported are based on a sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples are water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The water extracts and solid samples were analyzed for the major and trace elements. A limited number of samples were analyzed for radiological components. The report includes the methods of sampling, sample processing, analysis, and data interpretation. Four major conclusions are: (1) trace element concentrations in shallow subsurface waters adjacent to the tailings temporally vary up to an order of magnitude; (2) the riverbank soils and borehole waters are contaminated with uranium, radium, and trace elements from tailings solids and solutions discharged during the time the mill was active, however, the movement of contaminants toward the Colorado River does not appear to be significant; (3) the Colorado River adjacent to the tailings is not contaminated; and (4) trace metals have accumulated at both the tailings/cover interface and the tailings/soil interface because of precipitation reactions caused by chemical differences between the two materials. (Auth)

429

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Grand Junction, Colorado

UMTRA-DOE/AL-0232; DOE/UMT-0232; GECR-R-8215; 33 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings and raffinate pond sites at Grand Junction, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. The methods of data interpretation and results of the investigation are described in the report, "Geochemical Investigation of UMTRAP Designated Site at Grand Junction, Colorado." Data are from a duplicate sampling of surface and subsurface waters from the background and the area adjacent to the site at high and low water conditions, representing temporal variations. Core sampling from the background, adjacent area, and site was not repeated. The solid samples were water extracted to remove easily soluble salts. The waters, extracts, and solids were analyzed for selected major and trace elements. Gross alpha was determined in many of the water samples, and radium was determined in solids on and adjacent to the site. (Auth)

430

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Geochemical Investigation of UMTRAP Designated Site at Shiprock, New Mexico

UMTRA-DOE/AL-0233; DOE/UMT-0233; GECR-R-825; 56 pp. (1983, September)

This report is the result of a geochemical investigation of the former uranium mill and tailing site at Shiprock,

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

New Mexico, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. This is one in a series of site-specific geochemical investigations performed on the inactive uranium mill tailings included in the UMTRA Project. The objectives of the investigation are to characterize the geochemistry, to determine the contaminant distribution resulting from the former milling activities and tailings, and to infer chemical pathways and transport mechanisms from the contaminant distribution. The results will be used to model contaminant migration and to develop criteria for long-term containment media such as a cover system that is impermeable to contaminant migration. This report assumes a familiarity with hydrologic conditions of the site and the geochemical concepts underlying the investigation. The results reported are based on a sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples are water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The waters, water extracts, and solid samples were analyzed for the major and trace elements. The report includes the methods of sample processing, analysis, and data interpretation. Major conclusions are that: (1) there is no contamination of the San Juan River; (2) there are traces of tailings at the base of the bluff below the tailings; (3) there is surface contamination of uranium, vanadium, and associated trace metals in the drainage from the former ore storage area and in the flood plain below the upper tailings; (4) salts and associated trace metals migrate to the surface of the tailings; and (5) acid has penetrated the soils below the tailings; however, the trace metals have precipitated at the tailings/soil interface. (Auth)(CAJ)

431

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Shiprock, New Mexico

UMTRA-DOE/AL-0234; DOE/UMT-0234; GECR-R-8216; 61 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings and raffinate pond sites at Shiprock, New Mexico, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. The methods of data interpretation and results of the investigation are described in the report, "Geochemical Investigation of UMTRAP Designated Site at Shiprock, New Mexico." Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

432

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Geochemical Investigation of UMTRAP Designated Site at Salt Lake City, Utah

UMTRA-DOE/AL-0235; DOE/UMT-0235; GECR-R-326; 85 pp. (1983, September)

This report is the result of a geochemical investigation of the former uranium mill and tailings site at Salt Lake City, Utah, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. This is one in a series of site specific geochemical investigations performed on the inactive uranium mill tailings included in the UMTRA Project. The objectives of the investigation are to characterize the geochemistry, to determine the contaminant distribution resulting from the former milling activities and tailings, and to infer chemical pathways and transport mechanisms from the contaminant distribution. The results will be used to model contaminant migration and to develop criteria for long-term containment media such as a cover system that is impermeable to contaminant migration. This report assumes a familiarity with hydrologic conditions of the site and the geochemical concepts underlying the investigation. The results reported are based on a sampling of waters and solid material from the background, the area adjacent to the site, and the site. The solid samples are water extracted to remove easily soluble salts and acid extracted to remove carbonates and hydroxides. The water extracts and solid samples were analyzed for the major and trace elements. A limited number of samples were analyzed for radiological components. The report includes the methods of sampling, sample processing, analysis, and data interpretation. Four major conclusions are: (1) sediments in the ditches and creeks adjacent to the site contain tailings, however, the waters were generally not contaminated; (2) tailings are mixed with the soils within a meter below the tailings in some locations, however, water-soluble contaminants decrease to below background levels within 30 cm below the tailings; (3) there has not been significant acid seepage into the soils below the tailings; and (4) salt crusts on the tailings contain trace elements, with the elements that form chloride complexes having the greatest accumulation. (Auth)

433

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Salt Lake City, Utah

UMTRA-DOE/AL-0236; DOE/UMT-0236; GECR-R-8217; 58 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings and raffinate pond sites at Salt Lake City, Utah, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. The methods of data interpretation and results of the investigation are described in the report, "Geochemical Investigation of UMTRAP Designated Site at Salt Lake City, Utah." Data are from samplings of surface and subsurface waters, sediments and core samples from the background, the area adjacent to the site, and the tailings site. The solid samples were water extracted to remove easily soluble salts. The waters, extracts, and solids were analyzed for selected major and trace elements. Gross alpha was determined in many of the water samples, and radionuclides were determined in solids on and adjacent to the site. (Auth)

434

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Data for the Geochemical Investigation of UMTRAP Designated Site at Rifle, Colorado

UMTRA-DOE/AL-0238; DOE/UMT-0238; GECR-R-833; 95 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings sites at Rifle, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

435

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Gunnison, Colorado

UMTRA-DOE/AL-0239; DOE/UMT-0239; GECR-R-834; 45 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Gunnison, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

436

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Ambrosia Lake, New Mexico

UMTRA-DOE/AL-0240; DOE/UMT-0240; GECR-R-835; 38 pp. (1983, September)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

This report contains the geochemical data and the methods of data collection from the former tailings site at Ambrosia Lake, New Mexico. The data are from a one-time sampling of the soils and waters from the tailings pile, its adjacent area, and its background. Selected waters, extracts of solids, and solid samples were chemically analyzed for major and trace elements. The objectives of the study were to characterize the geochemistry of the tailings materials, to determine the contaminant distribution resulting from the former milling activities and the tailings, and to infer chemical pathways and transport mechanism from the contaminant distribution. The characterization study was omitted, however, and this data report represents the final product. (Auth)

437

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Falls City, Texas

UMTRA-DOE/AL-0241; DOE/UMT-0241; GECR-R-836; 26 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Falls City, Texas, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters and extracts were analyzed for selected major and trace elements. (Auth)

438

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Tuba City, Arizona

UMTRA-DOE/AL-0242; DOE/UMT-0242; GECR-R-837; 57 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Tuba City, Arizona, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

439

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Lakeview, Oregon

UMTRA-DOE/AL-0243; DOE/UMT-0243; GECR-R-838; 33 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Lake view, Oregon, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts and acid extracted to remove carbonates and hydroxides. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

440

Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Green River, Utah

UMTRA-DOE/AL-0244; DOE/UMT-0244; GECR-R-839; 14 pp. (1983, September)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Green River, Utah, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The water samples were analyzed for selected major and trace elements. (Auth)

441
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Slick Rock, Colorado

UMTRA-DOE/AL-0245; DOE/UMT-0245; GECR-R-8310; 29 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Slick Rick, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts. The waters and extracts of solids samples were analyzed for selected major and trace elements. (Auth)

442
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Maybell, Colorado

UMTRA-DOE/AL-0246; DOE/UMT-0246; GECR-R-8311; 15 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Maybell, Colorado, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The water samples were analyzed for selected major and trace elements. (Auth)

443
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Monument Valley, Arizona

UMTRA-DOE/AL-0247; DOE/UMT-0247; GECR-R-8312; 15 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings and raffinate pond sites at Monument Valley, Arizona, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts. The waters, extracts, and solids samples were analyzed for selected major and trace elements. (Auth)

444
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Converse County, Wyoming

UMTRA-DOE/AL-0248; DOE/UMT-0248; GECR-R-83133; 15 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings site at Converse County, Wyoming, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. Selected solid samples were water extracted to remove soluble salts. The waters and extracts of solids samples were analyzed for selected major and trace elements. (Auth)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

445
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Data for the Geochemical Investigation of UMTRAP Designated Site at Lowman, Idaho

UMTRA-DOE/AL-0249; DOE/UMT-0249; GECR-R-8314; 14 pp. (1983, September)

This report contains the methods of collection and the data used in the geochemical investigation for the former tailings sites at Lowman, Idaho, performed under contract with the U.S. Department of Energy, Uranium Mill Tailings Remedial Action (UMTRA) Project. Data are from a one-time sampling of waters and solid material from the background, the area adjacent to the site, and the tailings site. The water samples were analyzed for selected major and trace elements. (Auth)

446
Mason, W.C., and D.M. Ball, Weston (Roy F.), Inc., Albuquerque, NM; U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Overview - Canonsburg, Pennsylvania UMTRA Site

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 433-442) (1984, February)

Processing of ores at this site goes back over 70 years. For 15 years, uranium oxide was extracted for use by the Atomic Energy Commission. The Uranium Mill Tailings Remedial Action Project will stabilize the residual radioactive materials on the site. Principal objectives of the remedial action include protection of groundwater, the long-term stability of the surface of the site, and the containment of radiological contamination. Most of the contaminated material at the site will be excavated and placed into an encapsulation cell. Radon emission and contact with groundwater will therefore be reduced to acceptable limits in compliance with the applicable U.S. Environmental Protection Agency standards. Site preparation activities began in October 1983, with major earth moving activities planned to begin in April, 1984, and completion in the summer of 1985. Cleanup of vicinity properties began in October 1982 and will continue into 1985. Vicinity properties are the properties on which residual radioactive material from the site have been used as construction or fill material. (Auth)

447
Narasimhan, T.N., T. Tokunaga, A.F. White, and A.R. Smith, Lawrence Berkeley Laboratory, Earth Sciences Division, Berkeley, CA

Mathematical Simulation of Contaminant Distribution in and Around the Uranium Mill Tailing Piles, Riverton, Wyoming

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 197-207) (1984, February)

Field data from the Riverton, Wyoming, site were used in mathematical modeling efforts to address questions concerning the transport of contaminants in the groundwater system as well as the dynamic soil-water regime near the upper boundary of the tailings pile. This paper presents a description of the key mathematical issues, the models needed to address these issues, and a discussion of the model results. (BDC)

448
Nelson, R.A., Jacobs Engineering Group, Inc., Albuquerque, NM

Recommendations for Ambient Radon Monitoring Around UMTRA Project Sites

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 287-295) (1984, February)

Standards for the UMTRA Project sites limit the ambient annual average radon concentration at the site boundary to less than 0.5 pCi/l above background. The major problem in demonstrating compliance with this

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

standard arises from the fact that the site-specific background levels were not determined prior to each site's initial construction and use. The influence of radon flux from the site makes determination of the present background values difficult. This is particularly important for sites which have other local sources of radon present, thus precluding estimation of site background by simply monitoring at large distances from the site. Specific recommendations of sampling and analysis methods which can be used to measure background at the site boundary are made for areas in which background varies with location. A case study of an UMTRAP site radon monitoring program is presented, with emphasis on determination of the annual average values of background and site contribution to the measured values. Recommendations are made of sampling intensity at high-, medium- and low-priority sites before, during, and after remedial action. The costs of each monitoring and analysis method are contrasted. (Auth)

449

Sandia National Laboratories, Albuquerque, NM

Summary Report on Reprocessing Evaluation of Selected Inactive Uranium Mill Tailings Sites

UMTRA-DOE/AL-0020 (1983, September)

The tailings at twelve UMTRAP sites were drilled, sampled, and tested. Mineral concentrations were determined, and evaluations indicated that at current market prices mineral recovery is not economically feasible. Environmental and engineering data were obtained, and support activities were performed. The program is described and results are summarized. (Auth)

450

Sandia National Laboratories, Albuquerque, NM

Contents of Environmental Impact Statements Prepared for the Uranium Mill Tailings Remedial Action Project

UMTRA-DOE/ALO-5; 21 pp. (1981, June)

This document presents an annotated outline that describes the contents of the environmental impact statements to be prepared for the Uranium Mill Tailings Remedial Action Project. The outline is intended to be flexible, with emphasis on a particular topic being left to the discretion of the author of each environmental impact statement. (Auth)(BDC)

451

Smith, G.N., R.E. Wardwell, and J.D. Nelson, Colorado State University, Department of Civil Engineering, Geotechnical Engineering Program, Fort Collins, CO

In Situ Strength Measurement at an Inactive UMTRAP Site

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 639-648) (1984, February)

This paper describes the use of a flat plate dilatometer (DMT) to measure the strength and compressibility of uranium tailings. Flat plate dilatometer tests were performed at the inactive impoundment at Riverton, Wyoming. The purpose and a brief history of the dilatometer are covered, as well as its basic operation and field use. The results from dilatometer tests are compared with standard geotechnical laboratory tests. The paper concludes with a summary of DMT and suggestions for future use of the dilatometer in obtaining strength and compressibility parameters on uranium impoundments. (Auth)

452

Stieff, L.R., Stieff Research and Development Company, Kensington, MD

A Feasibility Study of the Prompt Pb-214, Bi-214 Gamma Method for Measuring Radon Transport Gradients

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 307-316) (1984, February)

An experiment was performed to determine the feasibility of measuring the prompt Pb-214 gamma decay in

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

freshly collected tailings samples as a method of studying the undisturbed state of secular equilibrium between Ra-226 and Rn-222 at the time of and immediately preceding sample collection. Tailings pile core samples were collected from four layers of the sandbox, a special test area within the Grand Junction tailings pile, and immediately sealed in aluminum cans. Starting within 11 to 30 min of collection, a series of gamma spectral measurements using both NaI and Ge(Li) detectors were made to follow the prompt decay and subsequent buildup of Pb-214 and Bi-214. By observing the difference between the gamma count rate extrapolated to the time of sample collection and the final equilibrium count rate, a measure of the net loss or gain, if any, of Rn-222 that occurred in the sample during the 2 to 3 hr that preceded sample collection was obtained. Using this technique, it was found that at the time of collection, the two samples nearest the surface contained essentially unsupported Rn-222, one sample contained a net excess of Rn-222, four samples showed a net deficiency, and one sample contained Rn-222 and Ra-226, essentially in secular equilibrium. Although much additional work remains to be done, these preliminary data suggest that a technique may be developed to measure directly undisturbed radon transport gradients in uranium mill tailings piles, in different types of tailings pile covers, and in laboratory experiments. (Auth)

453

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Shiprock Site, Shiprock, New Mexico

UMTRA-DOE/ALO-172; 168 pp. (1982, December)

Investigation of the abandoned mill tailings at the Shiprock site was carried out. The Shiprock site was found to contain an estimated 2,658,603 dry short tons of tailings and subbase material containing 340,993 lb of U3O8, valued at $23/lb; 8,850,757 lb of V2O5, valued at $3/lb; and 165,254 lb molybdenum, valued at $8.50/lb. Based upon the low molybdenum grade and extractions, its recovery as a salable product was not warranted. The total production costs of uranium and vanadium recovery were estimated at $29,656,000, with a production sales value of $12,062,900. Reprocessing was not recommended. (BDC)(NPK)

454

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Gunnison Site, Gunnison, Colorado

UMTRA-DOE/ALO-173; 103 pp. (1982, December)

Investigation of the abandoned mill tailings at the Gunnison site was carried out. The Gunnison site was found to contain an estimated 738,368 dry short tons of tailings and subbase material containing 80,417 lb of U3O8, valued at $23/lb; 123,514 lb of V2O5, valued at $3/lb; and 46,101 lb of molybdenum. Quantities of vanadium and molybdenun were considered to be too low for recovery. The total cost for recovery of uranium was estimated to be $16,587,000, with a marketable production value of $1, 178,000. Reprocessing was not recommended. (BDC)

455

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Grand Junction Site, Grand Junction, Colorado

UMTRA-DOE/ALO-174; 156 pp. (1982, November)

The abandoned mill tailings at the Grand Junction, Colorado, site were investigated. The Grand Junction site was found to contain an estimated 2,220,671 dry short tons of tailings and subbase material containing 698,507 lb of U3O8, valued at $23/lb; 12,404,837 lb of V2O5, valued at $3/lb; and 71,215 lb of molybdenum valued at $8. 50/lb. Based upon the low molybdenum grade and extractions, its recovery was not warranted. The total production costs of uranium and vanadium were estimated to be $33,887,000, with a total sales value estimated to be $21,767,000. Reprocessing of Grand Junction tailings was not recommended. (BDC)(NPK)

456

Teel, J.H., Mountain Research and Development, Tucson, AZ

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

Economic Evaluation of Inactive Uranium Mill Tailings, Old Rifle Site, Rifle, Colorado

UMTRA-DOE/ALO-175; 139 pp. (1982, December)

Investigation of the abandoned mill tailings at the Old Rifle site was carried out. The Old Rifle site was found to contain an estimated 491,921 dry short tons of tailings and subbase material containing 370,449 lb of U3O8, valued at $23/lb; 1,372,612 lb of V2O5, valued at $3/lb; and 5,123 lb of molybdenum, valued at $8.50/lb. Because of the low molybdenum grade and extractions, its recovery was not warranted. Total production costs of uranium and vanadium recovery were estimated to be $18,511,000, with a production sales value estimated at $6,799,400. Reprocessing of the tailings was not recommended. (BDC)(NPK)

457
Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, New Rifle Site, Rifle, Colorado

UMTRA-DOE/ALO-176; 147 pp. (1982, December)

Investigation of abandoned mill tailings at the New Rifle site was carried out. The New Rifle site was found to contain an estimated 2,144,844 dry short tons of tailings and subbase material containing 739,849 lb of U3O8, valued at $23/lb; 18,147,395 lb of V2O5, valued at $3/lb; and 112,296 lb of molybdenum, valued at $8.50/lb. Quantities of vanadium and molybdenum available for recovery were considered to be low. Total production costs for uranium recovery were estimated to be $43,526,000, with a production sales value of $19,921,700. Reprocessing was not recommended. (BDC)(NPK)

458
Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Maybell Site, Maybell, Colorado

UMTRA-DOE/ALO-177; 111 pp. (1982, December)

Investigation of the abandoned mill tailings at the Maybell, Colorado, site was carried out. The Maybell site was found to contain an estimated 3,431,167 dry short tons of tailings and subbase material containing 761,363 lb of U3O8, valued at $23/lb; 663,171 lb of V2O5, valued at $3/lb; and 89,848 lb molybdenum, valued at $8.50/lb. Quantities of vanadium and molybdenum were considered to be too low for recovery. Total production cost of uranium recovery was estimated to be $38,018,000, with a marketable production value of $14,885,000. Reprocessing of the tailings was not recommended. (BDC)(NPK)

459
Teel, J.H., Mountain States Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Riverton Site, Riverton, Wyoming

UMTRA-DOE/ALO-178; 98 pp. (1982, December)

The abandoned uranium and vanadium mill tailings at the mill site in Riverton, Wyoming, were investigated. The Riverton site was found to contain an estimated 1,430,835 dry short tons of tailings and subbase material containing 237,873 lb of U3O8, valued at $23/lb; 975,060 lb of V2O5, valued at $3/lb; and 136,518 lb of molybdenum (as 95% MoS2), valued at $8.50/lb. The total cost of recovery was estimated at $29,239,000. Total value of recovered material was estimated at $4,381,770. Recovery efforts at this site were not recommended. (BDC)

460
Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Spook Site, Converse County, Wyoming

UMTRA-DOE/ALO-179; 93 pp. (1982, December)

Investigation of abandoned mill tailings at the Spook site was carried out. The Spook site was found to contain an estimated 90,389 dry short tons of tailings and subbase material containing 20,802 lb of U3O8, valued at $23/lb; 51,908 lb of V2O5, valued at $3/lb; and 586 lb of molybdenum, valued at $8.50/lb. Average site vanadium and molybdenum contents were considered too low for recovery. Total production costs for uranium recovery were estimated to be $1,132,700, with a production sales value of $411,500. Reprocessing was not recommended. (BDC)(NPK)

461

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Ambrosia Lake Site, Ambrosia Lake, New Mexico

UMTRA-DOE/ALO-180; 148 pp. (1982, December)

Investigation of abandoned mill tailings at the Ambrosia Lake site was carried out. The Ambrosia Lake site was found to contain an estimated 3,390,052 dry short tons of tailings and subbase material containing 749,313 lb of U3O8, valued at $23/lb; 4,937,441 lb of V2O5, valued at $3/lb; and 218,055 lb of molybdenum, valued at $8.50/lb. Quantities of vanadium and molybdenum available for recovery were considered to be low. Total production costs for recovery of uranium was estimated to be $25, 337,000, with a production sales value of $13,273,200. Reprocessing was not recommended. (BDC)

462

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Mexican Hat Site, Mexican Hat, Utah

UMTRA-DOE/ALO-181; 150 pp. (1982, December)

Investigation of the abandoned mill tailings at the Mexican Hat site was carried out. The Mexican Hat site was found to contain 2,205,779 dry short tons of tailings and subbase material containing 557,294 lb of U3O8, valued at $23/lb; 5,813,075 lb of V2O5, valued at $3/lb; and 211, 976 lb of molybdenum, valued at $8.50/lb. Quantities of vanadium and molybdenum available for recovery were considered to be low. Total production costs for recovery of uranium were estimated to be $39,033,000, with a production sales value of $14,758,655. Reprocessing was not recommended. (BDC)(NPK)

463

Teel, J.H., Mountain Research and Development, Tucson, AZ

Economic Evaluation of Inactive Uranium Mill Tailings, Tuba City Site, Tuba City, Arizona

UMTRA-DOE/ALO-182; 142 pp. (1982, December)

Investigation of the abandoned mill tailings at the Tuba City site was carried out. The Tuba City site was found to contain 886,153 dry short tons of tailings and subbase material containing 411,068 lb of U3O8, valued at $23/lb; 696,978 lb of V2O5, valued at $3/lb; and 166,744 lb of molybdenum, valued at $8.50/lb. Quantities of vanadium and molybdenum available for recovery were considered to be low. Total production costs of uranium recovery were estimated to be $20,735,000, with a marketable sales value of $6,262,100. Reprocessing was not recommended. (BDC)(NPK)

464

U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Environmental Assessment of Remedial Action at the Shiprock Uranium Mill Tailings Site, Shiprock, New Mexico - Volume 1: Text

DOE/EA-0232 (Vol. 1); 236 pp. (1984, May)

The report assesses and compares the environmental impacts of various alternatives for remedial action at the Shiprock uranium mill tailings site located on the Navajo Indian Reservation, south of Shiprock, New Mexico. The site contains 72 acres of tailings and four of the original mill buildings. The Uranium Mill Tailings Radiation

Control Act of 1978 (UMTRCA), Public Law 95-604, authorizes the U.S. Department of Energy to clean up the site to reduce the potential health impacts associated with the residual radioactive materials remaining at the site and at associated properties off the site. The U.S. Environmental Protection Agency promulgated standards for the remedial actions (40 CFR Part 192). Remedial actions must be performed in accordance with these standards and with the concurrence of the Nuclear Regulatory Commission. The proposed action is to stabilize the tailings at their present location by consolidating the tailings and associate contaminated soils into a recontoured pile. A 7-ft-thick radon barrier would be constructed over the piles and various erosion control measures would be taken to ensure the long-term integrity of the pile. Three other alternatives, which involve moving the tailings to new locations are assessed in this report. These alternatives generally involve greater short-term impacts and are more expensive but their implementation would result in the tailings being stabilized in a more remote location. The no-action alternative is also assessed. (Auth)(NPK)

465

U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Environmental Assessment of Remedial Action at the Shiprock Uranium Mill Tailings Site, Shiprock, New Mexico - Volume 2: Appendices

DOE/EA-0232 (Vol. 2); 236 pp. (1984, May)

Pursuant to the requirements of the Uranium Mill Tailings Radiation Control Act of 1974 (UMTRCA), the U.S. Environmental Protection Agency (EPA) has promulgated health and environmental standards to govern cleanup, stabilization, and control of residual radioactive materials at inactive uranium mill tailings sites. The promulgated standards establish requirements for long-term stability and radiation protection and provide procedures for ensuring the protection of groundwater quality. In developing the standards, EPA determined that the primary objective for control of tailings should be isolation and stabilization to prevent their misuse by man and dispersal by natural forces such as wind, rain, and flood waters and that a secondary objective should be to reduce radon emissions from tailings piles. A third objective should be the elimination of significant exposure to gamma radiation from tailings piles. These conclusions were based on a determination that the most significant public health risks associated with inactive tailings were posed by exposure to people living and working in structures contaminated by relocating tailings. EPA further concluded that the potential for contamination of groundwater and surface water should be evaluated on a site-specific basis. The EPA standards are summarized in a table in the appendices. Other topics in the appendices include: long-term stabilization, radon emissions control, water-quality protection, and cleanup of tailings. (Auth)(NPK)

466

U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Environmental Impact Statement Implementation Plan: EIS for Proposed Remedial Actions on Uranium Mill Tailings Located at or near Canonsburg, Pennsylvania

Report; 59 pp. (1982, February)

In December of 1980, Pennsylvania nominated seven areas within Washington County as possible disposal areas for the residues from Canonsburg's Vitro Rare Metals Plant. The last two nominated areas were considered by the state to meet their criteria for radioactive waste disposal; DOE, in an independent investigation, concurred. After distribution of the proposed plans to the public and other interested parties, an environmental impact statement was prepared to assess the environmental implications of remedial actions to be performed on the Canonsburg site and associated vicinity properties. The following alternatives were included in the EIS for comparative evaluation: no action; stabilization of all material at the Canonsburg site; stabilization in place at both Canonsburg and Burrell Township; decontamination of the Canonsburg and Burrell Township sites and transfer of all tailings to a new disposal site in Hanover Township; and disposal of Canonsburg material at a new disposal site in Hanover Township and stabilization of Burrell Township material at its present site. (BDC) (ARE)

467

U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

Criteria for Evaluating Disposal Sites for Wastes Transferred in Connection with the Uranium Mill Tailings Remedial Action Program (UMTRAP)

UMTRA-DOE/ALO-7; 35 pp. (1982, March)

The Department of Energy (DOE) criteria for evaluating potential disposal sites and some recommendations for their use in the site-evaluation process are described. The criteria proposed here are intended for use by cooperating agencies, state and local jurisdictions, or any persons who must recommend to DOE and other parties cooperating in the Uranium Mill Tailings Remedial Action Program (UMTRAP) real areas or locations in which the disposal sites may be placed. A justification for the criteria is supplied in the report which reviews standards, regulations, and other constraints on the remedial actions in the UMTRAP and discusses the implications of those constraints for site-evaluation criteria. Twenty-five criteria and recommendations for their use in the site-evaluation process are presented. For purposes of comparison, criteria actually used by the state of Utah in a preliminary selection of disposal sites for the Vitro tailings in Salt Lake City are attached in the Appendix. (Auth)(MFB)

468

U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Issues Final Environmental Impact Statement for Remedial Action at Canonsburg and Burrell Residual Radioactive Waste Sites

DOE News (August 11, 1983):1-5 (1983, August 11)

The Department of Energy has issued the Final Environmental Impact Statement on the options available for remedial actions on the residual radioactive waste sites at the former Vitro Rare Metals Plant in Canonsburg, Pennsylvania and at a railroad landfill in Burrell Township, Pennsylvania. (BDC)

469

U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Plans Data Collection at Inactive Mill Tailings Site Near Gunnison

DOE News (August 23, 1983):1-2 (1983, August 23)

The Department of Energy is planning a series of fact-finding studies to determine the physical characteristics of groundwater and soil in and around the inactive uranium mill tailings site near Gunnison, Colorado. Four different studies will be carried out and the data will be used to design remedial actions for the tailings pile. (BDC)

470

U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

Department of Energy Announces Change in Environmental Impact Statement Schedule

DOE News (October 19, 1983):1-2 (1983, October 19)

The Department of Energy has announced a change in the schedule for environmental documents for remedial actions at the Grand Junction and Rifle, Colorado inactive uranium mill tailings sites. The new schedule calls for further work on the documents to be postponed until January 1985, with remedial action on the tailings piles planned to start in the fall of 1986 at Grand Junction and the spring of 1987 at Rifle, as originally scheduled. (BDC)

471

U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE to Conduct Survey of Open Land at Durango Tailings Site

DOE News (October 25, 1983):1 (1983, October 25)

The Department of Energy has started a program of extensive survey and sampling of open land adjacent to the inactive uranium mill tailings site in Durango, Colorado. The survey will determine the extent of windblown material around the tailings pile. (BDC)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

472
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE to Conduct Informational Meeting on Gunnison Mill Tailings Site

DOE News (September 17, 1983):1 (1983, September 17)

The Department of Energy held an informational meeting in Gunnison, Colorado, regarding the inactive uranium mill tailings sites on September 21, 1983. The discussion covered various groundwater and soil sampling tests conducted at the site, a radiological survey, and future remedial action plans for stabilizing the tailings pile. (BDC)(ARE)

473
U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE to Conduct Survey of Open Land at Riverton Tailings Site

DOE News (September 2, 1983):1 (1983, September 2)

The Department of Energy has started a program of extensive survey and sampling of open land immediately adjacent to the inactive uranium mill tailings site near Riverton, Wyoming. The survey is designed to determine the extent of windblown material around the tailings pile. (BDC)(NPK)

474
U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

Processing Site Characterization Report - Canonsburg, Pennsylvania

UMTRA/DOE/AL-0041; 138 pp. (1984, May)

This report summarizes the existing data contained in reports produced for the UMTRA project that are pertinent to the assessment of existing conditions and the design of the remedial action plan for the Canonsburg site. Major sections include: site description, land survey data, radiation data, groundwater hydrology, surface-water hydrology, site geotechnical data, borrow area geotechnical data, meteorological data, and miscellaneous data. (Auth)

475
U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

Processing Site Characterization Report for the Uranium Mill Tailings Site at Shiprock, New Mexico

UMTRA/DOE/AL-0042; 153 pp. (1984, April)

This report summarizes the existing data contained in reports on the Shiprock, New Mexico, site produced for the UMTRA project that are pertinent to the assessment of existing conditions and the design of the remedial action plan. Major sections include: site description, land survey data, radiation data, groundwater hydrology, surface water hydrology, geotechnical data, borrow area geotechnical data, meteorological data, and miscellaneous data. The report contains the following appendices: Radium-226 Analysis for Shiprock Site Tailings Samples; Radiological Characterization of the Shiprock, New Mexico, Uranium Mill Tailings Remedial Action Site; Site Erosion Evaluation Report; and Evaluation of Potential Earthquake Events. (Auth)

476
U.S. Department of Energy, Washington, DC

Remedial Actions at the Former Vitro Rare Metals Plant Site, Canonsburg, Washington County, Pennsylvania - Final Environmental Impact Statement, Volume 1

DOE/EIS-0096-F (Vol. 1); 366 pp. (1983, July)

The environmental impacts associated with remedial actions in connection with residual radioactive materials remaining at the inactive uranium processing site located in Canonsburg, Washington County, Pennsylvania are evaluated. The Canonsburg site is an 18.5-acre property

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

that was formerly owned by the Vitro Rare Metals Company. The expanded Canonsburg site would be 30-acre property that would include the Canonsburg site (the former Vitro Rare Metals plant), seven adjacent private houses, and the former Georges Pottery property. During the period 1942 through 1957 the Vitro Manufacturing Company and its successor, the Vitro Corporation of America, processed onsite residues and ores, and government-owned ores, concentrates, and scraps to extract uranium and other rare metals. The Canonsburg site is now the Canon Industrial Park. In addition to storing the residual radioactive materials of this process at the Canonsburg site, about 12,000 tons of radioactively contaminated materials were transferred to a railroad landfill in Burrell Township, Indiana County, Pennsylvania. This Canonsburg FEIS evaluates five alternatives for removing the potential public health hazard associated with the radioactively contaminated materials. In addition to no action, these alternatives involve various combinations of stabilization of the radioactively contaminated materials in place or decontamination of the Canonsburg and Burrell sites by removing the radioactively contaminated materials to another location. In addition to the two sites mentioned, a third site located in Hanover Township, Washington County, Pennsylvania has been considered as a disposal site to which the radioactively contaminated materials presently located at either of the other two sites might be moved. (EDB)

477

U.S. Department of Energy, Washington, DC

Remedial Actions at the Former Vitro Rare Metals Plant Site, Canonsburg, Washington County, Pennsylvania - Final Environmental Impact Statement, Volume 2, Appendices

DOE/EIS-0096-F (Vol. 2); 421 pp. (1983, July)

This report provides a summary of the conceptual design and other information necessary to understand the proposed remedial action at the expanded Canonsburg, Pennsylvania site. This design constitutes the current approach to stabilizing the radioactively contaminated materials in place in a manner that would fully protect the public health and environment. This summary is intended to provide sufficient detail for the reader to understand the proposed remedial action and the anticipated environmental impacts. The site conceptual design has been developed using available data. In some cases, elements of the design have not been developed fully and will be made final during the detailed design process. (EDB)

478

U.S. Department of Energy, Washington, DC

Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah: Draft Environmental Impact Statement

DOE/EIS-0099-D; 465 pp. (1983, February)

This statement evaluates three alternatives for minimizing the public health hazards associated with the Vitro site contaminated materials: (1) no action, (2) stabilization of the contaminated material on the Vitro site, and (3) decontamination of the Vitro site and disposal of the contaminated material at a site located about one mile south of Clive, Utah. An assessment of the impacts of these three alternatives was made in terms of effects on radiation levels, air quality, soils and mineral resources, surface water and groundwater resources, ecosystems, land use, sound levels, historical and cultural resources, populations and employment, economic structures, and transportation networks. The main impact of alternative 1 is the 0.24 excess cancer death per yr predicted for the Salt Lake Valley population from the above-background levels of radon emitted by the Vitro site. Implementation of alternative 2 or 3 would reduce the existing radon levels to near background levels and eliminate the potential for incremental cancer deaths. Another impact of alternative 1 is the inhibition of an ongoing expansion of the CVWRF sewage-treatment plant to a capacity of 100 million gal per day by the year 2000; the CVWRF Board requires land in the northern half of the site to complete this expansion. Implementation of alternative 2 would allow the board to use 50% of the site while alternative 3 would release 100% of the site for board use. The major impacts of alternative 2 include: 0.34 expected excess cancer death among the general public; 0.02 expected cancer death and 0.04 expected death by occupational accidents among the remedial-action workers; the closing of businesses and demolition of buildings on a 5.4-a industrial strip located on the southwest side of the site; the importation by truck of about 1.9 million cu yd of soil, clay, and rock to the site; and the use of 5.9 million kW(e)/hr of electricity and 1.1 million gal of engine fuel. The major impacts of alternative 3 include: 0.34 expected excess cancer death among the general public; 0.06

expected cancer death and 0.07 expected death by occupational accidents among the remedial-action workers; permanent use of 200 a of Utah state lands at the site south of Clive; importation of about 1.1 million cu yd of soil to the site and 225 thousand cu yd of rock to the site south of Clive; and the use of 13.1 million kW(e)/hr of electricity and 3 million gal of engine fuel. (Auth)(MFB)

479
U.S. Department of Energy, Washington, DC

Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah - Final Environmental Impact Statement, Volume 1: Text

DOE/EIS-0099-F (Vol. 1); 237 pp. (1984, July)

This statement includes an evaluation of the environmental impacts associated with the cleanup of those residues remaining at the abandoned uranium mill tailings site located in South Salt Lake, Utah, referred to as the Vitro site. The site is a 128-acre plot containing about 2.5 million cu yd of contaminated residues and soil. The residues were produced between 1951 and 1964. The purpose of the actions analyzed in this EIS is to implement the remedial action program by stabilizing and controlling potentially hazardous radioactive materials associated with the former Vitro uranium mill, including those materials recovered in the cleanup of vicinity properties. (Auth)(PTO)

480
U.S. Department of Energy, Washington, DC

Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah - Final Environmental Impact Statement, Volume 2 - Appendicies

DOE/EIS-0099-F (Vol. 2); 278 pp. (1984, July)

The purpose of the actions analyzed in this EIS is to implement the remedial action program by stabilizing and controlling potentially hazardous radioactive materials associated with the former Vitro uranium mill, South Salt Lake, Salt Lake County, Utah, including those materials recovered in the cleanup of vicinity properties. This appendix provides the information needed to understand the conceptual designs for the remedial action alternatives addressed in this FEIS. The appendix is intended to provide sufficient detail for the reader to understand the remedial action alternatives and the anticipated environmental impacts; it is not intended to provide the detailed engineering necessary to implement the alternatives. (Auth)(PTO)(CAJ)

481
U.S. Department of Energy, Washington, DC

DOE Makes Available EIS Draft on Former Vitro Chemical South Salt Lake Inactive Uranium Mill Site, Utah

Federal Register 48(35):7294-7296 (1983, February 18)

The Department of Energy has published a draft environmental impact statement, (DEIS), DOE/EIS-0099D, "Remedial Actions at the Former Vitro Chemical Company Mill, South Salt Lake, Salt Lake County, Utah," (January 1983) in support of a DOE action to perform remedial activities on residual radioactive material at the inactive uranium mill in South Salt Lake, Utah. The DEIS evaluates the no-action alternative and two alternatives for minimizing the potential public health hazards associated with the contaminated materials at the Vitro site. The two alternatives are: (1) stabilization of the contaminated material on the Vitro site; and (2) decontamination of the Vitro site and disposal of the material at a site located about 1 mile south of Clive, Utah. The impact of these three alternatives are assessed in terms of effects on radiation levels, health effects, air quality, soil and mineral resources, surface water and ground water resources, ecosystems, land use, sound levels, historical and cultural resources, populations and employment, economic structures, and transportation networks. (Auth)(PTO)

482
U.S. Department of Energy, Washington, DC

DOE Plans to Postpone Completion of Draft EIS on Mill Tailings from the Inactive Uranium Mill Near Grand Junction, Colorado Until January 1985, with Remedial Action Scheduled for the Fall of 1986

Federal Register 49(23):4127 (1984, January 11)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

The U.S. Department of Energy (DOE) announces its intent to postpone completion of a Draft EIS regarding selection of an appropriate remedial action to stabilize or control mill tailings derived form the inactive uranium mill near Grand Junction, Colorado. The original schedule for compliance with the National Environmental Policy Act (NEPA) provided for public review of the Draft EIS in late 1983. The new schedule postpones further work on the draft until January 1985 with public review intended to take place in the spring of 1985. Remedial action is scheduled to begin in the fall of 1986. (Auth)(LFG)

483

U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Final Environmental Statement Related to the Decommissioning of the Edgemont Uranium Mill - Docket 40-1341, Tennessee Valley Authority

NUREG-0846; 319 pp. (1982, June)

After an assessment of concerns and alternatives and the addition of conditions related to the proposed decommissioning project operations, the proposed action permits the decommissioning of the existing uranium milling facilities at Edgemont, South Dakota, including removal or cleanup of mill buildings, removal of tailings sands and slimes from the mill site, and removal of contaminated soil from the mill site and local environs. It is estimated by TVA that approximately 2.1 X 10(E+6) metric tons [2.3 X 10(E+6) tons] of tailings and an undetermined amount of contaminated soil will be removed from the mill site. It is also proposed that all radioactive materials, removed in the course of carrying out the proposed action, be transported by truck and/or slurry pipeline to an impoundment, located about 3.21 km southeast of the mill site, constructed especially to ensure containment of such material for the foreseeable future. The project area that will undergo major land disturbance consists of 207 ha (including 104 ha at the disposal site, 12 ha for the haul road to be constructed between the mill and disposal site, and the 86-ha mill site), plus the potential removal of at least 17 ha of ponderosa pine and surficial soil east of the mill site and an unestablished, but small, area of surficial soil in the Cottonwood community. The latter two areas have been contaminated by windblown tailings. All disturbed areas will be reclaimed and revegetated. The title to the tailings disposal site will be transferred to state or federal entities so that any future use can be controlled to ensure the health and safety of the public. Chapters are devoted to alternatives including the proposed action, the affected environment, environmental consequences, monitoring to detect impacts, and mitigation of impacts. Qualifications of the task group are given and agencies receiving the draft environmental statement are listed. (EDB)

484

Walters, W.H., and R.L. Skaggs, Pacific Northwest Laboratory, Richland, WA

Hydrologic Considerations for Rock Riprap Protection of Uranium Tailings Impoundments

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 541-548) (1984, February)

An in-depth study of the application of rock riprap for the long-term protection of uranium tailings impoundments was conducted. Decommissioned tailings sites at Grand Junction and Slickrock, Colorado, were selected to review the method and to evaluate variable sensitivity and data requirements. Preliminary results from the Grand Junction case study indicated that the use of a safety factor in sizing the rock riprap may provide an overly conservative design that may not be justified. A safety factor, usually a value of 1.5 to 2.0, is normally used in riprap design to allow for the uncertainties in the hydraulic calculations. The computation of the hydraulic designs variables using the probable maximum flood event introduces conservatism into the design and the added safety factor may not be warranted. This paper presents some preliminary results from the Grand Junction site concerning the implications of using a safety factor for riprap design. (Auth)(BDC)

485

Weston (Roy F.), Inc., West Chester, PA

Environmental Assessment of Preliminary Cleanup Activities at Vicinity Properties

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

Contaminated by Tailings from the Vitro Rare Metals Plant, Canonsburg, Pennsylvania

DOE/EA-0183; UMTRA-DOE/ALO-125; 70 pp. (1982, July)

This report assesses the environmental impacts of the decontamination and restoration of about 100 properties located near the former Vitro Rare Metals Plant in Canonsburg, Pennsylvania, and the transfer of the contaminated material to the Canon Industrial Park for temporary storage. The analyses are based on measurements at 24 of the properties that have already been officially included by the DOE in the list of properties requiring preliminary cleanup activities. (Auth)

486

Weston (Roy F.), Inc., West Chester, PA

Preliminary Evaluation of Areas for Canonsburg Residues

UMTRA-DOE/ALO-168; 41 pp. (1981, September)

Seven areas in Washington County, Pennsylvania, previously studied by the Pennsylvania Department of Environmental Resources for suitability to receive residues from the Canonsburg Industrial Park were evaluated in order to identify which areas warrant study in greater detail. Criteria used for comparison and evaluation of these areas included population density, land use, subsidence and landslide potential, groundwater characteristics, the presence of industry, location of oil- and gas-well fields, transportation availability, aesthetics and cultural resources, antiquities and historic sites, exposure and wind erosion, slope, streams, wetlands, or flood plains. Two areas near Hanover Township were recommended as potential sites. (BDC)(ARE)

487

Weston (Roy F.), Inc., West Chester, PA

Evaluation of Site Suitability for Canonsburg Residues

UMTRA-DOE/ALO-169; 31 pp. (1981, September)

A preliminary study was conducted by the Pennsylvania Department of Environmental Resources to nominate areas for potential disposal of low-level radiological waste from the Canonsburg site. Upon further investigation, two areas in Hanover Township, Pennsylvania, were selected. A specific site within these areas which met criteria established by the investigating organization and the Uranium Mill Tailings Remedial Action Project was designated. The site selected consists of a dry grass-lined trench resulting from strip-mining activities in the area. (BDC)(ARE)

488

White, A.F., A. Yee, T.N. Narasimhan, and A.R. Smith, Lawrence Berkeley Laboratory, Berkeley, CA

Groundwater Contamination at the Inactive Riverton Wyoming Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 185-195) (1984, February)

Low pH process waters contained in a number of inactive and abandoned uranium mill tailings represent potential sources of radionuclide and trace metal contamination of groundwater. Detailed investigation at a typical site at Riverton, Wyoming, indicates that chemical transport occurs from initial dewatering of the tailings, downward infiltration due to precipitation, and groundwater intrusion into the base of the tailings pile. Relict contaminant plumes, including sulfate, in the shallow groundwater indicate past periods of tailings dewatering. Except for elevated uranium and molybdenum concentrations, radionuclide and trace metal transport are limited by near-neutral pH conditions in the groundwater. The pH is controlled by neutralization of acid tailings water by soil carbonates. A geochemical mixing model employing the PHREEQE computer code was used to estimate current rates of groundwater contamination by tailings water. Significant reactions are the dissolution of calcite, formation of CO_2 and precipitation of gypsum, iron, and aluminum hydroxides. Calculated results indicate a mixing rate of 1.5 X 10(E-4) cu m/s beneath the tailings and an evapotranspiration loss of 1.8 X 10(E-3) cu m/s from the tailings surface. (Auth)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

489

Young, J.A., P.O. Jackson, V.W. Thomas, L.C. Schwendiman, and R.W. Perkins, Pacific Northwest Laboratory, Richland, WA

Workshop on Radiological Surveys in Support of the Edgemont Clean-Up Program

NUREG/CP-0021; PNL-3784; Proceedings of a Conference, Denver, CO, January 21-22, 1981, 85 pp. (1981, October)

Responsibility for the development of procedures for the identification of offsite structures and properties in the vicinity of Edgemont, South Dakota, that require remedial action was assigned to Pacific Northwest Laboratory. To acquaint interested investigators with these procedures and resultant measurements, a Workshop on Radiological Surveys in Support of the Edgemont Clean-Up Action Program was organized. Equipment techniques and procedures employed in radon daughter measurements within structures, indoor and outdoor gamma radiation surveys, and Ra-226 measurements in surface and subsurface soils were described. Measurements results were also presented. The procedures were discussed in depth with the purpose of eliciting suggestions for possible improvements. (Auth) (BDC)(ARE)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DECONTAMINATION STUDIES

490

Tolbert, V.R., and L.D. Voorhees, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN

Decommissioning of a Uranium Mill

ORNL-6009; Environmental Sciences Division Annual Report for Period Ending September 30, 1983, 188 pp.; (pp. 47-49) (1984, April)

The impacts of decommissioning the Silver King Uranium Mill in Edgemont, South Dakota are described. This is the first decommissioning to occur as a major federal action under requirements set by NRC in the Uranium Mill Tailings Radiation Control Act of 1978. The decommissioning of the mill tailings and mill facilities, removal of contaminated soil beneath the tailings piles and ponds, and removal of windblown tailings will serve as a prototype for future decommissionings. Several major environmental issues were identified in the evaluation of plans for decommissioning the mill site. Removal of the tailings to an isolated location rather than stabilization in place was determined to be the best alternative for long-term isolation and stabilization. This alternative may increase windborne and erosional transport of contaminated materials, but control measures for dust and runoff and use of the best-available technologies for excavation and removal of tailings will minimize short-term effects during decommissioning. This alternative will also remove the source of ground water and surface water contamination at the mill site. (BDC)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

491

Baker, E.G., J.N. Hartley, and H.D. Freeman, Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Radon Barrier Systems for Uranium Mill Tailings - A Summary of the Technology

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 235-244) (1984, February)

An asphalt emulsion cover system to reduce the release of radon from uranium mill tailings was developed. The system was field tested at the tailings site in Grand Junction, Colorado. Results from laboratory and field tests indicate that this system effectively reduces radon release to near-background levels (less than 2 pCi/sq m/s) and has the properties required for long-term effectiveness and stability. Engineering specifications have been developed, and a cost analysis indicates that asphalt emulsion covers are competitive with other cover systems. (Auth)(BDC)

492

Baker, E.G., J.N. Hartley, H.D. Freeman, T.F. Gates, D.A. Nelson, and R.L. Dunning, Pacific Northwest Laboratory, Richland, WA

Asphalt Emulsion Radon Barrier Systems for Uranium Mill Tailings - An Overview of the Technology

DOE/UMT-0214; PNL-4840; 133 pp. (1984, March)

The Pacific Northwest Laboratory (PNL), under contract to the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP) office, has developed an asphalt emulsion cover system to reduce the release of radon from uranium mill tailings. The system has been field tested at Grand Junction, Colorado. Results from laboratory and field tests indicate that this system is effective in reducing radon release to near-background levels (less than 2.5 pCi/sq m/s) and has the properties required for long-term effectiveness and stability. Engineering specifications have been developed, and analysis indicates that asphalt emulsion covers are cost competitive with other cover systems. (Auth)(NPK)

493

Beedlow, P.A., Pacific Northwest Laboratory, Richland, WA

Revegetation and Rock Cover for Stabilization of Inactive Uranium Mill Tailings Disposal Sites: Final Report

DOE/UMT-0217; PNL-5105; 78 pp. (1984, May)

Guidelines for using vegetation and rock to protect inactive uranium mill tailings from erosion were developed by Pacific Northwest Laboratory as part of the Department of Energy's Uranium Mill Tailings Remedial Action Project (UMTRAP) Technology Development program. Information on soils, climate, and vegetation was collected for 20 inactive tailings sites in the western United States. Sites were grouped according to similarities in climate and vegetation. Soil loss for those sites was characterized using the Universal Soil Loss Equation. Test plots were used to evaluate (1) the interaction between vegetation and sealant barrier systems, and (2) the effects of surface rock on soil, water, and vegetation. Lysimeter and simulation studies were used to direct and support field experiments. (Auth)

494

Buelt, J.L., and S.M. Barnes, Pacific Northwest Laboratory, Richland, WA

Performance of Asphalt and Clay Liners as a Uranium Mill Tailings Leachate Barrier

PNL-SA-9637; 8 pp.; CONF-811122; Proceedings of the Materials Research Society Annual Meeting, Boston, MA, November 16, 1981; (pp. 489-496) (1981)

Pacific Northwest Laboratory is evaluating the long-term effectiveness of various asphalt clay liner materials as a radionuclide and process chemical barrier from uranium mill tailings. A field test is being conducted by monitoring asphalt and clay liners installed at the Grand Junction, Colorado, tailings site. In addition, eight prospective liners have undergone three months exposure to accelerated conditions to predict their behavior over a 1000-yr period. High-calcium leachates have been forced through thin layers of clay to determine the ability of the clay to resist ion exchange, which reduces its swelling capabilities. Asphalt liners have been exposed to elevated temperatures and increased strengths of oxidizing agents to accelerate their aging process. The permeability coefficients measured during this exposure were then used to predict each liners stability with time. The analyses thus far show that clay soils with bentonite amendments and most asphalt compositions have good long-term performance characteristics. (EDB)

495

Dreesen, D.R., M.E Bunker, „ E.J. Cokal, M.M. Denton, J.W. Starner, E.F. Thode, L.E. Wangen, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM; New Mexico State University, Department of Management, Las Cruces, NM

Research on the Characterization and Conditioning of Uranium Mill Tailings, I - Characterization and Leaching Behavior of Uranium Mill Tailings

LA-9660-UMT (Vol. 1); DOE/UMT-0263; 136 pp. (1983, June)

The initial step in developing and evaluating means of conditioning uranium mill tailings is to characterize the composition and mineralogy of the starting materials and determine the magnitude of contaminant releases from untreated tailings. The emanation of Rn-222 gas and the leaching of hazardous elements are the release mechanisms of primary importance. A variety of tailings samples have been characterized; these materials cover wide ranges of major, minor, and trace element compositions and primary mineral components. Vast differences in leaching behavior have been found. The within-pile and between-pile variability in composition and leachable constituents has also been assessed. The removal of radionuclides and valuable metals by sulfuric acid leaching has also been evaluated. (Auth)

496

Dreesen, D.R., E.J. Cokal, E.F. Thode, L.E. Wangen, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM; New Mexico State University, Department of Management, Las Cruces, NM

Research on the Characterization and Conditioning of Uranium Mill Tailings - 2: Thermal Stabilization of Uranium Mill Tailings, Technical and Economic Evaluation

LA-9660-UMT (Vol. 2); DOE/UMT-0264; 62 pp. (1983, June)

A method of conditioning uranium mill tailings has been devised which greatly reduces radon emanation and contaminant leachability by using high-temperature treatments (i.e., thermal stabilization). The thermally stabilized products appear resistant to weathering, as measured by the effects of grinding and water leaching. The technical feasibility of the process has been partially verified in pilot-scale experiments. A conceptual thermal stabilization process has been designed, and the economics of the process show that the thermal stabilization of tailings can be cost competitive compared with relocation of tailings during remedial action. The alteration of morphology, structure, and composition during thermal treatment would indicate that this stabilization method may be a long-lasting solution to uranium mill tailings disposal problems. (Auth)(JMF)

497

Dreesen, D.R., E.J. Cokal, E.F. Thode, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM; New Mexico State University, Department of Management, Las Cruces, NM

Research on the Characterization and Conditioning of Uranium Mill Tailings - III: Summary of Uranium Mill Tailings Conditioning Research and Implications Regarding Remedial Actions

LA-9660-UMT (Vol. 3); DOE/UMT-0265; 7 pp. (1983, June)

This report summarizes the research findings dealing with uranium mill tailings conditioning technology development performed for the Department of Energy's (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP). Hazards and risks posed by tailings piles are discussed in conjunction with the goal of conditioning the tailings to reduce these hazards. Characterization of tailings, removal of radionuclides, mineral recovery, thermal stabilization, and engineering/economic analysis of conditioning results are presented. The implications of these results for remedial action plans are discussed and conclusions regarding the applicability of these technologies are also presented. (Auth)(JMF)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

498

Freeman, H.D., J.N. Hartley, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Radon Barrier Field-Test Monitoring at Grand Junction Tailings Pile

PNL-SA-11857; 10 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (10 pp.) (1983, November)

Pacific Northwest Laboratory (PNL), as part of the Department of Energy (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP) technology development program, has conducted three large-scale field tests of radon covers at the uranium mill tailings pile in Grand Junction, Colorado. The barrier systems, monitored for radon flux for over two years, include earthen, multilayer, and asphalt emulsion covers. Results of the monitoring have shown that a variety of cover systems can meet the Environmental Protection Agency (EPA) standard. The most effective covers tested were asphalt emulsion and earthen (Mancos shale). (EDB)

499

Froisland, L.J., P.L. Placek, and M.B. Shirts, U.S. Bureau of Mines, Salt Lake City Research Center, Salt Lake City, UT

Restoration of Surface Vegetation on Uranium Wastes at Uravan, Colorado

PB-82-232489; Bureau of Mines Report of Investigation 8653; 19 pp. (1982, May)

The Bureau of Mines conducted a four-year research program at Uravan, Colorado, on a 2.5-acre reclamation plot on the slope of a uranium tailings pile that had been covered with mine waste rock. The purpose of this study was to determine the effects of plant species, type of irrigation, type of fertilizers, and use of dust control chemicals on plant growth and surface coverage. Best grass coverage, nearly 100% with 240 plants per sq ft, was developed in a section that was seeded with crested wheatgrass, fertilized with sewage sludge, and sprinkler irrigated. (EDB)

500

Hans, J.M., Jr., U.S. Environmental Protection Agency, Las Vegas, NV

Use of Earth Moving and Ancillary Equipment to Decontaminate a Uranium Millsite

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 189-195) (1981)

The decontamination of a uranium mill site is principally an earth moving task. A considerable backlog of experience concerning earth moving equipment selection and use was acquired during the decontamination work conducted at the former Shiprock, New Mexico, uranium mill site. Many different types of excavation equipment were available to the Shiprock decontamination project because the Navajo Engineering and Construction Authority (NECA) heavy equipment operator's school was doing the decontamination work and a variety of equipment was needed for training. The equipment is described, and its general use for decontamination is discussed. Its on-the-job use for decontaminating the Shiprock millsite is presented. (EDB)

501

Hans, J.M., Jr., T. Gorsuch, and E. Burris, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV; Navajo Engineering and Construction Authority, Shiprock, NM

Planning and Management Aspects of Uranium Millsite Decontamination Activities

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 936-941) (1981)

In any large earth-moving operation, good planning and management are necessary to complete the operational tasks promptly and successfully. When an earth moving operation is complicated by radioactive contaminants, normal earth moving techniques and management must include the radiological aspects of the operation. It was found that the radiological aspects dominated most of the planning and management activities and were extended to all facets of the decontamination work at the former Shiprock uranium millsite. The effect of these aspects on planning and the development of a management structure are discussed. (Auth)(EST)

502

Hartley, J.N., and J.L. Buelt, Pacific Northwest Laboratory, Richland, WA

Containment Systems for Uranium Mill Tailings

PNL-SA-10608; 6 pp.; CONF-821103; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 14, 1982; Transactions of the American Nuclear Society 43:310-312 (1982, November)

Cover and liner systems for uranium mill tailings in the United States must satisfy stringent requirements regarding long-term stability, radon control, and radionuclide and hazardous chemical migration. The cover and liner technology discussed in this paper involves: (1) single and multilayer earthen cover systems; (2) asphalt emulsion radon barrier systems; and (3) asphalt, clay, and synthetic liner systems. These systems have been field tested at the Grand Junction, Colorado, tailings pile, where they have been shown to effectively reduce radon releases and radionuclide and chemical migration. (EDB)

503

Hartley, J.N., G.W. Gee, E.G. Baker, and H.D. Freeman, Pacific Northwest Laboratory, Richland, WA

1981 Radon Barrier Field Test at Grand Junction Uranium Mill Tailings Pile

DOE/UMT-0213; PNL-4539; 127 pp. (1983, April)

Technologies to reduce radon released from uranium mill tailings are being investigated by Pacific Northwest Laboratory as part of the Department of Energy's Uranium Mill Tailings Remedial Action Project (UMTRAP) technology development program. These technologies include: (1) earthen cover systems, (2) multilayer cover systems, and (3) asphalt emulsion radon barrier systems. During the summer of 1981, a field test was initiated at the Grand Junction, Colorado, uranium tailings pile to evaluate and compare the effectiveness of each radon barrier system. Test plots cover about 1.2 ha (3 acres). The field test has demonstrated the effectiveness of all three cover systems in reducing radon release to near background levels (less than 20 pCi/sq m/s). In conjunction with the field tests, column tests (1.8 m diameter) were initiated with cover systems similar to those in the larger field test plots. The column tests allow a direct comparison of the two test procedures and also provide detailed information on radon transport. (Auth)

504

Metry, A.A., and D.R. Phoenix, Weston (Roy F.), Inc., West Chester, PA

In-Situ Stabilization of a Low-Level Radioactive Site: A Case History

CONF-820424; Treatment and Handling of Radioactive Wastes, Proceedings of an American Nuclear Society Topical Meeting, Richland, WA, April 19, 1982. Battelle Press, Columbus, OH; (pp. 497-504) (1982)

This paper is based on a feasibility study conducted by Roy F. Weston, Inc., for Sandia National Laboratory for the U.S. Department of Energy's (DOE's) Uranium Mill Tailings Remedial Action Program (UMTRAP) Project Office in Albuquerque, New Mexico. DOE is considering several methods for carrying out remedial actions at the site of an inactive uranium-processing mill in Canonsburg, Pennsylvania. The main objective of this study is to determine the feasibility of in-situ stabilization as the remedial action. In-situ stabilization is an alternative to site decontamination and offsite disposal. The problems associated with offsite hauling of large quantities of contaminated material and with the location and development of a new disposal site could be avoided by the implementation of an in-situ stabilization concept. In addition, the in-situ approach would be more cost-effective than offsite disposal. This study will establish that a technically feasible and implementable in-situ stabilization concept can be developed that meets regulatory requirements and is cost-effective. (EDB) (NPK)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

505

Nielson, K.K., V.C. Rogers, and D.C. Rich, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Small-Scale Field Test of Simple Earthen Covers for Uranium Mill Tailings

UMTRA-DOE/ALO-19; 35 pp. (1983, January)

Field tests of earthen cover materials were conducted on tailings piles at Salt Lake City and Mexican Hat, Utah, and at Grand Junction, Colorado. The cover tests were contained in 4-ft-diameter columns buried in the tailings, and involved local soils of 8 to 12 feet thickness. The performances of the covers were evaluated with respect to their reduction of the radon fluxes escaping from the bare tailings. A radon diffusion coefficient of 0.036 sq cm/s was obtained for the 12-ft cover at Mexican Hat, which reduced the radon flux from 99 to 10 pCi/sq m/s. At Grand Junction, diffusion coefficients of 0.024 and 0.029 respectively were obtained for 8- and 12-ft covers, which reduced radon fluxes to 250 and 100 pCi/sq m/s respectively. The higher fluxes resulted from the much higher 2000 pCi/sq m/s source flux at this site. At Salt Lake City, the measured diffusion coefficient of 0.00034 sq cm/s is believed to result from high moisture in the lower part of the cover. The radon flux from the 12-ft cover was 0.8 pCi/sq m/s and was dominated by the radium content of the cover soil. Radon gas concentration profiles measured in the covers were consistent with the measured radon flux data. The tests were conservative in their use of soil compactions lower than would be obtained in a large-scale field application. (Auth)

506

Rogers, V.C., and K.K. Nielson, Rogers and Associates Engineering Corporation, Salt Lake City, UT

UMTRAP Research on Cover Design for Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 245-255) (1984, February)

As a result of the UMTRAP research on radon attenuation and tailings cover design, the basis and general procedures are available for designing covers for uranium tailings piles to meet present criteria for radon emissions. The general procedures involve assessment of the radon source strength of the tailings, definition of candidate cover materials, assessment of their moisture retention and radon diffusion properties, computation of the required thicknesses of these materials, cost comparison, and evaluation of long-term performance criteria. Final selection of the cover design must ensure adequate long-term performance and radon retention as first priority and keep costs to a minimum in achieving this goal. (Auth)

507

Thiers, G.R., F.B. Guros, and E.S. Smith, International Engineering Company, Inc., San Francisco, CA

UMTRA Project: Canonsburg Final Design

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 423-431) (1984, February)

Final design for onsite stabilization of over 300,000 cu yd of abandoned mill tailings in Canonsburg, Pennsylvania, is being completed. This paper describes design criteria, design procedures, and difficulties encountered for the following elements: (1) encapsulation cell, (2) durability of erosion protection material, (3) flood control berm, (4) sedimentation pond, and (5) wastewater treatment plant. The 70,000 cu yd of tailings for which radiation levels exceed 100 pCi/g will be placed on a 2-ft thick compacted clay liner and encased by a 3-ft thick compacted clay cover. The remaining tailings will be covered with at least 2 ft of clay to prevent radon escape and to reduce rainfall infiltration. Erosion protection will be provided for the encapsulation cell, the drainage swales, and from potential meandering of nearby Chartiers Creek. (Auth)

508

U.S. Department of Energy, Washington, DC

DOE Proposes to Conduct Remedial Action to Stabilize and Control Uranium Mill Tailings at Certain Sites in Shiprock, New Mexico - Comment Deadline May 18, 1984

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

Federal Register 49(87):18884 (1984, May 3)

The Department of Energy (DOE) proposes to conduct remedial actions involving the stabilization and control of uranium mill tailings at a site in Shiprock, New Mexico. Remedial actions must comply with the standards promulgated by the Environmental Protection Agency (EPA) as required by the Uranium Mill Tailings Radiation Control Act of 1978. Remedial action would involve the removal of contaminated soils and vegetation from the floodplain/wetland area along the San Juan River. In accordance with DOE regulations for compliance with floodplain/wetland environmental review requirements, DOE will prepare a floodplain and wetland assessment, to be incorporated in the environmental assessment of this proposed action. (Auth)(LFG)

509
Weston (Roy F.), Inc., West Chester, PA

Engineering Feasibility Analysis for In-Situ Stabilization of Canonsburg Residues

UMTRA-DOE/ALO-170; 125 pp. (1982, January)

Several methods for carrying out remedial actions in Canonsburg, Pennsylvania, at the site of an inactive uranium-processing mill were considered. The main objective of this study was to determine the feasibility of in-situ stabilization, an alternative to site decontamination and offsite disposal, as the remedial action. Problems associated with offsite hauling of large quantities of contaminated material and with the location and development of a new disposal site could be avoided by implementing an in-situ concept. The in-situ approach would also be more cost effective than offsite disposal. Preliminary estimates put costs at about $10 million. A multilayered cover system (3 ft of clay, 1 ft of gravel, 6 ft of soil) was developed. Implementation of this plan would ensure long-term stability and would minimize impacts on the public during construction. (BDC)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM WASTE DISPOSAL

510

Buelt, J.L., Pacific Northwest Laboratory, Richland, WA

Liner Evaluation for Uranium Mill Tailings: Final Report

DOE/UMT-0216; PNL-4842; 164 pp. (1983, September)

The liner evaluation program for the Uranium Mill Tailings Remedial Action Project investigated the need for and performance of prospective lining materials for the long-term management of inactive uranium mill tailings piles. Two materials were identified for the purpose: natural foundation soil amended with 10% sodium bentonite and catalytic airblown asphalt membrane. It was determined that calcareous soils typical of western U.S. sites adequately buffer tailings leachates and prevent groundwater contamination without additional liner materials or amendments. At sites where significant groundwater mcvement or infiltration is expected and the tailings leachates are alkaline, the sodium bentonite or asphalt membrane may be necessary. (BDC)

511

U.S. Department of Energy, Washington, DC

Floodplain Statement of Findings: Remedial Action at the Former Vitro Rare Metals Plant Site at Canonsburg, Pennsylvania

Federal Register 48(196):45823-45826 (1983, October 7)

Under authority granted by Public Law 95-604, the U.S. Department of Energy proposes to clean up the radioactive residues remaining at the inactive uranium mill tailings site located in Canonsburg, Pennsylvania, and at an associated vicinity property in Burrell Township, Pennsylvania. The proposed remedial actions will move and stabilize the radioactive residues. Most of radioactively contaminated material at the site is currently below the water table in an area that is partially within the 100-year floodplain of Chartiers Creek and lies totally within the 500-year floodplain. The proposed action involves the relocation of most of the contaminated materials into an encapsulation cell above the elevation of the 100-year floodplain. The small amounts of residues that will not be encapsulated are less radioactive; they will be left in place and covered with a thick layer of soil. (BDC)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM REMEDIAL ACTION EXPERIENCE

512

Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Project Completion Report for Remedial Action at the Salt Lake County Fire Station No. 1 and Harmony Park

UMTRA-DOE/ALO-0260; 28 pp. (1982, April)

When Salt Lake County Fire Station No. 1 was constructed, radioactive uranium mill tailings from the Vitro millsite were used as structural fill. Radiological surveys showed radioactivity levels to be high enough to pose potential health hazards. In this remedial action plan, tailings were to be excavated from beneath the existing building and the surrounding area and replaced with clean fill. (BDC)

513

Thode, E.F., New Mexico State University, Department of Management, Las Cruces, NM

Analysis of Expert Opinion on Uranium Mill Tailings Remedial Action Project (UMTRAP) Alternatives: A Decision Support System Pilot Study

LA-9532-UMT; DOE/UMT-0262; 35 pp. (1983, January)

The Uranium Mill Tailings Remedial Action Project requires a remedial action chosen specifically for each individual site. A panel of professionals was asked to rate objectives for remedial action and to rank alternative ways of meeting the objectives. Responses were statistically analyzed. The panel's preference was emplacement of an earthen cover at the Salt Lake City, Utah, and Shiprock, New Mexico, sites. An asphalt cover was selected for use at the Salt Lake City site. This decision support system is appropriate for use with other inactive and active tailings sites. (Auth)(NPK)

514

U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

Remedial Actions Completed on 23 Vicinity Properties Associated with Inactive Uranium Mill Tailings Site

DOE News (September 23, 1983):1-2 (1983, September 23)

The Department of Energy and its contractors have completed remedial actions this summer on 23 vicinity properties in Canonsburg and North Strabane, Pennsylvania that contained materials from the inactive uranium mill tailings site in Canonsburg. The properties included the Canonsburg Town Park and 22 small commercial and residential properties. This brings to 29 the total number of vicinity properties in the Canonsburg area cleaned up as authorized by Public Law 95-604 and the Uranium Mill Tailings Radiation Control Act of 1978. (BDC)(NPK)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM GENERAL STUDIES

515

Chee, P.C., Y.C. Yuan, and C.J. Roberts, Argonne National Laboratory, Argonne, IL

Costs and Benefits of Alternatives for Mill-Tailings Management: A Perspective

IAEA-CN-43/468; CONF-830523; Radioactive Waste Management, Proceedings of an International Conference, Seattle, WA, May 16, 1983 (1983)

Past milling of uranium and thorium ore in the United States has produced tailings that are stored at numerous sites around the country. Some of these storage sites are located near towns and cities, and the local populations are exposed to radiation and radioactive materials migrating off the sites. The federal government has initiated remedial action programs (e.g., the Uranium Mill Tailings Remedial Action Program and the Formerly Utilized Sites Remedial Action Program) to clean up land and buildings that have become contaminated with radioactive materials, and thus eliminate or reduce population exposure to radiation. The degree of long-term benefit from any reduction of the population dose will be different for each remedial action, as will the cost. To gain a perspective on the cost-benefit ratios of various alternatives (remedial actions), estimates are made of the potential radiation doses to affected populations near two inactive sites and of the costs associated with: (1) onsite stabilization of radioactive tailings, and (2) transportation of tailings to remote locations for stabilization. The calculations presented in this paper were based on actual conditions at an inactive uranium mill tailings site (the Vitro site in Salt Lake City, Utah) and at a former thorium-processing facility (Kerr-McGee site in West Chicago, Illinois). (EDB)

516

Matthews, M.L., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

Remedial Actions at Inactive Uranium Mill Tailings Sites

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 196-199) (1981)

In 1978, Congress enacted Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978. The Act authorizes the Department of Energy (DOE) to stabilize and control the tailings from designated inactive uranium mill tailings sites in a safe and environmentally acceptable manner. DOE has established the Uranium Mill Tailings Remedial Actions (UMTRA) Project Office to implement -- in cooperation with the affected states, Indian tribes and owners of the sites -- remedial actions at the sites. The UMTRA Project Office has initiated efforts to perform remedial actions in accordance with EPA cleanup standards. (EDB)

517

Matthews, M.L., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM

An Update Report on the Uranium Mill Tailings Remedial Actions Project

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 413-422) (1984, February)

In 1978, Congress enacted Public Law 95-604, the "Uranium Mill Tailings Radiation Control Act of 1978." The Act authorized the Department of Energy (DOE) to perform remedial actions at designated inactive uranium mill tailings sites. DOE established the Uranium Mill Tailings Remedial Actions Project (UMTRAP) Office to implement -- in cooperation with the affected states, Indian tribes, and owners of the sites -- remedial actions at the sites. The UMTRAP Office has completed an intensive research and development program and has begun remedial actions at one mill site and numerous vicinity properties in accordance with U.S. Environmental Protection Agency standards. Remedial actions at additional locations are planned. (Auth)(BDC)

518

Uranium Mill Tailings Radiation Control Act of 1978

Public Law 95-604; 23 pp. (1978, November 8)

This law authorizes the Secretary of Energy to enter into cooperative agreements with certain states respecting residual radioactive material at existing sites and to provide for the regulation of uranium mill tailings under the Atomic Energy Act of 1954. It provides for cooperative programs to assess and remedy existing hazards associated with uranium mill tailings at 20 inactive disposal sites and clarifies and reinforces Nuclear Regulatory Commission authority to license and regulate production and disposal of uranium mill tailings at active sites. It also requires that the Nuclear Regulatory Commission determine the extent of the authority of the state of New Mexico to undertake appropriate remedial action to limit public exposure to radiation. (Auth)(NPK)(CAJ)

519

Residual Radioactive Materials Act of 1978

Senate Report 95-1266; 16 pp. (1978, October 3)

The committee recommends passage, with an amendment in the nature of a substitute, of Senate Bill 3078, the Residual Radioactive Materials Act of 1978, to provide for cooperative Department of Energy and state programs to assess and remedy existing radioactive hazards associated with uranium mill tailings (the waste product of the uranium ore milling process) at 24 inactive disposal sites. It also provides for EPA establishment and Nuclear Regulatory Commission enforcement of standards for mill tailings disposal. (Auth)

520

U.S. Department of Energy, Office of Terminal Waste Disposal and Remedial Action, Washington, DC

Annual Status Report on the Uranium Mill Tailings Remedial Action Program

DOE/NE-0025/2; 25 pp. (1983, December)

This Fifth Annual Status Report summarizes activities undertaken during Fiscal Year (FY) 1983 by the Department of Energy and other agencies as part of the Uranium Mill Tailings Remedial Action (UMTRA) Project. FY 1983 project accomplishments include completion of the Remedial Action Plan and Phase 1 engineering design for the Canonsburg processing site, completion of remedial action on an additional 52 vicinity properties plus the inclusion of an additional 303 properties in the UMTRA Project, execution of cooperative agreements with four states and the Navajo Nation, publication of the Draft EIS for the Salt Lake City site, and issuance of the approved Project Plan. FY 1984 project goals are to initiate processing site remedial actions at Canonsburg and Salt Lake City to continue cleanup of high-priority vicinity properties at Canonsburg, Salt Lake City, Grand Junction, and Edgemont; and to execute cooperative agreements to cover all remaining sites. (BDC)

521

U.S. Department of Energy, Washington, DC

Proposed Designation of Processing Sites and Establishment of Priorities Under the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604)

Federal Register 44(173):51894-51917 (1979, September 5)

The purpose of the Uranium Mill Tailings Radiation Control Act of 1978 is to provide, in cooperation with interested states, Indian tribes, and persons who own or control inactive mill tailings sites, a program of assessment and remedial action at these sites to stabilize and control the tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards. Where appropriate, the program may include the reprocessing of tailings to extract residual uranium and other minerals. As a part of the site designation, boundaries for each site shall be determined. This notice announces the proposed designation of 22 processing sites for remedial action and includes the site boundaries. These 22 sites are listed, along with their respective boundary descriptions in Appendix A. Potential health hazards to the public from the residual radioactive materials at designated processing sites will be assessed. Priority for carrying out remedial action at each site is established. The proposed priority ranking for the 22 sites is given in Appendix B. (Auth)(BDC)

522

U.S. Department of Energy, Washington, DC

DOE Designates All Vicinity Properties near 24 Inactive Uranium Processing Sites Under the Uranium Mill Tailings Radiation Control Act (UMTRCA)

CHAPTER 4. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM GENERAL STUDIES

Federal Register 49(23):4127 (1984, February 2)

The purpose of the Uranium Mill Tailings Radiation Control Act of 1978 is to provide Indian tribes, and persons who own or control inactive mill tailings sites, a program of assessment and remedial action at these sites to stabilize and control the tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards. In accordance with the provision of section 102(a)(1) of the Act, the Secretary of Energy designated on November 8, 1979, 24 inactive uranium processing sites and established priorities for conducting remedial action at these sites. Following the designation of these properties, surveys will be conducted to confirm whether any levels of radioactivity found at these properties exceed the EPA Standards for Remedial Actions at Inactive Uranium Processing Sites, which would make these properties eligible for inclusion in the Department's remedial action program. (Auth) (LFG)

Chapter 5

GRAND JUNCTION REMEDIAL ACTION PROGRAM

CHAPTER 5. GRAND JUNCTION REMEDIAL ACTION PROGRAM

523
Coffman, F.E., U.S. Department of Energy, Washington, DC

Health and Environmental Aspects of DOE's Remedial Action Program

Transactions of the American Nuclear Society 46:64-65; CONF-840614; Proceedings of an American Nuclear Society Annual Meeting, New Orleans, LA, June 3-7, 1984; (pp. 64-65) (1984, June)

The U.S. Department of Energy is conducting a program to eliminate the potential health and environmental hazards of residual radioactive contamination at facilities and sites for which DOE has remedial action authority. Among the hazards addressed are inhalation of radon and radon daughter products, direct gamma radiation, and leaching of radium-226 and chemicals into water or intake into the food chain. Following authorization of responsibility and designation of sites, the contaminated area is analyzed to determine its radiological status and to identify and evaluate the engineering options. Activities are conducted in compliance with applicable DOE, EPA, and NRC standards and with procedures established by the National Environmental Policy Act. (Auth) (PTO)

524
Ferguson, S.W., Colorado Department of Health, Denver, CO

Health Effects Among Nonminers in Mining Communities

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (1981)

Since 1978, the Colorado Department of Health has become involved in specific investigations of possible radiation hazards among nonminers in Colorado communities. In each instance, the improper disposal of mill tailings has precipitated concerns and allegations of radiation hazards. This presentation is a brief summary of the findings, to date, of 4 such investigations involving tailings disposal problems in Canon City, Denver, Durango, and Grand Junction Colorado. (EDB)

525
Franz, G.A.

Instrumentation Use in the Uranium Mill Tailings Program in Colorado

CONF-770231; Proceedings of the Radon Workshop, New York, NY, February 1977; (pp. 105-107) (1977)

A brief summary is presented of the instruments used in the uranium mill tailings program. The instruments measure gross gamma and alpha radiation from radon and radon daughters. (EDB)(JMF)

526
Ouimette, D.R., S.W. Ferguson, D. Zoglo, S. Murphy, S. Alley, and S. Bahler, Colorado Department of Health, Denver, CO

Cancer Incidence Study in Mesa County, Colorado

CONF-830101; Epidemiology Applied to Health Physics, Proceedings of a Conference, Albuquerque, NM, January 10, 1983; (pp. 484-494) (1983)

In November 1982, the Colorado Department of Health completed an epidemiologic investigation of leukemia, multiple myeloma, and cancers of the lung, stomach, pancreas and colon in Mesa County, Colorado for the years 1970 to 1979. This investigation was performed in response to a concern that the presence of uranium mill tailings in some Mesa County homes presents a potential cancer hazard. The results of the investigation show that the incidence of multiple myeloma, colon, stomach and pancreatic cancer are not above expected rates. The incidence of leukemia is not above expected rates for the entire study period, 1970 to 1979. The incidence of lung cancer appears elevated when compared to the The Third National Cancer Survey data for Colorado but lower than expected when compared to Surveillance, Epidemiology and End Results data. To further examine the leukemia and lung cancer incidence findings, a case/control study was conducted. The controls consisted of colon, stomach and pancreatic cancer cases. The results of the leukemia case/control analysis show no association with the radiation exposure variables: occupational radiation exposure; uranium mining exposure; having ever lived in a type A home (uranium tailings home); and radiation therapy. The lung cancer case/control analysis shows a significant association with only the radiation exposure variable, uranium mining history, indicating cases were more likely to have been uranium miners than were controls. As with leukemia, the study found no association between lung cancer and living in a uranium mill tailings home. The relatively low radiation exposures typical of type A homes and the small number of persons exposed make it very difficult to establish by epidemiologic methods that a risk exists. (EDB)

527

Peterson, B.H.

Background Working Levels and the Remedial Action Guidelines

CONF-770231; Proceedings of the Radon Workshop, New York, NY, February 1977; (pp. 108-109) (1977)

The Grand Junction, Colorado, 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 some 50 control locations. As long as the radon daughter levels in remedial locations are well in excess of the minimum action levels, 0.007 WL will be adequate. However, it is neither adequate nor appropriate when the observed levels approach the lower guidelines for post-remedial successfulness evaluation. Background is, in fact, a range of values. The actual background level for a particular location cannot be determined, only the probability of its being greater than or less than a certain value. (EDB)(JMF)

528

Radiation Exposure, Remedial Action

Public Law 95-236; 2 pp. (1978, February 21)

This legislation authorizes appropriations for financial assistance to limit radiation exposure to the public from uranium mill tailings used for construction and for other purposes. It extends and increases authorizations for and transfers to the Department of Energy jurisdiction for the Energy Research and Development Administration's program which provides financial assistance to Colorado to limit radiation exposure from uranium mill tailings used as fill dirt at construction sites in Grand Junction. (ARE)

529

Siek, R.D., Colorado Department of Health, Denver, CO

State Review of Environmental Aspects of Uranium Mill Operations

CONF-770581; Methods for Measuring Radiation In and Around Uranium Mills, Proceedings of a Workshop, Albuquerque, NM, May 23-26, 1977, 434 pp.; (pp. 3-8) (1977)

Programs of the state of Colorado initiated in 1957 for investigating environmental problems and health hazards associated with the disposal of uranium mill tailings are reviewed. Emphasis is placed on health hazards resulting from the external exposure of human populations to gamma radiation and inhalation exposure to radon daughter products. The cost of remedial actions in Grand Junction, Colorado, where 200 occupied structures were constructed on or with mill tailings, was $3, 316,097. The cost of the dose reduction work was about $63/rem. It was recommended that developers of new uranium mills make financial arrangements to provide for the perpetual surveillance and maintenance of mill tailings disposal sites. (EDB)(JMF)

Chapter 6

URANIUM MILL TAILINGS MANAGEMENT

- Design, Planning, and Regulations
- Environmental Studies and Site Surveys
- Decontamination Studies
- Site Stabilization and Reclamation
- Waste Disposal
- Remedial Action Experience
- General Studies

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

530
Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Joint Panel on Occupational and Uranium Production

Report; 50 pp. (1983)

The activities of the Joint Panel on Occupational and Environmental Research for Uranium Production in 1982 are outlined. Lists of problems facing the uranium production industry in 1983, research projects being carried out during 1982, research projects completed during 1982, and a bibliography of relevant publications dating back to 1974 are included. (JMF)

531
Dory, A.B., Atomic Energy Control Board, Ottawa, Ontario, Canada

Health and Safety Regulation of Uranium Mining and Milling

AECB-1180-12; 33 pp. (1980, July)

The Canadian Atomic Energy Control Board licenses all nuclear facilities in Canada, including uranium mines and mills. The protection of health, safety and the environment is one of the requirements of each license. A limit of 4 WL-months per year exposure to radon and radon daughters has been set, and guidelines for weekly or more frequent workplace monitoring have been established. Personal monitoring devices are being tested, and thermoluminescent dosimeters are to be introduced. The Board reviews its licensees' ventilation plans continuously. The staged licensing process involves the granting of the following documents: (1) ore removal; (2) underground exploration permit; (3) site and construction approval; (4) mining facility operating license; and (5) shut-down approval. Compliance with regulations and license conditions is monitored mainly by inspectors appointed by provincial agencies, with Board staff exercising auditing functions. The Board involves the workers directly with their own health and safety by sending their unions copies of all relevant documents and inviting comments. (EDB)

532
Hamill, K., U.S. Nuclear Regulatory Commission, Washington, DC

Uranium Mill Licensing Requirements in the United States of America

CONF-820552; STI/PUB-622; IAEA-SM-262/53; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 103-109) (1982)

Since the last international symposium on uranium mill tailings management, the United States Nuclear Regulatory Commission (NRC) has made significant progress in developing a comprehensive regulatory program for protecting the public health and safety and the environment from hazards associated with mill tailings. The NRC issued regulations governing mill tailings licensing in October 1980. The bases for the regulations are contained in the generic environmental impact statement. The significant features of NRC's mill tailings regulations, outlined in this paper, relate to the following areas: (1) long-term isolation; (2) operational controls; (3) radon control; (4) reclamation cover; and (5) institutional requirements. (EDB)

533
Hendricks, D.W., Helgeson Nuclear Services, Inc., Pleasanton, CA

Environmental Protection Agency: Review of Environmental Aspects of Uranium Mill Operations

CONF-770581; Methods for Measuring Radiation In and Around Uranium Mills, Proceedings of a Workshop, Albuquerque, NM, May 23-26, 1977, 434 pp.; (pp. 9-14) (1977)

The preparation of a data base on various segments of the uranium fuel cycle to ensure the protection of the environment and public health is discussed. Emphasis is placed on radiation protection standards applicable to uranium mills and mill tailings. Studies on active and inactive uranium mill sites are under way to assist in the preparation of standards that will be cost effective. These standards will be valuable in the preparation of proposals for the construction of additional uranium mills and in the preparation of preconstruction environmental impact statements. (EDB)(JMF)

534

International Atomic Energy Agency, Vienna, Austria

Radiological Health and Safety in Mining and Milling of Nuclear Materials

Proceedings of an International Atomic Energy Agency, International Labour Organization, and World Health Organization Symposium, Vol. 2, Vienna, Austria, August 26-31, 1963 (1964)

This volume of the proceedings contains papers concerned with technical problems of radiclogical protection, waste management, monitoring programs, medical supervision and assessment of internal contamination, standards, and regulations. (BDC)

535

Johnson, H.V., U.S. Army Waterways Experiment Station, Geotechnical Laboratory, Vicksburg, MS

Geotechnical Quality Control: Low-Level Radioactive and Uranium Mill Tailings Disposal Facilities

CONF-820854; Proceedings of the Fourth Annual Participants' Information Meeting of the DOE Low-Level Waste Management Program, Denver, CO, August 31, 1982; (pp. 197-201) (1982, October)

Current general regulations for low-level radioactive waste (LLW) do not contain any nationally accepted geotechnical standards or criteria that apply to the disposal of this type of waste. The Nuclear Regulatory Commission (NRC) through its rulemaking authority is charged with the responsibility of developing necessary standards and technical criteria for LLW disposal. Through an interagency agreement with the NRC, the US Army Corps of Engineers, Waterways Experiment Station will provide to the NRC technical assistance and guidance to develop a geotechnical quality control program for use during construction, operation, and closure of LLW and uranium mill tailings disposal facilities. This paper presents the work to be conducted in accomplishing this task and work that has been accomplished to date. (EDB)

536

Klohn, E.J., Klohn Leonoff Consulting Limited, Vancouver, British Columbia, Canada

The Development of Current Tailings Dam Design and Construction Methods

Mineral and Energy Resources 25(5):16 (1982, September)

State-of-the-art tailings dam design and construction methods are illustrated. In the near future all tailings dam designs will use sound engineering principles and be based on conventional water storage dam design technology. This will often involve compacted dams having impervious zones to control seepage rather than relying on the slimes beach. Future disposal techniques for some tailings could involve dry tailings storage, which eliminates large tailings ponds containing large volumes of water. (ENVIR)

537

McLean, D.C., Davy McKee Corporation, San Mateo, CA

Potential Effect of Uranium Tailings Regulations on Plant Design and Operations

Proceedings of the American Mining Congress Mining Convention, Los Angeles, CA, September 23-26, 1979; (14 pp.) (1979)

Target objectives of present government regulations are: zero discharge of plant waters, non-contamination of ground waters, below-grade tailings disposal, tailings area reclamation, plant facilities dismantling, and perpetual care of property. This paper discusses several modifications in conventional uranium mill design that will enable operators to meet these constraints at the lowest possible costs. Changes in flowsheet design and operating procedures are suggested rather than modifications or expansions of tailings pond installations. (EIX)(JMF)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

538

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

CONF-820552; STI/PUB-622; IAEA-SM-262/30; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 471-481) (1982)

The Nuclear Energy Agency of OECD has organized a study of the applicability of the ICRP system of dose limitation to the management of uranium mill tailings. Reference sites in Australia, the United States and Canada have been defined, management options costed and the radiation doses from radionuclides dispersed from the tailings determined, either from existing data or by new modelling. The values of incremental cost-effectiveness between options have been estimated with reduction in collective effective dose equivalent commitment being the measure of effectiveness. Included in the options are erodible and non-erodible covers, vegetative covers, impermeable dams, removal of radium and thorium, and burial of waste rock. The effects on incremental cost-effectiveness of different integration times for estimating the collective dose commitment and of a dose rate cut-off for that calculation are noted. (EDB)

539

U.S. Environmental Protection Agency, Washington, DC

EPA Extends Comment Period to June 14, 1983 and Schedules Hearing on June 15, 1983 in Denver, Colorado Concerning Proposed Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites

Federal Register 48(103):23666; DOCKET AH-FRL 2371-5 (1983, May 26)

The Environmental Protection Agency (EPA) has received several requests to conduct public hearings close to the uranium producing districts on this proposed rulemaking (48 FR 19584). Requests have also been received to extend the time for submittal of written comments. EPA is announcing that an additional public hearing will be held in Denver, Colorado, beginning June 15, 1983. The period for written comments will be extended to June 14, 1983. The hearing record will be kept open until June 30, 1983. Therefore, EPA expects to be able to fully consider any written comments received at the Docket by June 30, 1983. Public hearings will also be conducted in Washington, DC, starting on May 31, 1983, as initially announced. (Auth)(LFG)

540

U.S. Environmental Protection Agency, Washington, DC

Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites - Final Rule

Federal Register 48(196):45926 (1983, October 7)

Final health and environmental standards to govern stabilization and control of by-product materials (primarily mill tailings) at licensed commercial uranium and thorium processing sites are presented. The standards apply to tailings at locations that are licensed by the Nuclear Regulatory Commission or states. The standards for disposal of tailings require stabilization so that the health hazards associated with tailings will be controlled and limited for at least one thousand years. The standards require that disposal be designed to limit releases of radon to 20 pCi/sq m/s, averaged over the surface of the disposed tailings, and require measures to avoid releases of radionuclides and other hazardous substances from tailings to water. The standards for tailings at operating mills, prior to final disposal, add two elements and a measure of radioactivity to the groundwater protection requirements currently specified. Existing EPA regulations and Federal Radiation Protection Guides remain unchanged. (Auth)(ARE)

541

U.S. House of Representatives, Washington, DC

Statement on Inactive Uranium Mill Tailings Remedial Action

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

Testimony Before the United States House of Representatives, Subcommittee on Energy and Environment of the Full Committee on Interior; 123 pp. (1978, June)

This collection of material includes testimony, newspaper clippings, and correspondence relating to the inactive uranium mill tailings remedial action efforts in the states of New Mexico, Colorado, Pennsylvania, and Utah. General problems are presented as well as site-specific information. (ARE)

542
U.S. Nuclear Regulatory Commission, Washington, DC

Nuclear Regulatory Commission - 10 CFR Part 40 - Revocation of General License

Federal Register 47(33):7205-7206 (1982, February 18)

Each of the four "agreement states" with active uranium mills covered by the general license (Washington, Colorado, Texas, and New Mexico) has acted to exercise authority under state law over uranium mill tailings. Congress intends to delay the exercise of NRC jurisdiction in those states until October 1, 1982. Accordingly, the general license serves no purpose at the present time and should be revoked. However, should no further legislative action be taken by Congress to amend the Uranium Mill Tailings Radiation Control Act of 1978, or otherwise to further extend the time for accession of jurisdiction to NRC, it may be necessary by October 1, 1982 to reinstate the general license or require specific NRC licenses for uranium mill tailings. (Auth)

543
U.S. Nuclear Regulatory Commission, Washington, DC

NRC Extends Comment Deadline on Proposed Rulemaking Filed by Union Carbide (47 FR 53889), Petitioning for Amendment of Portions of Regulations Setting Criteria for Uranium Mill and Disposition of Tailings or Wastes Activities from January 31 to May 2, 1983

Federal Register 48(39):8085; DOCKET PRM-40-24 (1983, February 25)

On November 30, 1982, the NRC published a notice of receipt of a petition for rulemaking filed by the Union Carbide Corporation (47 FR 53889). The petition requested that the NRC amend portions of its regulations setting out criteria for the operation of uranium mills and the disposition of tailings or wastes resulting from uranium milling activities. The notice of receipt requested public comment on the petition and established a comment closing date of January 31, 1983. Several interested parties have requested that NRC extend the comment period on PRM-40-24 for varying lengths of time. Because of the length and complexity of the petition, NRC has agreeed to extend the comment period for 90 days from the original comment closing date. (Auth)(PTO)

544
U.S. Nuclear Regulatory Commission, Washington, DC

NRC Receives Request from the Sierra Club to Amend Its Regulations to License the Possession of Uranium Mill Tailings at Inactive Storage Sites or Take Other Action to Protect the Public Health

Federal Register 48(85):19722 (1983, May 2)

The Nuclear Regulatory Commission (NRC) is publishing for public comment a notice of receipt of an amendment to a petition for rulemaking submitted by the Sierra Club. The petitioner, in both the original petition and in this amendment to that petition, requests that the NRC amend its regulations to license the possession of uranium mill tailings at inactive storage sites or take other regulatory action to protect the public health and safety and the environment from the radiological and nonradiological hazards associated with the tailings. The petitioner believes that this action is necessary if NRC is to adequately fulfill its statutory responsibilities. (Auth)(LFG)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

545

Bander, T.J., Pacific Northwest Laboratory, Richland, WA

Literature Review of Models for Estimating Soil Erosion and Deposition from Wind Stresses on Uranium-Mill-Tailings Covers

NUREG/CR-2768; PNL-4302; 25 pp. (1982, November)

Pacific Northwest Laboratory (PNL) is investigating the use of a rock armoring blanket (riprap) to mitigate wind and water erosion of an earthen radon-suppression cover applied to uranium mill tailings. The mechanics of wind erosion, as well as of soil deposition, are discussed in this report. Several wind erosion models are reviewed to determine if they can be used to estimate the erosion of soil from a mill tailings cover. One model, developed by W.S. Chepil, contains the most important factors that describe variables influencing wind erosion. Particular features of other models are also discussed, as well as the application of Chepil's model to a particular tailings pile. For this particular tailings pile, the estimated erosion was almost one inch per year for an unprotected tailings soil surface. Wide variability in the deposition velocity and lack of adequate deposition models preclude reliable estimates of the rate at which airborne particles are deposited. (EDB)

546

Bartlett, C.L., and D. van Zyl, University of Arizona, Department of Civil Engineering and Engineering Mechanics, Tucson, AZ

Utilizing Numerical Analysis of Unsaturated Seepage to Design Tailings Management Strategy

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp. (1984, February)

Considerable amounts of data on the unsaturated-flow parameters of uranium mill tailings have been published. These and other published data were used in numerical analyses to simulate drainage and evaporation of water from a layer of deposited tailings. The program UNSAT2 was used in the analyses. The effect of evaporation on a 3-m, initially saturated profile with a static water table at the base was investigated. This paper presents a summary of the results obtained for coarse and fine tailings. One of the important questions in the design of a tailings management strategy is how long to wait between deposition cycles to obtain the maximum dewatering benefit from evaporation and drainage. This and other management considerations are described, as well as the basis of the results obtained, to show how an unsaturated analysis can be used to design a management strategy for a specific set of material and climatic conditions. (Auth) (NPK)

547

Bernhardt, D.E., Rogers and Associates Engineering Corporation, Salt Lake City, UT

Measurement of Radon and Radon Progeny

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983 (1982, July)

Radon and radon progeny (RP) constitute two of the primary sources of radiation exposure to people. The Environmental Protection Agency has set exposure standards based on the use of uranium mill tailings in structures and homes built on reclaimed phosphate lands in Florida. These standards have been extended to other situations by other agencies. The impact of lifestyle variables on exposures and the availability of measurement techniques are important considerations for setting and implementing standards. Studies have been conducted on the variability of commercially available long-term measurement techniques, the air change rate (ACR) of residences, the impact of life styles on the concentration of condensation nuclei (CN) in residences, and the impact of CN on the concentration of RP. Limited results for the ACR of residences, which is an important parameter for estimating the potential concentration of radon and RP in structures, indicate values less than the nominally accepted value of one air change per hour. The concentration of CN is strongly affected by life style and has significant impact (up to a factor of about five) on the concentration of RP in residences. Specifically, lifestyle conditions such as cigarette smoking, natural gas pilot lights, and central systems can change the RP concentration (the general basis of standards) by several factors. Radon standards are usually set in terms of the working levels, a measure of the concentration of RP. Although the radiation exposure and risk are due to the RP, the basic potential for exposure in a residence under various lifestyle conditions can be characterized better by measuring the concentration of radon and projecting the working level than by measuring the working level. (Auth)(JMF)

548

Beverly, R.G.

Review of Environmental Aspects of Uranium Mill Operations: Industry's View

CONF-770581; Methods for Measuring Radiation In and Around Uranium Mills, Proceedings of a Workshop, Albuquerque, NM, May 23-26, 1977, 434 pp.; (pp. 53-39) (1977)

Problems faced by uranium mill operators in complying with new environmental regulations and guidelines are discussed. Valid data must be available in order to evaluate impacts on the environment, to determine background radiation levels, to measure the effectiveness of control techniques, and to determine compliance with standards and regulations. Specific problem areas facing mill operators today and some of the unresolved questions include: sampling methods and equipment for radon in ambient air, measurements of radon and radon daughter exposures, radon emanation rate measurements applicable to monitoring mill tailings, the calibration of gamma counters, measurements of population doses, regulations concerning mill tailings reclamation and stabilization, and the comparative value of in-vivo counting and measurements of the urinary excretion of uranium for monitoring personnel. (EDB) (JMF)

549

Bigu, J., M. Grenier, N.K. Dave, T.P. Lim, and J.L. Chakravatti, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada

Radon Gas Concentration, Surface Radon Flux and Other Radiation Variables from Uranium Mine Tailings Areas

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 211-220) (1984, February)

A study of radon gas concentration, surface radon flux, and other radiation variables was conducted at uranium tailings sites. Meteorological data and soil profile data were measured in order to investigate the relationship of these variables to radiation data. Radon gas measurements were conducted at several depths and at the soil/air interface. Results showed that the radon gas concentration increased with depth. Radon which escaped to the atmosphere was limited to the boundary layer, and the pore concentration of radon in this zone was significantly affected by barometric pressure changes and other meteorological variables. These observations are in qualitative agreement with theoretical expectations and with the work by other authors. The data collected at the Standrock tailings site and reported here are of interest because of the harsh environmental conditions at the location (greater than 30 deg C to less than -40 deg C). The investigation is part of a research program aimed at evaluating long-term trends in radon gas exhalation from local uranium tailings piles. (Auth) (NPK)

550

Bland, C.J., University of Calgary, Calgary, Alberta, Canada

Method of Computing the Rate of Leaching of Radio-Nuclides from Abandoned Uranium Mine Tailings

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp. (1982)

To determine how fast radionuclides leach out of mine tailings, a simple mathematical model has been constructed. A set of coupled differential equations include the effects of loss by leaching, radioactive decay, and growth from precursors. Using a desk top microcomputer, leaching rates can be derived if data are available providing the radionuclide concentrations for fresh tailings and similar tailings that have undergone leaching for a known time since they were deposited. When further data become available, such effects as seasonal variations in leaching could be easily incorporated in the model. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

551

Brewer, L.W., H.L. Rarrick, and D.M. Minnema, Sandia National Laboratories, Albuquerque, NM

Radium-226 Measurements Below Uranium Mill Tailings Piles

Proceedings of the 27th Annual Meeting of the Health Physics Society, Las Vegas, NV, June 27-July 1, 1982 (1982, July)

More than 3000 in-soil measurements for radium-226 have been made in and beneath 12 uranium mill tailing piles. The following conditions were encountered beneath the piles: (1) rock, with essentially no contamination; (2) very dry soil with average contamination ranging from 30 pCi/g in the first 2.5-ft depth beneath the piles to 7 pCi/g in the 5-to-7.5-ft depth beneath the piles; (3) near-saturated and saturated soils with contamination similar to (2); and (4) saturated soils underlaid by cobbles and water where the water had fine particles containing radium-226 in suspension. A number of exceptions to these averages are discussed. Vertical profiles of the piles using 2.5-ft-core barrels resulted in tailing activities from background to over 1000 pCi/g. The tailing piles were generally heterogeneous. Direct comparison calibrations were performed using analyzed mill tailings mixed with very low background sand. (Auth)(JMF)(ARE)

552

Buhl, T., J. Millard, D. Baggett, T. Brough, and S. Trevathan, New Mexico Department of Health and Environment, Environmental Improvement Division, Santa Fe, NM

Radon and Radon Progeny Concentrations in New Mexico's Uranium Mining and Milling District

Proceedings of the 27th Annual Meeting of the Health Physics Society, Las Vegas, NV, June 27-July 1, 1982 (1982, July)

Elevated radiation levels associated with uranium mining and milling activities have been of concern in recent years. In 1978, a New Mexico Environmental Improvement Division (NMEID) study was initiated to determine: (1) sources of high airborne radioactivity; (2) background radioactivity levels; and (3) if NMEID radiation standards were being exceeded in concentrated uranium milling and mining areas responsible for approximately 50% of the U.S. yellowcake production. Radon, radon progeny, external gamma rates, and soil concentrations were measured within the Grants Mineral Belt region. Over 1700 radon samples were collected at 33 sites. Radon concentrations near uranium mines were found to exceed state and federal limits for public exposure at three of nine locations in the Ambrosia Lake area. All radon concentrations associated with uranium mills not located near mines were below radiation limits. Radon contributions from mines, mills, waste storage piles, and natural sources were estimated. In addition, estimates of dose to the bronchial epithelium and lifetime risk of premature cancer death per year of exposure were made for indigenous populations. (Auth)(JMF)

553

Bush, K.J., and G. Markos, GECR, Inc., Rapid City, SD

Application of Geochemical Modeling to Solute Transport Modeling of Contaminant Migration Away from Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 135-144) (1984, February)

Mixing of waste solutions with ground water of different chemical compositions induces a set of precipitation and dissolution reactions to attain equilibrium between the aqueous species and the solid phases in contact with the solution. Coprecipitation and adsorption associated with iron and aluminum hydroxides immobilize contaminants along the portion of the flow path of chemical disequilibrium. Assuming the rates of chemical reactions are rapid relative to the flow rate, disequilibrium is confined to a narrow zone at the interface between two unlike media. Upon attaining chemical equilibrium, steady state is maintained and nonspecific adsorption dominates attenuation of contaminants, which can be described by distribution coefficients. Further reactions will occur as the solution passes into a different rock or soil type. Incorporation of geochemical concepts into solute transport models is achieved by modeling the resulting geochemical equilibrium from mixing the waste solution with the buffered ground water and determining the source term for the solute transport as the equilibrium concentrations exit the reaction zone. (Auth)

554

Cohen, B.L., University of Pittsburgh, Pittsburgh, PA

Health Effects of Radon Emissions from Uranium Mill Tailings

Health Physics 42(5):695-702 (1982, May)

The problem of health effects of radon emissions from uranium mill tailings is reviewed. A history is presented of estimates of these effects and how the estimates have been refined by further research. A current best estimate is given. The theory and practice of mitigating the effects of radon emissions by covering tailings with soil are described, and the present situation as regulated by 10 CFR 40, Appendix A is evaluated. (EDB)(PTO)

555

Curtis, D.B., and A.J. Gancarz, Los Alamos Scientific Laboratory, Los Alamos, NM

Lead Isotopes as Indicators of Environmental Contamination from the Uranium Mining and Milling Industry in the Grants Mineral Belt, New Mexico

CONF-780740; LA-UR-78-2147; Management, Stabilization, and Environmental Impact of Uranium Mill Tailings, Proceedings of a Conference, Albuquerque, NM, July 24-28, 1978, 498 pp.; (8 pp.) (1978)

The unique isotopic composition of lead from uranium ores can be useful in studying the impact of ore-processing effluents on the environment. Common lead on the earth's surface is composed of 1.4% of lead-204, 24.1% of lead-206, 22.1% of lead-207, and 52.4% of lead-208. In contrast, lead associated with recent uranium ores may contain as much as 95% lead-206. These extreme differences provide the means to evaluate quantitatively the amount of lead introduced into the environment from the mining and milling of uranium ores by measuring variations of the isotopic composition of lead in environmental samples. The use of lead isotopes as diagnostic tools in studying the hydrologic transport of materials from uranium ore dressing plants in Grants Mineral Belt, New Mexico, is discussed. Preliminary measurements of effluents intimately associated with processing wastes are consistent with a simple model in which radiogenic lead from the ores is mixed with common lead from the uncontaminated environments. (EDB)(JMF)

556

Dave, N.K.. and T.P. Lim, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Modified Accumulator Method for Measuring Surface Radon Flux from a Uranium Tailings Pile

Canadian Institute of Mining and Metallurgy Bulletin 75(843):131-134 (1982, July)

A modified accumulator was devised to measure surface radon flux from porous media. It consists of a collector hood accumulator with a homogenizer pump and a pressure balancer. The latter was used to compensate for any pressure changes produced during sample withdrawal and hence eliminate additional radon transport from media. Errors resulting from radon back diffusion due to decreasing concentration gradient with time across the interface were eliminated by measuring radon concentrations in the accumulator for two different periods of time and calculating the true radon flux, J(o), from the solution of a time-dependent radon transport equation. Core samples from the observation site were withdrawn for laboratory determination of porosity, moisture content bulk and grain densities, Ra-226 source concentration and the fraction of Rn-222 produced in the void volume. The data were used to calculate the radon diffusion coefficient for the media. Using the present method, the true value of surface radon flux for an abandoned uranium tailings pile was found to be J(o) = 2020.2 mBq/sq m/s compared to the value J = 1406.0 mBq/sq m/s obtained by the conventional method. The bulk diffusion coefficient of radon for the medium was obtained as 1.2 X 10(E-7) sq m/s. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

557

Dave, N.K., and T.P. Lim, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Migration from Underwater Buried Uranium Tailings - Laboratory Investigation of Ra-226, Total Dissolved Solids, Ca+2 and SO4-2 Transfer Flux

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 83-92) (1984, February)

Laboratory tests were performed to study the migration of contaminants from underwater-buried uranium tailings to the overlaying water column. The tests were conducted under two conditions, a continuous flow steady-state condition and a no-flow, stagnant water condition. The parameters measured were the mass transfer flux 'J', the transfer coefficient 'K' and the tailings porewater concentration 'Co' profile as a function of depth and their variations with time for Ra-226 and total dissolved solids (TDS). The results showed that for Ra-226 all the measured parameters decreased with time, the values changing from J = 4.48 to 0.37 Bq/sq m/hr (121 to 10 pCi/sq m/hr), K = 0.4 to 0.18 m/month and Co = 9.9 to 3.9 Bq/l (267 to 105 pCi/l). From the porewater concentration profiles, a molecular diffusional component of transport flux can be established, but it is small compared to a mass dissolution-transfer component. For TDS, the measured transfer coefficients K = 0.16 to 0.05 m/month were only one-third of those obtained for Ra-226. The test results from a no-flow condition indicated that the transfer coefficient 'K' for calcium ranges from 0.107 to 0.265 m/month and J sub o ranges from 25.7 to 26.5 mg/sq m/hr. Under the same conditions, results for sulphate were K = 0.048 to 0.023 m/month with J sub o = 92.9 to 98.4 mg/sq m/hr. The variation of values obtained for the transfer coefficient 'K' from different species suggested that those two components of tailings, solid and liquid phase, migrate differently. (Auth)(NPK)

558

Dave, N.K., T.P. Lim, and A.J. Vivyurka, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Chemical and Radioisotope Stratification in an Abandoned Uranium Tailings Pile

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 180-188) (1981)

Chemical and radioisotope stratification studies were carried out in an abandoned uranium tailings pile at Elliot Lake, Ontario, Canada. The tailings, with an average thickness of 7 meters over an area of 16 hectares, were deposited approximately 20 years ago on a layer of black peaty material which overlays deposits of permeable glacio-fluvial sands. Geohydrochemical investigations of this tailings area have been ongoing since 1978. The radioisotope profile study was conducted on three adjacent sites. Solid core samples, collected with a split spoon sampler at various depths, were analyzed for various chemical and radioisotope constituents. The groundwater hydrology of the system was observed to be complex showing downward and lateral flow in the dry season and lateral and upward flow during the spring and periods of heavy rainfall. The results are discussed in terms of a model based on the combined segregation and settling process of the tailings fine fraction, and the geohydrochemical interaction of the solid and liquid phases. (EDB)

559

Davis, L.A., Water, Waste and Land, Inc., Fort Collins, CO

The Use of Flow and Transport Modeling to Design a Groundwater Monitoring System for a Lined Uranium Tailings Impoundment

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 71-81) (1984, February)

A one-dimensional, analytical flow model is utilized in the unsaturated region beneath lined uranium tailings impoundments to determine conservative quantities of seepage that could enter an underlying aquifer from possible liner failure. The seepage quantities are used as input to a model based on an analytic solution to the hydrodynamic dispersion equation. This model is used to determine the location of detectable concentrations of conservative contaminants in the resulting plume at various times after inception of the leak. This information provides a basis for locating groundwater monitoring wells such that detection of seepage impacts from even small liner failures is possible in an acceptable time. (Auth)

560

DeKorompay, V., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Determination of the Relative Discharge Rate from a Uranium Mine Tailings Pond by Water Level Measurements

MRP/MRL-79-25; 19 pp. (1979, January)

A method using only water level measurements was developed to determine the effectiveness of revegetation or other selected materials as seepage reducing agents for uranium mine tailings ponds. The rate of the surface and subsurface water contamination around the tailings pond is directly proportional to the water head difference existing between the water tables inside and outside the pond. The method uses water level measurements taken before and after revegetation or taken simultaneously under revegetated and barren sections of the pond. Effluent rate variation of plus or minus 1% can be detected with the measuring technique. For this reason the method is suitable for monitoring the fluctuation of the contamination rate from abandoned uranium mine tailing ponds. In addition, the method can predict the performance of the revegetation or other selected seepage reducing materials before the commitment of any large expenditure. (EDB)

561

Dodson, M.E., G.W. Gee, and R.J. Serne, Pacific Northwest Laboratory, Richland, WA

Effects of Crystalline Fe and Mn Oxides on Contaminant Migration Through Soil Liners

PNL-SA-11652; 11 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 125-134) (1984, February)

Tailings solution produced from tailings excavated at the Canonsburg, Pennsylvania, UMTRAP site was used in liner material column flow studies to test the attenuation characteristics of local borrow pit soil found adjacent to the tailings area. The effluents from liner columns, under saturated conditions, were sampled at fractional pore volumes and analyzed for macro cation, anion, trace metal, and radionuclide contents. Solution displacement was allowed to continue until three pore volumes of tailings solution had contacted the liner material. Two amended liner mixtures were contacted with the tailings solution to assess the effects of crystalline iron and manganese oxides in attenuating contaminants. The ammended mixes represented Canonsburg soil plus either 2% (dry weight basis) reagent grade iron oxide or 2% manganese saturated green sand zeolite. Attenuation of most trace metals and radionuclides was high in all three column studies, while macro ions, zinc, and the anions Cl and SO4 showed limited signs of attenuation, regardless of whether the soil was amended or not. There were no signs of excess leaching of Fe or Mn from the columns enriched with their oxides. General results indicate that the addition of iron and manganese in their crystalline forms is of little additional value compared to the attenuation of contaminants achieved with native iron and manganese oxides found as partial coatings on the silicate minerals of the unamended Canonsburg soil. (Auth)(NPK)

562

Dory, A.B., Atomic Energy Control Board, Ottawa, Ontario, Canada

Environmental Impact of Uranium Mining and Milling: The Canadian Experience

Energy Progress 2(1):28-32; INFO-0062; 13 pp. (1982, March)

An outline of the basic regulatory approaches for minimization of environmental impacts from uranium mining and milling in Canada is presented. Requirements of the Atomic Energy Control Board (AECB) currently being enforced are much more rigorous for uranium mill tailings than for other tailings, even though the environmental hazards of uranium mill tailings are generally the same order of magnitude as those associated with other tailings. Safety considerations set forth by the AECB are outlined. The extent of the environmental impact of the AECB rulings are discussed using mines in the Elliot Lake area of Ontario for illustrative purposes. Opinions on necessary steps that need to be taken to regain public confidence and acceptance of uranium mining and the entire uranium industry are presented. (EDB)(BLM)(PTO)

563

Dreesen, D.R., E.J. Cokal, and C. Lujan, Los Alamos National Laboratory, Los Alamos, NM

Uptake and Migration of Uranium Mill Tailings Contaminants

LA-9816-PR; Los Alamos Life Sciences Division's Biomedical and Environmental Research Programs: Progress Report, January-December 1982; (pp. 184-187) (1983, August)

An investigation was conducted on contaminant migration and uptake from a set of representative uranium mill tailings composites from 12 inactive mill sites collected by Mountain States Research and Development for DOE's Uranium Mill Tailings Remedial Action Project. Uptake and migration of contaminants were studied in microcosms containing 14 types of tailings from 12 sites. One-half of these microcosms were seeded with spring barley (HORDEUM VULGARE) and the remaining microcosms had no vegetation. Another set of experiments investigated contaminant uptake by 10 important plant species from 2 tailings sites (Shiprock fines and Salt Lake City composite) and a control group soil. (EDB)

564

Dreesen, D.R., J.M. Williams, M.L. Marple, E.S. Gladney, and D.R. Perrin, Los Alamos National Laboratory, Los Alamos, NM

Mobility and Bioavailability of Uranium Mill Tailings Contaminants

Environmental Science and Technology 16(10) :702-709 (1982, October)

An evaluation of environmental transport and contamination resulting from the release of trace elements and radionuclides from uranium mill tailings was performed by utilizing both laboratory and field studies. The composition of tailings showed the enrichment of a suite of uranium analogue elements (As, Mo, Se, and V) as well as the frequent occurrence of heavy metals generally associated with sulfide minerals (Co, Cu, Ni, and Pb). Aqueous leaching of alkaline tailings mobilized base labile (anionic) species As, Mo, Se, and U, whereas acid tailings leachates contained appreciable Co and Ni. The assimilation of mobile constituents by the roots of native plant species was most evident for Mo and Se in alkaline tailings; levels of these contaminants reported to be toxic to grazing animals were found. The laboratory studies on contaminant mobility and bioavailability are compared with contamination of water, soil, and biota by Mo and U in the vicinity of an alkaline-leach uranium mill. (EDB)(EST)

565

Edgar, T.V., Colorado State University, Fort Collins, CO

Moisture Movement in Nonisothermal Deformable Media (Uranium Mill Tailings)

Thesis (1983)

Many inactive uranium mill tailings impoundments currently exist in the United States. One part of the Department of Energy's reclamation plan for these sites is to enclose the impoundments with a cover. Several cover options are available, including thick and thin soil covers, synthetic covers, and layers of asphalt. Placement of any cover material could cause the water content of the tailings to change due to changes in the evaporation and infiltration rates. Because the state of stress of the soil is a function of its water content, these changes could cause the surface of the impoundment to settle and thus affect the performance of the liner material. This report investigates the effects of changing mechanical and fluid stresses on deformable media. A set of one-dimensional equilibrium and balance equations for both two and three phase soils is developed based on a coordinate system that is defined by the soil solids. This analysis is based on the concepts of continuum thermomechanics and the theory of mixtures. A significant result of this

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

analysis involves the natural importance of the stress state variables investigated by Fredlund and Morgenstern (1976) on the balance equations. A finite difference model was developed to solve the three coupled nonlinear partial differential equations. The model permits the study of the effects of liquid, gas, and heat flows on the deformation of the soil. A set of constitutive relationships was selected, which is compatible with a wide range of soil material, including uranium tailings mixtures and Yolo light clay (Moore, 1939). Comparison shows excellent correlation between both vertical infiltration into a dry soil (Philip, 1957) and saturated consolidation (Terzaghi, 1943). A series of example problems were selected to analyze the effects of varying the soil and environmental parameters. Four significant cases were: (1) drainage of an originally saturated soil; (2) consolidation of a partially saturated soil due to placement of a cover; (3) the effect of a low permeability layer on drainage; and (4) the effects of soil drying and crusting on evaporation. (CDA)

566

Ellett, W.H.

Recent Advances in Understanding the Risk Due to the Inhalation of Radon Daughters

CONF-770231; Proceedings of the Radon Workshop, New York, NY, February 1977; (pp. 102-104) (1977)

Many estimates of cancer risk due to radon daughter inhalation, made on the basis of epidemiological data available in the late 1960s, are becoming obsolete. In addition, these earlier estimates appear to be somewhat low. The 1972 BEIR report updated and detailed results published in Joint Monograph No. 1, Radon Daughter Exposure and Respiratory Cancer by Lundin, Wagoner, and Archer. As in all BEIR estimates, the risk of lung cancer was assessed in two ways: (1) absolute risk, or the number of excess cancers expected per 10(E+6) organ rem per year at risk and relative risk, and (2) the proportion of excess cancer incidence observed per rem compared to the incidence in an unexposed control population. For U.S. uranium miners, the absolute risk estimated in 1972 was one excess cancer incidence per 10(E+6) organ rem per year at risk. Archer and others have monitored uranium miner deaths since the BEIR report was prepared and also re-examined criteria for accepting some of the death data previously used. This has led to revised conclusions. The most recently published estimate of the risk to U.S. uranium miners was published in the 1976 NAS Report, Health Effects of Alpha-Emitting Particles in the Respiratory Tract, prepared by a BEIR ad hoc committee to investigate the hot particle problem. The conclusion reached in this report is that the previous BEIR estimate was low by a factor of two and that a better estimate of the absolute risk is two lung cancers per 10(E+6) organ rem per year at risk. Other recent studies using non-U.S. data are reviewed that also appear to support a higher risk due to radon daughter inhalation. (EDB)(JMF)

567

Follin, S.E., G.L. Chedsey, and A.M.G. Robertson, U.S. Bureau of Mines, Twin Cities Research Center, Minneapolis, MN; Geotechnical Engineering and Mining Services, Inc., Lakewood, CA; Robertson and Kirsten, Inc., Lakewood, CA

Unconventional Uses of Geotechnical Tools for Impoundment Seepage Investigations

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 615-625) (1984, February)

Proper design of dewatering or seepage control systems for existing waste impoundments requires reliable estimates of soil parameters, knowledge of pore pressure distribution, and good information about the layering present. As part of a program to improve the effectiveness of dewatering systems used in the mining industry, the Bureau of Mines sponsored field tests of two recently developed instruments, the piezocone penetrometer and the Delft 66 mm continuous sampler. These tools, developed for other applications in which soft soils are encountered, were used to obtain soil and hydrologic information at an active uranium tailings impoundment. This paper describes the equipment, its operation, the field work performed, and the results obtained. (Auth) (BDC)

568

Franklin, J.C., R.A. Washington, J.C. Kerkering, H. Montone, and R. Regan, U.S. Bureau of Mines, Spokane Research Center, Spokane, WA

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

Radon Emanation from Stopes Backfilled with Cemented Uranium Mill Tailings

PB-82-232109; 14 pp. (1982, May)

An experiment was conducted by the U.S. Bureau of Mines and the Canada Center for Mineral and Energy Technology (CANMET) to measure the emanation rate of radon from cemented unclassified mill tailings in two dewatered stopes of a uranium mine at Elliot Lake, Ontario, Canada. The radon was monitored upstream and downstream and in both stopes to determine the concentration in the stopes and the amount emanated from both stopes. The emanation rate was determined to be 0.55 pCi/sq cm/s from the mill tailings, which is approximately 1000 times higher than the average flux in the mine before backfilling. (EDB)

569

Freeman, H.D., and J.N. Hartley, Pacific Northwest Laboratory, Richland, WA

Predicting Radon Flux from Uranium Mill Tailings

PNL-SA-11855; 14 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 221-233) (1984, February)

Technology for the design of radon barriers for uranium mill tailings piles was developed. To properly design a radon cover for a particular tailings pile, the radon flux emanating from the bare tailings must be known. The tailings characteristics required to calculate the radon flux include radium-226 content, emanating power, bulk density, and radon diffusivity. This paper presents the theoretical and practical aspects of estimating the radon flux from a uranium tailings pile. Results of field measurements to verify the calculation methodology are also discussed. (Auth)(BDC)

570

Garratt, D.G., Eldorado Resources Limited, Waste Management-Solution Purification, Ottawa, Ontario, Canada

Decommissioning and Reclamation of Beaverlodge Tailings - Evaluation of Potential Radionuclide and Trace Metal Migration

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 359-368) (1984, February)

This paper discusses the laboratory studies which were undertaken to evaluate the potential for radionuclide and trace heavy metal migration from tailings in three natural lakes: Fookes Lake, Marie Lake, and Minewater Lake in Saskatchewan. The results of the work served as direct input into the environmental and radiological assessment of close-out options of the sites. Data generated for input into the water quality models are presented. These include leaching rates of uranium, radium-226, and other species as a function of several factors, including the concentrations of the species of concern in the tailings, the tailings themselves, the tailings pore-water characteristics, the lake water quality and mixing characteristics, the oxidation state of the species of concern in the tailings, the local temperature of the lake water and the presence of highly insoluble gangue materials or films either absorbed or precipitated on the surfaces of the tailings particles. Finally the main parameters affecting water quality are presented. (Auth)(BDC)

571

Gee, G.W., K.K. Nielson, and V.C. Rogers, Pacific Northwest Laboratory, Richland, WA; Rogers and Associates Engineering Corporation, Salt Lake City, UT

Predicting Long-Term Moisture in Earthen Covers

PNL-SA-11684; 7 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 267-276) (1984, February)

Earthen cover systems will be used to control radon flux levels at most, if not all, uranium mill tailings disposal sites in the United States. The long-term residual moisture in an earthen cover will determine, to a large degree, the effectiveness of the cover for radon control. The cover's moisture content is a function of climate, plant cover, soil type, and depth to water table. Estimates of long-term moisture content can be made in several ways. Simulation, using deterministic water flow models, provide the most complete description but require the most detailed information, including long-term climate and plant cover changes, which at present have a high degree of uncertainty. Simpler correlation, related to soil type and expected periodic drought conditions, will likely be more practical for estimating long-term saturation to water retention characteristics of the soil and assumes that residual moisture in the entire soil cover will approach the so called "permanent wilting point" (15 bar percentage). The expected residual moisture saturation at permanent wilting ranges from 0.07 to 0.56 as soil texture varies from sands to clays at typical field densities. Radon diffusion coefficients for soil cover materials range from 0.05 sq cm/s to 0.005 sq cm/s for sands and clays respectively at typical field densities. With increased compaction, the residual moisture saturation can increase significantly, and radon diffusion coefficients as low as 3 X 10(E-4) sq cm/s have been measured. The optimal soil cover design will likely be a two-layer cover system with at least a 1-m-thick plant root zone of uncompacted soil over moistened, tightly compacted fine-textured soil. This design concept has been tested successfully at Grand Junction, Colorado. (Auth)

572

Gureghian, A.B., N.J. Beskid, and G.J. Marmer, Argonne National Laboratory, Argonne, IL

Predictive Capabilities of a Two-Dimensional Model in the Ground Water Transport of Radionuclides (Uranium Mill Tailings)

CONF-780740; Management, Stabilization, and Environmental Impact of Uranium Mill Tailings, Proceedings of a Conference, Albuquerque, NM, July 24-28, 1978, 498 pp.; (pp. 155-173) (1978)

The discharge of low-level radioactive wastes into tailings ponds is a potential source of groundwater contamination. The estimation of the radiological hazards related to the groundwater transport of radionuclides from tailings retention systems depends on reasonably accurate estimates of the movement of both water and solute. A two-dimensional mathematical model having predictive capability for groundwater flow and solute transport has been developed. The flow equation has been solved under steady-state conditions and the mass transport equation under transient conditions. The simultaneous solution of both equations is achieved through the finite element technique using isoparametric elements based on the Galerkin formulation. However, in contrast to the flow equation solution, the weighting functions used in the solution of the mass transport equation have a nonsymmetric form. The predictive capability of the model is demonstrated using an idealized case based on analyses of field data obtained from the sites of operating uranium mills. The pH of the solution, which regulates the variation of the distribution coefficient (K sub d) at a particular site, appears to be the most important factor in assessing the migration rate of the elements considered. (EDB)(JMF)

573

Haji-Djafari, S., P.E. Antommaria, and H.L. Crouse, D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA

Attenuation of Radionuclides and Toxic Elements by In Situ Soils at a Uranium Tailings Pond in Central Wyoming

American Society for Testing and Materials, Special Technical Publication; (pp. 221-242) (1981)

Existing concentrations of radionuclides and arsenic, in a uranium tailings pond and groundwater, and hydrogeologic and mass transport parameters were utilized in a Galerkin-based finite element mass transport model to predict future migration potential for discrete chemical species. Field and laboratory data and the results of computer modeling indicate that movement of chemical species of interest at the subject site is mitigated by chemical reaction with in situ soils, including precipitation, coprecipitation, and ion exchange. The study showed that among the hydrogeologic and mass transport parameters, distribution coefficients are the major controlling factor in determining the extent of attenuation of radionuclides and arsenic. (EDB)

574

Hans, J.M., Jr., U.S. Environmental Protection Agency, Las Vegas, NV

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

Gamma Radiation Surveys Around Uranium Mill Tailings Piles

CONF-770581; Methods for Measuring Radiation In and Around Uranium Mills, Proceedings of a Workshop, Albuquerque, NM, May 23-26, 1977, 434 pp.; (pp. 275-292) (1977)

Wind and water erosion of uranium mill tailings over large areas have been observed at both active and inactive sites. A technique for assessing the gamma activity of off-pile tailings is described. Any suitable instrumentation, other than that described in the report, may be used if properly calibrated. Knowledge of the extent of eroded tailings is necessary to check stabilization effectiveness and to document or identify potential exposures for compliance purposes. (EDB)(JMF)

575
Hinton, T.G., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Field Experiment on Rn-222 Flux from Reclaimed Uranium Tailings

DOE/EV/10305-10; 44 pp. (1983)

Design and construction techniques are described for a 1.6 ha experimental uranium mill tailings reclamation plot. A passive, activated charcoal device was developed and tested for measurement of radon flux. Experiments on radon flux versus overburden depth showed that tailings covered with 1.5 m of revegetated or 0.3 m of bare overburden had exhalation rates comparable to background. Vegetated subplots exhibited a significantly higher (often an order of magnitude) flux than the bare subplots. Results on the variation of flux over time did not reveal any definitive patterns, possibly due to the high variability among replicates. A positive correlation was demonstrated between precipitation and radon flux. This is discussed in detail and possibly explained by the increase in water content of the micropores within the tailings, which increases the emanation coefficient without adversely effecting the diffusion coefficient of the overburden. (EDB)

576
IEC Beak Consultants Limited, Mississauga, Ontario, Canada

Atmospheric Dispersion of Radionuclides from Uranium Mill Tailings Disposal Sites - Technical Appendix

INFO-0097 (Appendix); 137 pp. (1983, March)

This report describes the study of the generation and dispersion of airborne radionuclide species from a hypothetical tailings disposal site. Important aspects of the atmospheric modelling process and findings resulting from that process are presented. An attempt has not been made to predict real radiation doses or real atmospheric radionuclide dispersion patterns for any specific site. For the hypothetical tailings site and tailings mass, results of the study indicate that: (1) mass permanent flooding of the tailings reduces radon gas emanations significantly and eliminates loss of particulate matter; (2) covering the tailings with vegetation increases radon gas emanation; and (3) currently available models describing wind erosion from tailings masses require further development. (BDC)(ARE)

577
IEC Beak Consultants Limited, Mississauga, Ontario, Canada

An Approach to the Calculation of Dose Commitment Arising from Different Methods for the Long-Term Management of Uranium Mill Tailings Through Aquatic Pathways - Technical Appendix

INFO-0097 (Appendix); 268 pp. (1983, March)

Radionuclide dispersion through aquatic pathways from a hypothetical mill tailings disposal site was investigated. Dose commitment calculations for human exposure to the simulated patterns of radionuclide concentrations over time are presented. The report describes the aquatic portion of a diagnostic model; the modelling of the hypothetical tailings site and tailings mass; and the findings resulting from use of the models. Results indicate that critical group dose rates are largely controlled by the amount of Pb-210 ingested by eating fish taken from the lake receiving tailings seepage and that collective dose commitments to all exposed populations are dominated by internal exposure to principally Ra-226, Pb-210 and Po-210. (BDC)(ARE)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

578

IEC Beak Consultants Limited, Mississauga, Ontario, Canada

An Approach to the Calculation of Dose Commitment Arising from Different Methods for the Long-Term Management of Uranium Mill Tailings - Summary Report

INFO-0097 (Summary); 65 pp. (1983, March)

Major aspects of a diagnostic model designed to improve understanding of the release of radionuclides to the natural environment from uranium mill tailings management areas and the findings obtained through its use are described. Results of the study for a hypothetical site indicated: the dose rates to the critical groups, in the six cases studied, ranged from a small fraction of the dose limit for members of the public to a level approaching the dose limit; permanent flooding of the tailings significantly reduces the dose rate to the critical group; removal of 90% of the uranium and thorium daughters mobilized during the acid leach process reduces the global collective dose commitment by a comparable amount; and only a small fraction of the global collective dose commitment arises from individual dose rates greater than 1 urem per year. (BDC)

579

Kalin, M., University of Toronto, Toronto, Ontario, Canada

Long-Term Ecological Behavior of Abandoned Uranium Mill Tailings: 1 - Synoptic Survey and Identification of Invading Biota

EPS-4-ES-83-1; 143 pp. (1983, March)

Inactive uranium mill tailing sites in Ontario, Canada, were surveyed and their surface characteristics, naturally invading biota, and chemical parameters are described. Inactive tailing sites generally have wet areas, dry areas, and tailings completely covered with water, with concurrently different surface and chemical characteristics. Concentrations of calcium and uranium are found to vary widely from site to site, while concentrations of magnesium, nickel, copper, cobalt, and aluminum vary less. (ENVIR)

580

Kalin, M., and H.D. Sharma, University of Toronto, Institute for Environmental Studies, Toronto, Ontario, Canada; University of Waterloo, Waterloo, Ontario, Canada

Radium-226 and Lead-210 Uptake in TYPHA LATIFOLIA from Inactive Uranium Mill Tailings in Canada

CONF-810722; IAEA-SM-257/10; 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. International Atomic Energy Agency, Vienna; (pp. 247-262) (1982)

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 TYPHA LATIFOLIA from tailings is shown to differ from the uptake of the elements by the same plants growing in the soil. Concentration factors calculated on solids concentrations (tailings or soils) lead to different conclusions with respect to uptake than do 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. (EDB)

581

Kalin, M., and H.D. Sharma, University of Toronto, Toronto, Ontario, Canada

Radium-226 and Other Group Two Elements in Abandoned Uranium Mill Tailings in Two Mining Areas in South Central Ontario

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 707-712) (1981)

The inactive uranium mill tailings investigated in this study are located in two mining districts, Elliot Lake and Bancroft, Ontario, Canada. The sites exhibit a mixture of surface features consisting of dry areas with or without vegetation, and areas covered with water. It was found that most of the radium-226 remains in the roots of the plants, and that the solubility of radium-226 in control soil differs from that in tailings. The uptake of radium-226 by vegetation and other biota is related to the solubility of the element in water. Factors controlling the solubility of radium-226 in uranium mill tailings are of interest in assessing the environmental effects of these wastes. (EDB)

582

Kalin, M., and H.D. Sharma, University of Toronto, Toronto, Ontario, Canada

Lead Total and Lead-210 in 20-Year-Old Uranium Mill Tailings

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 697-700) (1981)

Measurements of Pb-210 and total lead on tailings samples taken from 16 sites indicate that the ratios of the activity of Pb-210 to the mass of total lead can provide parameters which are helpful in the estimation of the total amount of radon and its decay products diffusing from the tailings ponds. In this paper, the results of measurements of activities of Ra-226, Pb-210 and total lead in samples from various ponds situated in both mining districts are presented. The measurements were confined to samples taken at 0 to 25 cm depth from the surface. (EDB)(CAJ)

583

Kaufmann, R.F., Converse Ward Davis Dixon Consultants, Las Vegas, NV

Role of the Aqueous Pathway in Environmental Contamination from Uranium Mining

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 1004-1013) (1981)

In response to the Uranium Mill Tailings Radiation Control Act (Public Law 95-604, Section 114c), a report has been prepared by the U.S. Environmental Protection Agency which describes the potential health and environmental effects associated with uranium mine wastes. All potential sources of contaminants, solids, liquids, and airborne emissions, which might cause adverse impacts upon the environment or health of nearby populations as well as the geology, hydrology, and aqueous pathways were considered. Wastes at both active and inactive uranium mines are described and assessed with respect to dose and health effects. The emphasis of this paper is on the liquid emissions and the aqueous pathway. (EDB)

584

Kaufmann, R.F., C.R. Lawrence, and R.J. Hughes, U.S. Environmental Protection Agency, Las Vegas, NV;

Hydrogeologic Influences on the Long Term Disposal of Uranium Mill Tailings

CONF-790270; Groundwater Pollution, Proceedings of the Conference, Perth, Western Australia, February 19-23, 1979 (1980)

Experience in the United States with management and disposal of uranium mill tailings is reviewed with the emphasis on siting, design, monitoring, operation, and eventual stabilization of tailings piles. Most important are questions concerning the roles soil and hydrologic factors have in affecting radon exhalation and leachate production. Three case histories are used as examples of groundwater contamination at leach mills. Recently published performance objectives, licensing guidelines, and licensing actions for uranium mills and related tailings disposal options are reviewed. Groundwater monitoring at active and inactive tailings sites is discussed. (EDB) (JMF)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

585
Kelly, T.E., R.L. Link, and M.R. Schipper, Geohydrological Associates, Inc., Albuquerque, NM

Effects of Uranium Mining on Ground Water in Ambrosia Area, New Mexico

CONF-7905120; Proceedings of the New Mexico Bureau of Mines and Mineral Resources Conference, Albuquerque, NM, May 13-16, 1979; (pp. 313-331) (1980)

This paper discusses the impact of mining on the principal aquifer in the Ambrosia Lake area, the Westwater Canyon member of the Morrison Formation. Loss of potentiometric head has resulted in interformational migration of groundwater. This migration has produced local deterioration in the chemical quality of the groundwater. (EIX)(JMF)

586
Klohn, E.J., Klohn Leonoff Consulting Limited, Richmond, British Columbia, Canada

Seepage Control for Tailings Dams

CONF-7905106; Proceedings of the First International Mine Drainage Symposium, Denver, CO, May 20-23, 1979; (pp. 671-672) (1979)

The problem of seepage control for tailing dams is addressed. Conventional flow nets are presented to illustrate the effectiveness of various seepage control measures that normally are used in the design of water storage dams. The application of these measures to tailings dam design and construction is discussed. Examples are presented to illustrate some of the problems that can develop when uncontrolled seepage occurs. Also presented are several case histories, illustrating seepage control measures incorporated into the design of several existing tailings dams. (EIX)(JMF)

587
Knight, G.B.

Radiation Surveys in Contaminated Communities

CONF-770231; Proceedings of the Radon Workshop, New York, NY, February 1977; (pp. 73-77) (1977)

Radiation surveys of uranium contamination in Uranium City and Port Hope, Canada, are described. Samples of soil, water, and crops grown in contaminated soil and air in homes were analyzed for radon content. Following decontamination, measurements were made of gamma exposure rates both inside and outside of buildings. (EDB)(JMF)

588
Kvasnicka, J., Northern Territory Department of Mines and Energy, Mines Division, Occupational Hygiene Branch, Darwin, Australia

Progress Report - Radiation Data Input for the Design of Dry or Semi-Dry Tailings Disposal

Northern Territory, Occupation Hygiene Branch Progress Report; 23 pp. (1984, January)

Prior to discussion of design criteria for the handling of dry or semi-dry tailings, it is necessary to obtain an insight into the radiation levels concentrated in the tailings particles and to study the basic physical properties of dry tailings. This report presents the experimental results of assessment of radium and specific alpha activity distribution in particle size fractions of Ranger and Nabarlek Uranium Mines dry tailings samples. The variation of radon emanation coefficient versus particle size of dry tailings was also measured. Track etch technique, gamma spectrometry, and alpha counting were used for the above measurements. Surface radon flux from the hypothetical Nabarlek semi-infinite dry tailings pile is 57 Bq/sq m/s and the same figure for Ranger is 22 Bq/sq m/s. The theoretical exposure rates for 1 m above these hypothetical tailings piles are 3.7 mR/hr and 1.1 mR/hr, respectively. Several simple suggestions were proposed to maintain the principles of radiation safety during the handling of dry tailings. (Auth)

589
Landa, E.R.

Leaching of Radionuclides from Uranium Ore and Mill Tailings

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

Uranium (Amsterdam) 1(1):53-63 (1982, November)

The geochemical association of uranium, thorium-230, and radium-226 in a uranium-ore blend and the tailings derived from the ore blend at an acid-leach uranium mill were studied by a sequential, selective extraction procedure. The majority of the extractable uranium was associated with the readily acid-soluble fraction in both ore and tailings. Most of the extractable radium-226 was associated with an iron, manganese hydrous-oxide fraction in the ore and tailings, while the major portion of extractable thorium-230, which was the least leachable of the radionuclides, was associated with alkaline-earth sulfate precipitates, organic matter, or both. (ENVIR)

590

Lepel, E.A., W.B. Silker, V.W. Thomas, and D.R. Kalkwarf, Pacific Northwest Laboratory, Richland, WA

Comparison of Field-Measured Radon Diffusion Coefficients with Laboratory-Measured Coefficients

NUREG/CR-2769; 36 pp. (1983, April)

Experiments were conducted to compare radon diffusion coefficients determined for 0.1-m depths of soils by a steady-state method in the laboratory, and diffusion coefficients evaluated from radon fluxes through several-fold greater depths of the same soils covering uranium-mill tailings. The coefficients refer to diffusion in the total pore volume of the soils and are equivalent to values for the quantity, D/P, in the Generic Environmental Impact Statement on Uranium Milling prepared by the U.S. Nuclear Regulatory Commission. Two soils were tested: a well-graded sand, and an inorganic clay of low plasticity. For the flux evaluations, radon was collected by adsorption on charcoal following passive diffusion from the soil surface and also from air recirculating through an aluminum tent over the soil surface. An analysis of variance in the flux evaluations showed no significant difference between these two collection methods. Radon diffusion coefficients evaluated from field data were statistically indistinguishable, at the 95% confidence level, from those measured in the laboratory; however, the low precision of the field data prevented a sensitive validation of the laboratory measurements. From the field data, the coefficients were calculated to be 0.03 plus or minus 0.03 sq cm for the sand cover and 0.0036 plus or minus 0.0004 sq cm/s for the clay cover. The low precision in the coefficients evaluated from field data was attributed to high variation in radon flux with time and surface location at the field site. (EDB)

591

Levins, D.M., and R.K. Ryan, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Leaching of Radium-226 from Uranium Tailings

IAEA Waste Management Research Abstracts 11:47-48 (1976)

The principal waste arising from acid leaching of uranium ores is a slurry consisting of a mixture of tailings and acidic raffinate. This slurry is impounded, possibly after neutralization, in a tailings retention system. The subsequent natural leaching of radium from these tailings is important because water seeping from the retention system could become a source of groundwater pollution. A systematic study of the factors affecting the leachability of radium-226 from tailings (derived from an ore containing 0.22% uranium) is being undertaken in order to propose a mechanism for this leaching. Batch experiments are being conducted in a 2-l agitated vessel. Major findings are as follows: (1) initial release of radium from tailings is very rapid, occurring within one minute; (2) equilibrium is established between solution and tailings in about one hour; (3) significant quantities of radium can be leached by contact of tailings with large volumes of water (while only 0.10% of radium was released into solution at a liquid/solid weight ratio of 1.25, over 3% was released at a liquid/solid ratio of 60, with the equilibrium concentration of radium-226 in solution varying from 400-650 pCi/l); and (4) high sulfate concentrations in solution tend to retard the release of radium. (Auth)(MFB)

592

Li, C.T., M.R. Elmore, and J.N. Hartley, Pacific Northwest Laboratory, Richland, WA

Review of Fugitive Dust Control for Uranium Mill Tailings

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

NUREG/CR-2856; PNL-4360; 54 pp. (1983, January)

An immediate concern associated with the disposal of uranium mill tailings is that wind erosion of the tailings from an impoundment area will subsequently deposit tailings on surrounding areas. Pacific Northwest Laboratory (PNL), under contract to the U.S. Nuclear Regulatory Commission, is investigating the current technology for fugitive dust control. Different methods of fugitive dust control, including chemical, physical, and vegetative, have been used or tested on mill tailings piles. This report presents the results of a literature review and discussions with manufacturers and users of available stabilization materials and techniques. (EDB)

593
Lindsay, D.B., J.E. Oberholtzer, and C.H. Summers, Little (Arthur D.), Inc., Cambridge, MA

Sealant Tests to Control Radon Emanation in a Uranium Mine - Open File Report, September 1979-December 1981

Bureau of Mines Open File Report 172-82; PB-83-122762; 91 pp. (1981, December)

This report describes a field-test program to determine the effectiveness of a polymeric wall sealant to reduce the escape of naturally occurring radioactive radon gas from the walls of an underground uranium mine into the ventilation air. (EDB)

594
Lush, D.L., W.J. Snodgrass, and P. McKee, Beak Consultants Limited, Toronto, Ontario, Canada

Aquatic Pathway Variables Affecting the Estimation of Dose Commitment from Uranium Mill Tailings

CONF-820552; STI/PUB-622; IAEA-SM-262/9; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 483-503) (1982)

In a series of studies being carried out for the Atomic Energy Control Board of Canada, the environmental variables affecting population dose commitment and critical group dose rates from aquatic pathways were investigated. A model was developed to follow uranium and natural thorium decay series radionuclides through aquatic pathways leading both to long-term sediment sinks and to man. Pathways leading to man result in both a population dose commitment and a critical group dose rate. The key variables affecting population dose commitment are suspended particulate concentrations in the receiving aquatic systems, the settling velocities of these particulates, and the solid-aqueous phase distribution coefficient associated with each radionuclide. Of secondary importance to population dose commitment are the rate at which radionuclides enter the receiving waters and the value of the water to food transfer coefficients that are used in the model. For the critical group dose rate, the rate at which the radionuclides leave the tailings, the water to food transfer coefficients, the rate of water and fish consumption, and the dose conversion factors for Pb-210 and Po-210 are of secondary importance. (EDB)

595
Markos, G., and K.J. Bush, University of Colorado at Denver, Denver, CO

Contamination of Ground and Surface Waters by Uranium Mining and Milling - Volume 2: Field Sampling and Empirical Modeling

Bureau of Mines Open File Report 19-83; GECR-R-818; 129 pp. (1981, December)

Uranium mill tailings represent a potential threat to the human habitat by containing large amounts of radioactive and chemically toxic substances in high concentrations. These undesired components enter the human habitat in various pathways such as by erosion and water or air transport. The main objective of this investigation is to evaluate the actual movement and model the potential movement of contaminants by seepage of water from the tailings into the subtailings soil. This report represents various models of the movement of contaminants using both theoretical approaches and empirical evaluation of data available from other investigations. Data analysis shows that the critical area of investigating movements is the interfaces between tailings and the external environment. The chemical differences at interfaces seem to result in a sink system for contaminants. The tailings-soil-water system shows extreme complexities because of chemical and physical heterogeneity of the system, preventing the use of a single comprehensive model to represent real conditions. The validity of the simplifying assumption used has been shown, and increasing complexity has been built into the models. Analogs of these models can be used for evaluation of similar systems. (Auth)

596
Markos, G., and K.J. Bush, GECR, Inc., Rapid City, SD

Physico-Chemical Processes in Uranium Mill Tailings and Their Relationship to Contamination

Uranium Ore Processing and Tailings Conditioning for Minimizing Long-Term Environmental Problems in Tailings Disposal, Proceedings of a Workshop, Fort Collins, CO, October 28-30, 1981; (pp. 99-114) (1982)

Investigations over the last three years, of the physicochemical properties of abandoned uranium mill tailings, in a range of climatic and geologic environments of the United States, show that tailings are in chemical disequilibrium and are reactive due to their high salt and moisture content. The chemical reactions redistribute the water and salts causing physical forces to operate within the tailings which are manifested by many observable features. The chemical reactions are the ultimate driving force causing chemical and physical instability and must be considered in the development of safe long-term disposal practices. Chemical reactions are also significant at the contact of two differing chemistries of the tailings and environment where neutralization, precipitation, and immobilization of contaminations may occur. (EDB)

597
Marks, S., Pacific Northwest Laboratory, Richland, WA

Uranium Mill Tailings and Risk Estimation

PNL-SA-12198; CONF-840488; Low-Level Nuclear Waste Cleanup, Proceedings of a Conference, Arlington, VA, April 16, 1984; (10 pp.) (1984, April)

Work done in estimating projected health effects for persons exposed to mill tailings at vicinity properties is described. The effect of the reassessment of exposures at Hiroshima and Nagasaki on the risk estimates for gamma radiation is discussed. A presentation of current results in the epidemiological study of Hanford workers is included. (Auth)

598
Marple, M.L., and L.D. Potter, Los Alamos Scientific Laboratory, Los Alamos, NM

Radium-226 in Plants and Substrates at Inactive Uranium Mill Sites in the Southwestern United States

CONF-810153; Natural Radiation Environment, Proceedings of the Second Special Symposium, Bombay, India, January 19, 1981. John Wiley and Sons, Inc., New York, NY; (pp. 251-257) (1981, January)

The uptake and translocation of contaminants from uranium mill tailings piles and other similar wastes could be an important transport mechanism of these contaminants into the environment. The content of Ra 226, the radionuclide of most concern, was investigated in plants growing on inactive uranium mill tailings sites in the Four Corners Region of the southwestern United States and in plants grown under greenhouse conditions with minimal surficial contamination. This study provides a basis for estimating intake levels for herbivores and for evaluating transfer coefficients. (EDB)

599
Marple, M.L., and L.D. Potter, Los Alamos National Laboratory, Los Alamos, NM; University of New Mexico, Department of Biology, Albuquerque, NM

Uptake of Radium-226 by Plants at Inactive Uranium Mill Sites in the Southwestern United States

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

CONF-810722; IAEA-SM-257/81; 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. International Atomic Energy Agency, Vienna; (pp. 237-246) (1981)

The objectives of this study were: 1) to measure the uptake and translocation of radium to aboveground parts of plants growing in uranium mill tailings, 2) to compare these results to plants growing in uranium mill tailings and in local soils, and 3) 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 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. (EDB)(CAJ)

600

Moffett, D., G. Zahary, M.C. Campbell, and J.C. Ingles, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada; Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

CANMET's Environmental and Process Research on Uranium

CONF-780740; Management, Stabilization, and Environmental Impact of Uranium Mill Tailings, Proceedings of a Conference, Albuquerque, NM, July 24-28, 1978, 498 pp.; (pp. 325-351) (1978)

Environmental research related to uranium tailings is being carried out within the Mining Research Laboratories and Mineral Sciences Laboratories of CANMET, EMR. Field-related research on uranium tailings has been conducted at Elliot Lake for over 5 yr. Much of the work has been focused on a program to rehabilitate pyritic tailings. This has resulted in developing a practicable technology of regrowing vegetation on such wastes. The research has been limited by the small size of the test plots and the relatively short period during which experiments have been carried out. A research program aimed at identifying and reducing acidic and radioactive effluents is also under way at Elliot Lake. These liquid effluents have been identified as the most serious threat to the environment. Research at the Mineral Sciences Laboratories and its predecessor divisions relating to the processing of uranium and thorium ores is outlined. A process has been developed for recovering thorium, which could reduce the overall radioactive load in the tailings. Much of the current work is related to developing new technology for recovering uranium from lower-grade ores which is unlikely to be implemented within the next 10 yr. A significant effort is also being made in removing pyrite, preconcentrating radioactive mineral, and identifying and removing chemical compounds that carry radium in solid tailings. (EDB)(JMF)

601

Momeni, M.H., Argonne National Laboratory, Argonne, IL

Analyses of Uranium and Actinium Gamma Spectra: An Application to Measurements of Environmental Contamination

CONF-810647; X- and Gamma-Ray Sources and Applications, Proceedings of a Conference, Ann Arbor, MI, June 10, 1981; (16 pp.) (1981)

A system for the reduction of the complex gamma spectra of nuclides in the uranium, actinium, and thorium series, tailored to calculation of line intensities, analyses of errors, and identification of nuclides, is described. This system provides an efficient technique for characterizing contamination in the environs of uranium mines and mills. Identification of the nuclides and calculation of their concentrations require accurate knowledge of gamma energies and absolute quantum intensities. For some spectral lines, there are no reported measurements of absolute quantum intensities, and in some cases where reports are available the measured intensities are not in agreement. In order to improve this data base, the spectra of gamma rays (of nuclides in the uranium and actinium series) with energies between 40 and 1400 keV were measured using high-resolution germanium detectors. A brief description of the spectroscopy system, computational algorithms for deconvolution, and methods of calibration for energy and efficiency, are described. The measured energies and absolute quantum intensities are compared with those reported in the literature. (EDB)

602

Momeni, M.H., Argonne National Laboratory, Argonne, IL

Environmental Impact of Uranium Mining and Milling: An American View

CONF-8108160; Environmental Impact of Uranium Mining and Milling, Proceedings of an American Chemical Society Conference, Detroit, MI, August 18, 1981; (13 pp.) (1981)

Radiation dose rates to man from uranium milling activities are discussed. The sources of radiation, the radioisotopes involved, and the environmental exposure pathways are described. Risks of cancer to exposed individuals are presented and recommendations made for mitigation of contamination. (EDB)(ACR)

603

Momeni, M.H., and J.E. Carson, Argonne National Laboratory, Argonne IL

Temporal and Spatial Distribution of Radon-222 and Its Daughters in Complex Terrains

CONF-820101; Applications of Air Pollution Meteorology, Proceedings of the Third Joint Conference, San Antonio, TX, January 11, 1982. American Meteorological Society, Boston, MA; (pp. 178-182) (1982)

The dispersion characteristics in complex terrain near the Uravan mill (Colorado) and St. Anthony mine (New Mexico) were anabatic (up-flow) or katabatic (downflow) flows coupled to the synoptic pattern that changed slowly from sunrise to sunset. Whereas the diurnal distribution of radon and radon daughter concentrations in areas with level terrain is generally dominated by a well-behaved single peak associated with thermal inversion appearing from 4 to 6 AM, the pattern for regions with complex terrain indicated several minor peaks. The profiles of radon concentration during neutral to stable atmospheric conditions reflected the air flow patterns dominated by topography. The frequency distribution of radon concentration and working level within the canyon demonstrated a sharp rise to a maximum observed frequency, then decreased monotonically and slowly at higher concentrations. But the frequency distribution of radon concentration on the mesa and reliefs was a superposition of several distributions. The frequency distribution and profile of radon concentration and the tracer flow patterns indicated trapping of airborne radionuclides within the canyons during the night. (EDB)

604

Momeni, M.H., S.Y.H. Tsai, J.Y. Yang, A.B. Gureghian, and C.E. Dungey, Argonne National Laboratory, Argonne, IL

Radiological Impacts of Jackpile-Paguate Uranium Mines: An Analysis of Alternatives of Decommissioning

ANL/ES-131; 232 pp. (1983)

Potential pathways of radiation exposure and radiation-induced genetic and somatic effects from materials at the mine complex under five alternatives of decommissioning were analyzed using UDAD and PRIM computer codes. The principal pathways of exposure included in the analysis were inhalation of airborne radionuclides, ingestion of food and water containing radionuclides, and extended exposure to gamma and beta radiation from either airborne or ground-deposited radionuclides. The alternatives of decommissioning include: (A) No Action (site will be fenced, otherwise left as it is); (B) No Future

Use (site will be fenced and all disturbed area will be covered with 30 cm of soil, no grazing on the site); (C1) Grazing Land Use as developed by Anaconda Company (waste piles and open pits covered with 120 cm of soil, the remainder of the disturbed areas covered with 30 cm of soil, pits backfilled 90 cm above the equilibrium groundwater recovery level, no human habitation or farming allowed on the mine site, but grazing would be allowed); (C2) Grazing Land Use as developed by U.S. Department of the Interior (similar to Alternative C1, but the pits covered with 300 cm of soil above the groundwater recovery level); and (D) Maximum Future Use (similar to Alternative C2, except construction of commercial and industrial facilities, storage, recreation, and further mining would be allowed). Radiation doses from atmospheric transport and ingestion of radionuclides were calculated, and somatic and genetic effects in individuals living within 80 km from the mine complex were predicted. Hydrological flow patterns in the mine area were analyzed to determine the potential for future contamination of surface water and groundwater and to determine the groundwater recovery level after reclamation, thus permitting incorporation of corrective actions into the reclamation procedures. (EDB)

605

Myers, D.A., S.W. Tyler, P.J. Gutknecht, and D.H. Mitchell, Pacific Northwest Laboratory, Richland, WA

Leak Detection Systems for Uranium Mill Tailings Impoundments with Synthetic Liners

NUREG/CR-3259; PNL-4694; 49 pp. (1983, September)

This study evaluated the performance of existing and alternative leak detection systems for lined uranium mill tailings ponds. Existing systems for detecting leaks at uranium mill tailings ponds investigated in this study included groundwater monitoring wells, subliner drains, and lysimeters. Three alternative systems were evaluated which demonstrated the ability to locate leaks in bench-scale tests. The systems included moisture blocks, soil moisture probes, and a soil resistivity system. Several other systems in a developmental stage are described. For proper performance of leak detection systems (other than groundwater wells and lysimeters), a subgrade is required which assures lateral dispersion of a leak. Methods to enhance dispersion are discussed. Cost estimates were prepared for groundwater monitoring wells, subliner drain systems, and the three experimental systems. Based on the results of this report, it is suggested that groundwater monitoring systems be used as the primary means of leak detection. However, if a more responsive system is required because of site characteristics and groundwater quality criteria, subliner drains are applicable for ponds with uncovered liners. Leak-locating systems for ponds with covered liners require further development. Other recommendations are discussed in the report. (EDB)

606

Nelson, R.W., P.R. Meyer, P.L. Oberlander, S.C. Sneider, D.W. Mayer, and A.E. Reisenauer, Pacific Northwest Laboratory, Richland, WA

Model Evaluation of Seepage from Uranium Tailings Disposal Above and Below the Water Table

NUREG/CR-3078; PNL-4461; 139 pp. (1983, March)

Model simulations identify the rate and amount of leachate released to the environment if disposed uranium mill tailings come into contact with ground water or if seepage from tailings reaches ground water. In this study, simulations of disposal above and below the water table, with various methods of leachate control, were compared. Three leachate control methods were used in the comparisons: clay bottom liners; stub-sidewall clay liners; and tailings drains with sumps, with the effluent pumped back from the sumps. The best leachate control for both above and below the water table is a combination of the three methods. The combined methods intercept up to 80% of the leachate volume in pits above the water table and intercept essentially all of the leachate in pits below the water table. Effluent pumping, however, requires continuous energy costs and an alternative method of disposal for the leachate that cannot be reused as makeup water in the mill process. Without the drains or effluent pumping, the clay bottom liners have little advantage in terms of the total volume of leachate lost. The clay liners do reduce the rate of leachate flow to the ground water, but the flow continues for a longer time. The buffering, sorption, and chemical reactions of the leachate passing directly through the liner are also advantages of the liner. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

607

Nielson, K.K., and V.C. Rogers, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Mathematical Model for Radon Diffusion in Earthen Materials

NUREG/CR-2765; PNL-4301; RAE-18-2; 48 pp. (1982, October)

Radon migration in porous, earthen materials is characterized by diffusion in both the air and water components of the system as well as by the interaction of the radon between the air and water. The size distribution and configuration of the pore spaces and their moisture distributions are key parameters in determining the radon diffusion coefficient for the bulk material. A mathematical model is developed and presented for calculating radon diffusion coefficients solely from the moisture content and pore size distribution of a soil, reducing the need for resorting to radon diffusion measurements. The resulting diffusion coefficients increase with the median pore diameter of the soil and decrease with increasing widths of the pore size distribution. The calculated diffusion coefficients are suitable for use in simple homogeneous-medium diffusion expressions for predicting radon transport and compare well with measured diffusion coefficients and with empirical diffusion coefficient correlations. (EDB)

608

Oksza-Chocimowski, G.V., U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Basic Technique and Models for Determining Exposure Rates Over Uranium-Bearing Soils, Final Report

PB-83-147892; 160 pp. (1982, August)

The application of simple computer-implemented analytical procedures to predict exposure rates over uranium-bearing soil deposits is demonstrated in this report. The method is based, conceptually, on the energy-dependent point-source buildup factor and, operationally, on two consecutive integrations. The dependence of photon fluxes on spatial variables is simplified by an analytical integration over the physical dimensions of the deposit, represented as a slab bearing homogeneously distributed nuclides of the uranium-238 decay chain, at equilibrium, and covered with a source-free overburden slab; both slabs being of variable thickness but of infinite areal extent. The resultant analytical expression describes flux as function of energy-dependent parameters, thickness of the source slab, and depth of overburden, and is equated analytically to exposure rates bearing the same dependence. Elementary computer techniques are then employed to integrate numerically the exposure rates corresponding to the specific energies of the uranium-238 decay chain, for chosen thicknesses of the overburden and uranium-bearing slabs. (EDB)

609

Opitz, B.E., W.J. Martin, and D.R. Sherwood, Pacific Northwest Laboratory, Richland, WA

Gelatinous Soil Barrier for Reducing Contaminant Emissions at Waste-Disposal Sites

PNL-SA-10784; 26 pp.; CONF-821139; Management of Uncontrolled Waste Sites, Proceedings of the Third National Conference and Exhibition, Washington, DC, November 29, 1982 (1982)

The milling of uranium ore produces large quantities of waste (mill tailings) that are being deposited in earthen pits or repositories. These wastes, which remain potentially hazardous for long time periods, may reach the biosphere at levels greater than those allowed by the Environmental Protection Agency (EPA). For example, the leachates associated with these wastes contain numerous radionuclides and toxic trace metals at levels 100 to 10,000 times greater than allowable for drinking water based on EPA Primary Drinking Water Standards. As a result, technologies must be developed to ensure that such wastes will not reach the biosphere at hazardous levels. Under sponsorship of the Department of Energy's Uranium Mill Tailings Remedial Action Program (UMTRAP), Pacific Northwest Laboratory (PNL) has investigated the use of engineered barriers for use as liners and covers for waste containment. Results of these investigations have led to the development of a low permeable, multilayer earthen barrier that effectively reduces contaminant loss from waste disposal sites. The multilayer earth barrier was developed as an alternative to clay liner or cover schemes for use in areas where clays were not locally available and must be shipped to the disposal site. The barrier layer is comprised of 90% locally available materials whose liner or cover properties are enhanced by the addition of a gelatinous precipitate which entrains moisture into the cover's air-filled pore spaces, blocking the pathways through which gas would otherwise diffuse into the atmosphere or through which moisture would migrate into the ground. In field verification tests, the earthen seal reduced radon gas emissions by 95 to 99% over prior release rates with measured permeabilities on the order of 10(E-9) cm/s. (EDB)

610
Opitz, B.E., and D.R. Sherwood, Pacific Northwest Laboratory, Richland, WA

Neutralizing Barrier for Reducing Contaminant Migration from a Uranium Mill Tailings Disposal Pond

PNL-SA-11643; 11 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 93-103) (1984, February)

The use of various neutralizing reagents and techniques to attenuate the movement of contaminants associated with acidic uranium mill tailings solutions was investigated. Results of these investigations led to the development of a low-permeable, neutralizing barrier that may effectively reduce contaminant migration from a tailings impoundment. Incorporating a neutralizing barrier below the tailings pond ensures that the only solution treated is that which escapes, thus reducing the costs by not treating the entire solution. In laboratory verification tests, neutralizing barriers reduced the effluent solution concentrations of several constituents (Al, As, Cr, Fe, V, Pb-210, U-238, and Th-230) by greater that 90% in comparison with concentrations found in the pond. The neutralizing barrier inhibited drainage because of its reduced permeability [10(E-3)cm/s]. (Auth)

611
Osiensky, J., University of Idaho, Moscow, ID

Ground-Water Withdrawal Schemes for Uranium Mill Waste Disposal Sites

Ground Water Monitoring Review 3(1):22-27 (1983)

This article presents a brief overview of groundwater contamination from uranium mill waste disposal facilities and describes how one milling company is attempting to rectify the damage caused to the groundwater resource at their disposal site. Seepage from uranium mill waste disposal facilities is one of the more prominent sources of groundwater contamination in the western United States. (PA)

612
Pacific Northwest Laboratory, Richland, WA

Radon Diffusion Through Multilayer Earthen Covers: Models and Simulations

DOE/UMT-0204; PNL-3989; 55 pp. (1981, September)

The use of multilayered earthen covers for controlling radon gas emissions from uranium mill tailings was investigated. A modeling study of radon diffusion through multiple-cover layers was initiated to aid in the design of cover systems that can effectively control radon emissions to a prescribed flux limit. The design considers field conditions where compaction densities and variable moisture contents in the cover control the radon flux. The study used a four-phase approach. Phase one developed the solution to the steady-state, radon-diffusion equation in one dimension. Phase two developed the capability to model one-dimensional transient diffusion of radon gas and considers the effects of time-varying moisture content throughout the tailings pile. Phase three developed a multidimensional transient model that can be used to investigate the two- and three-dimensional aspects of radon diffusion. The final phase investigated the radon flux and concentration profiles that develop in tailings and cover systems. (Auth)(BDC)

613
Perkins, R.W., and V.W. Thomas

Direct Measurement of Radionuclides in Uranium Mill Tailings, Ores, and Dust

CONF-770581; Methods for Measuring Radiation In and Around Uranium Mills, Proceedings of a Workshop, Albuquerque, NM, May 23-26, 1977, 434 pp.; (pp. 255-274) (1977)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

The feasibility of measuring uranium-235 and some of the more important long-lived radionuclides in the uranium-238 series was demonstrated. This was accomplished by the use of a large area intrinsic germanium diode. The accuracies of the measurements are adequate for most purposes and the analytical procedure is quicker and less complex than chemical separation techniques. This procedure should be particularly useful in surveys of uranium tailings areas where hundreds to thousands of analyses are required. It should also be useful in determining the degree of disequilibrium in uranium ores and in ore dusts generated in the milling process. (EDB)(JMF)

614

Peterson, S.R., A.R. Felmy, R.J. Serne, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Predictive Geochemical Modeling of Interactions Between Uranium-Mill-Tailings Solutions and Sediments in a Flow-Through System: Model Formulations and Preliminary Results

NUREG/CR-3404; 93 pp. (1983, August)

An equilibrium thermodynamic conceptual model consisting of minerals and solid phases was developed to represent a soil column. A computer program was used as a tool to solve the system of mathematical equations imposed by the conceptual chemical model. The combined conceptual model and computer program were used to predict aqueous phase compositions of effluent solutions from permeability cells packed with geologic materials and percolated with uranium mill tailings solutions. Initial calculations of ion speciation and mineral solubility and our understanding of the chemical processes occurring in the modeled system were used to select solid phases for inclusion in the conceptual model. The modeling predictions were compared to the analytically determined column effluent concentrations. Hypotheses were formed, based on modeling predictions and laboratory evaluations, as to the probable mechanisms controlling the migration of selected contaminants. An assemblage of minerals and other solid phases could be used to predict the concentrations of several of the macro constituents (e.g., Ca, SO4, Al, Fe, and Mn) but could not be used to predict trace element concentrations. These modeling conclusions are applicable to situations where uranium mill tailings solutions of low pH and high total dissolved solids encounter either clay liners or natural geologic materials that contain inherent acid neutralizing capacities. (EDB)

615

Phillips, W.F., and D.A. Bell, Utah State University, Department of Mechanical Engineering, Logan, UT

Diffusion of Radon Gas from Uranium Mill Tailings

Journal of Energy Resources Technology 104(2) :130-133 (1982, June)

A finite element model is presented that predicts radon diffusion in an n-layer composite. The basis functions are obtained from an exact solution to the differential equation for a homogeneous layer. Thus the model gives the exact solution for n homogeneous layers and, by using many small layers, will give good results for any nonhomogeneous composite. The model can account for diffusion into the soil below the tailings, a finite radon concentration in the ambient, and a radon source in each layer and the underlying base soil. (EIX)

616

Pin, F.G., A.J. Witten, R.D. Sharp, and E.C. Long, Jr., Oak Ridge National Laboratory, Oak Ridge, TN

Rapid Seepage of Contaminants Through the Highwall of a Uranium Mill Tailings Pit

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 155-165) (1984, February)

A computer code (MIGRAT) is used to quantify the migration of moisture and multiple retarded contaminants in the unsaturated zone and to assess the impact of open mine disposal of uranium mill tailings. The model is applied to a generic uranium mill tailings pit constructed with a clay-lined bottom and steep unlined sidewalls. The migration of a two-contaminant system is modeled assuming that neither contaminant decays and

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

that only one contaminant is retarded. This study shows the anticipated result that moisture and contamination migrate slowly through the bottom clay liner and that, in this migration, concentrations of the retarded contaminant significantly lag the unretarded contaminant. This study also shows that the major pathway from the pit to the underlying water table is through the sidewall and that the time scales for this pathway are much shorter than those associated with the clay liner. More importantly, this study reveals that due to the strong nonlinear character of the hydraulic properties of unsaturated soils, concentrations of the retarded contaminant may only slightly lag the nonretarded contaminant through this pathway and contamination of the uppermost aquifer by the retarded contaminant may occur shortly after contamination by the nonretarded contaminant. (Auth) (NPK)

617

Pin, F.G., A.J. Witten, R.D. Sharp, and E.C. Long, Jr., Oak Ridge National Laboratory, Oak Ridge, TN

Numerical Study of Unsaturated Flows and Seepage of Contaminants from Subgrade Mill Tailings Disposal Areas Equipped with Bottom-Clay Liners

ORNL/TM-8822; NUREG/CR-3398; 55 pp. (1983, August)

A computer code (MIGRAT) was developed to quantify the migration of moisture and multiple decaying and retarded contaminants in the unsaturated zone. MIGRAT was specifically conceived to assess the impacts of open mine disposal to allow its use in many problems related to shallow, subsurface waste disposal. The model is applied to a generic uranium-mill-tailings pit constructed with a clay-lined bottom and steep unlined sidewalls. The contaminant decays and only one contaminant is retarded. As was anticipated, this study shows that moisture and contamination migrate slowly through the bottom clay liner and that, in this migration, concentrations of the retarded contaminant significantly lag the unretarded contaminant. More importantly, this study reveals that the major pathway from the pit to the groundwater is through the sidewall. The time scales for this pathway are much shorter than those associated with the clay liner, and retardation has little effect on the rate of contaminant migration. (EDB)(EST)

618

Pradel, J., Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France

Mining Wastes

CONF-810273; Radioactive Wastes, Proceedings of a Meeting, Cadarache, France, February 2, 1981; (pp. 111-130) (1981)

The term, mining wastes, refers to wastes obtained during the extraction and processing of uranium ores, including production of uraniferous concentrates. Hazards to the population include irradiation, ingestion, and dust or radon inhalation. Management is examined in the areas of liquid effluents, water treatment, contaminated materials, gaseous wastes and tailings. A review of the different wastes is made which includes a discussion of the environmental impact of these wastes during and after exploitation. Monitoring and measurements are carried out to insure that ICRP recommendations are met. Studies in progress to improve mining waste management are outlined. (EDB)(EST)

619

Pullen, P.F., and J.B. Davis, Rio Algom Limited, Elliot Lake, Ontario, Canada

Description of the Panel Mine Tailings Area, Rio Algom Limited, Elliot Lake, Ontario, Canada

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 29-44) (1982)

The geomorphological setting of the Panel Mine tailings management area is described in relation to the geology of the Canadian Shield subject to recent glaciation and subsequent weathering and erosion in a humid climate with temperature extremes. For the deposition of uranium tailings a topographic low is chosen that is surrounded by bedrock with a low water permeability. This latter is evaluated by a detailed geological investigation and by drilling to investigate the relative permeability of suspected seepage paths. It is estimated that seepage from the basin used will be less than 1 l/s. Monitor wells have been established to determine the quality of the groundwater flows. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

620

Raghavayya, M., A.H. Khan, R.E. Stanley, and A.A. Moghissi, Bhabha Atomic Research Center, Bombay, India; National Environmental Research Center, Las Vegas, NV

Radon Emanation from Uranium Mill Tailings Used as Backfill in Mines

CONF-730915; Proceedings of the Symposium on Noble Gases, Las Vegas, NV, September 24-28, 1973; (pp. 269-273) (1973)

As a standard practice, uranium mill tailings are returned to the mine as backfill to stabilize stoped areas. The tailings returned to the mine are the coarser fraction, as separated by hydrocyclones. These "sands" still contain significant quantities of radium. The sands which consist of small particle sizes have a much larger surface area per unit volume for the emanation of radon, compared to the unbroken ore. The emanation of radon from the backfill is, therefore, expected to be much higher than from the ore body itself. A method is described for estimating the radon emanation from mill tailings used as backfill. The effect of increased emanation on ventilation requirements is discussed. (Auth) (JMF)

621

Rich, D.C., K.K. Nielson, and V.C. Rogers, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Measurement of Radon Diffusion Coefficients through Various Soils

Health Physics 43(1):121-122; CONF-820655; Proceedings of the 27th Annual Meeting of the Health Physics Society, Las Vegas, NV, June 27-July 1, 1982 (1982)

Exposure to radioactive radon-222 gas released from uranium mill tailings can be reduced by covering the tailings with non-radium bearing soil. The reduction in the radon escaping is determined not only by the depth of the cover soil but also by the radon diffusion coefficient through the soil. Four techniques are presently in use by which the radon diffusion coefficients can be measured. These techniques are: (1) radon flux measurement on large columns of compacted soil in which the radon from a source such as uranium mill tailings is allowed to equilibrate; (2) small columns of soil exposed to a sudden radon source in which the transient radon flux from the soil is measured as a function of time; (3) radon concentration measurements in an air gap over a small tailings-soil column which is allowed to equilibrate; and (4) radon concentration and flux measurements in an air gap between the radon source and the soil after the system equilibrates. The advantages and disadvantages of all four techniques are discussed and diffusion coefficient measurement results are presented. (Auth)

622

Ritcey, G.M., and M. Silver, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Lysimeter Investigations on Uranium Tailings at CANMET

Canadian Institute of Mining and Metallurgy Bulletin 75(846):134-143 (1982, October)

The processing of uranium ores produces tailings that could constitute environmental problems. At most operations the tailings are dumped into a designated area, with the ultimate acid drainage occurring if sulfides are present, together with the release of metal constituents to the rivers and streams. If the chemical reactions occurring within the tailings could be predicted, perhaps methods could be developed to either increase or decrease the rates of reaction. One such study has been in progress at CANMET during the past three years. The paper describes the use of lysimeters containing low-grade and complex uranium tailings to determine the effects and interactions of bacteria, sulfides and solvent extraction organics on the release of radionuclides and on acid production. A simulated rain cycle nine-fold the normal was used and the lysimeters were subjected to timed intervals of light and darkness. As a result, the tests simulated a 25-year period. (EDB)

623

Rogers, V.C., K.K. Nielson, and D.R. Kalkwarf, Rogers and Associates Engineering Corporation, Salt Lake City, UT; Pacific Northwest Laboratory, Richland, WA

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

Radon Attenuation Handbook for Uranium Mill Tailings Cover Design

NUREG/CR-3533; PNL-4878; RAE-18-5; 84 pp. (1984, April)

This handbook has been prepared to facilitate the design of earthen covers to control radon emission from uranium mill tailings. Radon emissions from bare and covered uranium mill tailings can be estimated from equations based on diffusion theory. Basic equations are presented for calculating surface radon fluxes from covered tailings, or alternatively, the cover thicknesses required to satisfy a given radon flux criterion. Also described is a computer code, RAECOM, for calculating cover thicknesses and surface fluxes. Methods are also described for measuring diffusion coefficients from radon, or for estimating them from empirical correlations. Since long-term soil moisture content is a critical parameter in determining the value of the diffusion coefficient, methods are given for estimating the long-term moisture content of soils. The effects of cover defects or advection are also discussed and guidelines are given for determining if they are significant. In most situations, the effects of advection and cover defects on radon flux are negligible. Several examples are given to demonstrate cover design calculations. (Auth)(PTO)

624

Rogers, V.C., K.K. Nielson, and G.B. Merrell, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Engineering Guides for Estimating Cover Material Thickness and Volume for Uranium Mill Tailings

UMTRA-DOE/ALO-193; 36 pp. (1982, November)

Five nomographs have been prepared that facilitate estimations of cover thickness and cover material volume for the Uranium Mill Tailings Remedial Action Program. Key parameters determined include the cover thickness, with either a surface radon flux or a boundary radon air concentration criterion, and the total volume of cover material required for two different treatments of the edge slopes. Also included in the engineering guide are descriptions of and representative values for the radon source term, the diffusion coefficients, and the key meteorological parameters. (Auth)(NPK)

625

Rogers, V.C., K.K. Nielson, G.B. Merrell, and D.R. Kalkwarf, Pacific Northwest Laboratory, Richland, WA; Rogers and Associates Engineering Corporation, Salt Lake City, UT

Effects of Advection on Radon Transport through Earthen Materials

NUREG/CR-3409; PNL-4789; RAE-18-4; 68 pp. (1983, October)

The effects of advection mechanisms on radon transport through earthen materials were investigated experimentally and theoretically. Natural advective transport is typically induced by atmospheric pressure variations and moisture evaporation. Cyclic radon flux variations of a factor of 12 were induced by pressure variations in the laboratory, causing net increases in average radon flux of a factor of 2. Field flux measurements exhibited diurnal variations of a factor of 1.8, with little net flux enhancement. Moisture evaporation caused three-fold increases in laboratory radon fluxes, in agreement with theoretical predictions. Minimal evaporative enhancement is predicted for field conditions, however, because the vapor transport layer is usually thin compared to the tailings cover thickness. Equations were developed to predict radon flux enhancement from measured cyclic flux variations. Advection can enhance radon fluxes when advective velocities exceed diffusive velocities and when displacement distances exceed the radon relaxation length. However, these conditions did not appear to be common among the field conditions examined. (GRA)

626

Rust, E., D. van Zyl, and S.E. Follin, Robertson and Kirsten, Inc., Pretoria, South Africa; Robertson and Kirsten, Inc., Tucson, AZ; U.S. Bureau of Mines, Twin Cities Research Center, Minneapolis, MN

Interpretation of Piezometer Cone Testing of Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 627-638) (1984, February)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

The piezocone penetrometer is an in situ testing tool that is particularly useful for the investigation of tailings impoundments. It is ideally suited for testing tailings since a lightweight pushing frame can be used for advancing the probe. A field testing program was completed at a uranium tailings impoundment in Uravan, Colorado. This paper describes how the results of piezocone tests are interpreted and demonstrates these methods using the data obtained at Uravan. Continuous records of cone resistance, pore pressure, and cone sleeve friction are obtained during penetration. These records can be interpreted to obtain the piezometric pressure distribution in the tailings profile. Information on the state of tailings consolidation and the direction of seepage can be derived from these results. The piezocone results can also be used to identify the material types in the profile. In addition, pore pressure dissipation test results can be used to estimate the coefficients of consolidation and permeability for the material. This paper describes the interpretation methodology for the parameters above and briefly discusses methods for estimating the friction angle and relative humidity. (Auth)

627

Ruttenber, A.J., Jr., and K. Kreiss, Center for Disease Control, Atlanta, GA

Radiation Exposure Assessment Following the 1978 Church Rock Uranium Mill Tailings Spill

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 768-775) (1981)

Early in the morning of July 16, 1979, there was a breach in the earthen retaining dam of a tailings pond at the United Nuclear Corporation's (UNC's) Church Rock uranium mill. The acidified liquid and tailings slurry spilled through the damaged portion of the retaining wall into an arroyo that is a tributary to the Rio Puerco river system. This paper summarizes post-spill monitoring efforts and relates the assessment of this spill to the general question of evaluating the health effects of nuclear fuel-cycle wastes. (EDB)

628

Sabau, C.S., D.R. Rayno, N.D. Kretz, and P.W. Zelle, Argonne National Laboratory, Argonne, IL

Ra-226 Radioassay of Soil and Tailings

CONF-821107; The Scientific Basis for Radioactive Waste Management, Part 1, Proceedings of the Sixth International Materials Research Society Symposium, Boston, MA, November 1, 1982; Materials Research Society Symposium Proceedings 15:647-654 (1983)

Studies of inactive uranium tailings piles have shown that tailings sands containing Ra-226 and other radionuclides may be dispersed by wind and water erosion, causing contamination of adjacent areas. To conduct an effective cleanup operation, it is necessary that boundaries of contamination be well defined. To accomplish this, data from surface gamma-ray surveys made under the Measurement Monitoring Program of DOE's Uranium Mill Tailings Remedial Action Project (UMTRAP) are first used to delineate a general outline of the contaminated area. Then, data from portable scintillometer surveys and from sealed-can gamma-ray analyses of soil samples are used to more precisely define the perimeter of Ra-226 contamination. These field measurements are supported by radiochemical analyses of randomly selected samples. Because of its adaptability to the widely varying chemical composition of the material in these samples, the complexing agent EDTA is used in a complexometric leaching procedure to analyze Ra-226. By this procedure, natural concentrations of Ra-226 in soil (approximately 1 pCi/g) can be measured routinely. The potential limit of detection is in the 0.1 to 0.5 pCi/g range. Details of the method, which includes leaching of radium followed by radon de-emanation, are described. Comparative data for various soil and tailings samples are presented. (EDB)

629

Sautter, C.A., Concordia College, Moorhead, MN

An Independent Review of the Environmental Health Aspects of the Church Rock, New Mexico, Tailings Spill

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 377-386) (1984, February)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

On July 16, 1979, a breach occurred in the United Nuclear Corporation tailings dam located at Church Rock, New Mexico. An estimated 94 million gallons of liquids were released along with 1100 tons of "bottom" solids. A conservative estimate of the solids suspended in the pond raffinate additionally released is 17 times the latter amount. The study presented in this paper developed from a need for an independent assessment of the spill to better understand the potential physical health impact on the Navajos and livestock living in the area. In the 3-week period following the spill, the levels of some contaminants were high enough to pose a potential hazard to humans and livestock. However, there was no documented evidence of physical harm from the spill. Although concentrations of some radionuclides were significantly elevated during that period, there was no immediate radiation hazard. Any future increase in the effect on physical health from spill-related increases in the amounts of radioactivity in the domestic water supplies and food sources produced in the Rio Puerco valley will be negligible compared with those effects from the natural background and mining and milling radioactive sources which continue to exist in the water and food. The surface water quality with respect to both radioactive and chemical concentrations essentially returned to known or presumed prespill levels within 3 to 5 weeks following the spill. Shallow groundwater quality may have been affected, as two wells have shown elevated levels of constituents which were also present in the tailings pond liquor. There is no evidence that consumption of meat from livestock raised in the area poses any significant health problem. (BDC)

630

Schermerhorn, S., Impact Limited, Denver, CO,

Uranium Mystique: A Search for Identity

CONF-801171; Environment and Economical Considerations in Energy Utilities, Proceedings of the Seventh National Conference, Phoenix, AZ, November 30, 1980; (pp. 250-253) (1980)

A study is performed for the calculation of mass flux of radioactive particles from uranium mill tailings and their relationship or contribution to dose. The study concludes that modeling is a good technique for estimating, for design, and for determining the most cost-effective field verification technique but with no more definitive information than has been seen, it is simply not an appropriate tool for enforcing extremely rigid standards on the uranium milling industry. (EDB)

631

Serne, R.J., S.R. Peterson, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Laboratory Measurements of Contaminant Attenuation of Uranium Mill Tailings Leachates by Sediments and Clay Liners

NUREG/CR-3124; PNL-4605; 122 pp. (1983, April)

Progress on the development of laboratory tools to aid in the prediction of migration potential of contaminants present in acidic uranium mill tailings leachate is discussed. Further, empirical data on trace metal and radionuclide migration through a clay liner are presented. Acidic uranium mill tailings solution was percolated through a clay liner. These laboratory columns and subsequent sediment extraction data show: (1) As, Cr, Pb, Ag, Th, and V migrate very slowly; (2) U, Cd, Ni, Zn, Fe, Mn, and similar transition metals are initially immobilized during acid neutralization but later are remobilized as the tailings solution exhausts the clay liner's acid buffering capacity. Such metals remain immobilized as long as the effluent pH remains above a pH value of 4 to 4.5, but they become mobile once the effluent pH drops below this range; and (3) fractions of the Se and Mo present in the influent tailings solution are very mobile. Possible controlling mechanisms for the pH dependent immobilization-mobilization of the trace metals are discussed. Using several column lengths (from 4.5 to 65 cm) and pore volume residence times (from 0.8 to 40 days), no significant differences in contaminant migration rates or types and extent of controlling processes were found. Thus, it is concluded that the laboratory results may be capable of extrapolation to actual disposal site conditions. (GRA)(NPK)

632

Sharma, D., M. Asgian, W. Highland, and J. Moreno, Dames and Moore, Inc., Denver, CO

Analysis of Complex Seepage Problems with the Disposal of Uranium Tailings - Selected Case Studies

Mineral and Energy Resources 26(1):13-23 (1983, January)

Evaluations of seepage effects from existing uranium tailings impoundments, as well as those planned for the future operations, form the subject matter of this paper. The application of an integrated program involving field measurements, laboratory measurements, and mathematical modeling is reported. The paper deals with saturated and unsaturated fluid flows in subsurface media and with the associated geochemical interactions. In addition to groundwater, the influence of impoundment liners, native soil, and rock types are discussed. Selected case studies of applications are reported and discussed. (EIX)

633
Sharp, K.D., Utah State University, Logan, UT

Development of a Model for Probabilistic Slope Stability Analysis and Application to a Tailings Dam

Thesis (1982)

The model has been applied to an existing tailings dam and to several hypothetical examples. These examples are presented to illustrate the influence of the choice of the statistical soil strength variability parameters on the probability of failure. The results show that the critical failure surface, based on the minimum safety factor, is not necessarily the failure surface that will yield the maximum probability of failure. The analysis of the tailings dam shows that variance reduction can be large and that the model error is the dominant source of uncertainty for the embankment analyzed. (PA)

634
Skinner, D.J., Chem-Nuclear Systems, Inc., Columbia, SC

A Comparison of Ra-226 Deposition Predictions Obtained from MILDOS-ANL Computer Code to Soil Concentrations Measured Downwind from a Uranium Mill Tailings Complex

CONF-830695; Proceedings of the 28th Annual Health Physics Society Meeting, Baltimore, MD, June 19-24, 1983; (32 pp.) (1983)

A computer run simulating tailings dispersion with typically available uranium mill tailings operational data is compared to Ra-226 soil concentrations measured around the mill site. The subroutine that calculates dust suspension rates was modified to allow as input the tailings moisture content and % mass of the tailings less than 20 cm in diameter. High and low values for these two variable inputs were entered into the code. The resultant Ra-226 in soil for these runs are compared to measured values and the effects on prediction accuracy are discussed. (Auth)

635
Skinner, D.J., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Ra-226 Contamination of Soil and Foliage as a Function of Distance Downwind from Uranium Mill Tailings

DOE/EV/10305-9; 46 pp. (1982)

This study concerned Ra-226 contamination of soils and foliage as a function of distance downwind from a uranium mill tailings pile. In soils the radium contamination was primarily associated with particle sizes less than 0.045 mm and mainly found within the 0 to 0.6 cm soil horizon. The soil showed a decrease in activity concentration with distance. An attempt was made using ultrasonic washing to separate internal from external Ra-226 contamination in ARTEMISIA TRIDENTATA. Internal contamination appeared to be a larger contributor to total contamination at distances less than or equal to 0.16 km downwind from the tailings pile. At distances less than 0.16 km, external contamination became a larger contributor to the total Ra-226 contamination. In most soil samples Ra-226 concentrations approached background levels at a distance of 1.1 km from the tailings pile. Total vegetation contamination approached background at 6.6 km. This study suggested that a combination of root uptake and foliar absorption were responsible for internal contamination and further studies were suggested. (EDB)

636
Taylor, M.J., and R.S. Popielak, Canonie Engineers, Englewood, CO

Monitoring Results and Observations - Contaminant Migration - Unlined Uranium Tailings Disposal Site

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 369-375) (1984, February)

A western uranium tailings disposal facility has been operating for nearly 22 yr with an unlined evaporation pond. Investigations of existing conditions in 1977 indicated that heavy metals and toxic elements had not moved a significant distance from the pond. Predictions of contaminant movement indicated movement would be small in the future. Monitoring has continued for 6 yr since 1977. The validity of the predictions and other observations are discussed. (Auth)

637
Thomas, V.W., and R.R. Kinnison, Pacific Northwest Laboratory, Richland, WA

Recommended Sampling Strategies for Spatial Evaluation of Windblown Contamination Around Uranium Tailings Piles

NUREG/CR-3479; PNL-4830; 52 pp. (1983, October)

Spatially-distributed radium-226 concentrations measured in soil were statistically analyzed using Kriging to determine an optimum soil sampling strategy for detecting and delineating uranium mill tailings spread from storage piles by wind. A two-stage sampling plan is suggested, augmented by Kriging. Its use would result in significant savings in sampling or in attempting to locate areas requiring cleanup without the spatial distribution information provided by the Kriging process. Soil sampling with Kriging or possibly highly specialized in situ gamma-measurement techniques (currently being developed) are more appropriate. (GRA)

638
Travis, C.C., and L.M. McDowell-Boyer, Oak Ridge National Laboratory, Oak Ridge, TN

Potential Health Effects of Radon-222 to the General Public from Uranium Milling

CONF-791009; Energy Use Management, Proceedings of an International Conference, Los Angeles, CA, October 22-26, 1979; (p. 4) (1979)

This paper presents a discussion of the potential health risk that may result from present and future radon-222 releases at uranium mill tailings piles situated in the United States. These risks are contrasted with the health risk continually present as a consequence of background levels of radon-222 naturally present in the atmosphere. It is estimated that the current risk of lung cancer in the population due to uranium milling is less than 0.0001 times the natural risk. In addition, it is estimated that future risks due to mill tailings will be approximately a factor of 0.00001 lower than the natural radon-222 risk to the general public if stabilization of tailings piles is implemented. Thus, it appears that incremental population risk due to milling is insignificant with respect to the natural risk. (EDB)(JMF)

639
Tsivoglou, E.C., U.S. Department of Health, Education and Welfare, Physical and Engineering Sciences, Bethesda, MD

Environmental Monitoring in the Vicinity of Uranium Mills

CONF-104; Radiological Health and Safety in Mining and Milling of Nuclear Materials, Vol. 2, Proceedings of a Symposium, Vienna, August 26-31, 1963. International Atomic Energy Agency with International Labour Organization and the World Health Organization, Vienna; (pp. 231-245) (1963)

This paper describes the extensive experience of the Public Health Service in monitoring the environment near uranium mills in the United States and the highly successful pollution-control program that has resulted. Environmental contamination from mills has involved primarily the water environment and monitoring has been mainly for Ra-226, with determination of uranium and Sr-90 as desirable. Studies ranged from brief reconnaissance surveys to quantitative evaluation of radiation exposure of substantial population groups. A Ra-226 surveillance network covering seven states and eleven mills has been established recently to ensure continued protection. Monitoring has included river sediments, aquatic biota, water, mill effluents, and crops and topsoils from farms irrigated with contaminated river water.

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

This has provided understanding of the immediate and ultimate fate of Ra-226 in the water environment and has shown which medium best indicates pollution. These studies and the cooperation of the U.S. milling industry have yielded a high degree of protection of the waters of the Colorado Basin. Earlier dissolved Ra-226 concentrations ranged as high as 88 pg/l, whereas currently these streams contain less than 1.0 pg/l. (Auth)(BDC)

640
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Potential Health and Environmental Hazards of Uranium Mine Wastes - Volume 1: Executive Summary (Report to Congress)

EPA-520/1-83-007 (Vol. 1); 29 pp. (1983, June 10)

Uranium mining operations release some radioactive materials into both air and water and generate large quantities of solid wastes containing low levels of radioactive materials. Solid wastes produced by past mining operations remain on the surface at many inactive mining sites and represent a potential health and environmental hazard similar in concept to uranium mill talings. Contamination of surface and subsurface water supplies also represents a potential problem. To evaluate these potential problems, the Congress, in Section 114(c) of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), instructed the Administrator of the Environmental Protection Agency (EPA) to prepare a report that identifies the location and potential health, safety, and environmental hazards of uranium wastes together with recommendations, if any, for a program to eliminate these hazards. This report analyzes the potential health and environmental impacts of both active and inactive uranium mines, lists the locations of these mines, identifies additional information needs, and recommends needed actions. (GRA)

641
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Potential Health and Environmental Hazards of Uranium Mine Wastes - Volume 2 (Report to Congress)

EPA-520/1-83-007 (Vol. 2); 505 pp. (1983, June 10)

This report was prepared in response to Section 114(c) of Public Law 95-604 dated November 8, 1978. This section of the law stipulates that, not later than January 1, 1980, the administrator, in consultation with the commission, provide to the Congress a report that identifies the location and potential health, safety, and environmental hazards of uranium mine wastes together with recommendations, if any, for a program to eliminate these hazards. The purpose of this report is to comply fully with this request, as accurately and completely as available information will permit. (GRA)

642
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Potential Health and Environmental Hazards of Uranium Mine Wastes - Volume 3: Appendixes (Report to Congress)

EPA-520/1-83-007 (Vol. 3); PB-83-263350; 257 pp. (1983, June 10)

Contents include: summary of federal laws potentially affecting uranium mining; federal water programs and right activities; congressionally approved compacts that apportion water; state laws, regulations, and guides for uranium mining; active uranium mines in the United States; inactive uranium mines in the United States; general observations of uranium mine sites in Colorado, New Mexico, Texas, and Wyoming; influence of mine drainage on seepage to groundwater and surface water outflow; computation of mass emission factors for wind erosion; aquatic dosimetry and health effects models and parameter values; airborne pathway modeling; and health risk assessment methodology. (EDB)

643
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Final Environmental Impact Statement for Standards for the Control of By-Product Materials from Uranium Ore Processing (40 CFR 192) - Volume 1

EPA-520/1-83-008-1; 191 pp. (1983, September)

CHAPTER 6 URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

The Environmental Protection Agency is establishing public health and environmental standards (40 CFR 192) for uranium and thorium mill tailings at licensed mill sites under the Uranium Mill Tailings Radiation Control Act of 1978 (PL. 95-604). These standards are issued to reduce and control the hazards associated with uranium and thorium mill tailings. Mills are currently located in Colorado, New Mexico, South Dakota, Texas, Utah, Washington and Wyoming. Controls are required both during the operational period of mills and for disposal of the tailings piles, to assure environmentally sound, long-term protection of public health and stabilization of the tailings. (EDB)

644
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Final Environmental Impact Statement for Standards for the Control of By-Product Materials from Uranium Ore Processing (40 CFR 192) - Volume 2

EPA-520/1-83-008-2; 232 pp. (1983, September)

This part of the Final Environmental Impact Statement (FEIS), Volume II, presents responses to written and oral comments submitted to the agency on the proposed standards for the control of by-product materials from uranium processing. It also addresses comments on the Draft Environment Impact Statement (DEIS) and the Regulatory Impact Analysis (RIA). This volume includes summarized comments and responses for comments received by the U.S. Environmental Protection Agency Docket as of July 14, 1983. (EDB)

645
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Regulatory Impact Analysis of Final Environmental Standards for Uranium Mill Tailings at Active Sites

EPA-520/1-83-010; 245 pp. (1983, September)

The Environmental Protection Agency was directed by Congress, under PL 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), to set standards of general application that provide protection from the hazards associated with uranium mill tailings. Title II of the act requires standards covering the processing and disposal of by-product materials at mills which are currently licensed by the appropriate regulatory authorities. This Regulatory Impact Analysis (RIA) addresses the standards promulgated under Title II. There are two major parts of the standards for active mills: standards for control of releases from tailings during processing operations and prior to final disposal, and standards for protection of the public health and environment after the disposal of tailings. This report presents a detailed analysis of standards for disposal only, since the analysis required for the standards during mill operations is very limited. (EDB)

646
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites (40 CFR 192) - Volume 1, Final Report

EPA-520/4-82-013-1; PB-83-154153; 252 pp. (1982, October)

The Environmental Protection Agency is issuing final standards for the long-term control of tailings piles at inactive uranium processing sites and for cleanup of contaminated open land and buildings. These standards apply to tailings at locations that qualify for remedial actions under Title I of Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978. This act requires EPA to promulgate standards to protect the environment and public health and safety from radioactive and nonradioactive hazards posed by residual radioactive materials at the twenty-two uranium mill tailings sites designated in the act and at additional sites where these materials are deposited that may be designated by the Secretary of the Department of Energy. The Final Environmental Impact Statement (Volume I) examines health, technical considerations, costs, and other factors relevant to determining standards. Volume II contains EPA's responses to comments on the proposed standards and the Draft Environmental Impact Statement. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

647
U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC

Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites (40 CFR 192) - Volume 2

EPA-520/4-82-013-2; PB-83-166348; 313 pp. (1982, October)

The Environmental Protection Agency is issuing final standards for the long-term control of tailings piles at inactive uranium processing sites and for cleanup of contaminated open land and buildings. These standards apply to tailings at locations that qualify for remedial actions under Title I of Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978. This act requires EPA to promulgate standards to protect the environment and public health and safety from radioactive and nonradioactive hazards posed by residual radioactive materials at the twenty-two uranium mill tailings sites designated in the act and at additional sites where these materials are deposited that may be designated by the Secretary of the Department of Energy. The Final Environmental Impact Statement (Volume I) examines health, technical considerations, costs, and other factors relevant to determining standards. Volume II contains EPA's responses to comments on the proposed standards and the Draft Environmental Impact Statement (EPA 520/4-80-011). (EDB)

648
U.S. Nuclear Regulatory Commission, Washington, DC

Final Generic Environmental Impact Statement on Uranium Milling

Environmental Impact Assessment Review 3(2-3):184-193 (1982)

This generic environmental impact statement (EIS) was prepared by the U.S. Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards. The purpose of the EIS was to assess the potential environmental impacts of uranium milling operations in the United States. Also covered was the management of uranium mill tailings, which remain after the cessation of milling activities. The assessment was performed to determine what, if any, regulatory requirements for the management and disposal of mill tailings and mill decommissioning were necessary and appropriate. (EIX)

649
U.S. Nuclear Regulatory Commission, Washington, DC

NRC Issues Draft of New Regulatory Guide Entitled "Guidelines for Modeling Ground-Water Transport of Radioactive and Non-radioactive Contaminants at Tailings Disposal Sites"

Federal Register 48(108):25031 (1983, June 3)

The Nuclear Regulatory Commission (NRC) has issued for public comment a draft of a new guide planned for its Regulatory Guide Series together with a draft of the associated value/impact statement. This series has been developed to describe and make available to the public, methods acceptable to the NRC staff of implementing specific parts of the Commission's regulations and, in some cases, to delineate techniques used by the staff in evaluating specific problems or postulated accidents and to provide guidance to applicants concerning certain information needed by the staff in its review of applications for permits and licenses. (Auth)(LFG)

650
Veska, E., University of Waterloo, Waterloo, Ontario, Canada

Origin and Subsurface Migration of Radionuclides from Waste Rock at an Abandoned Uranium Mine Near Bancroft, Ontario

Thesis (1983)

Uranium-mine waste rock dump sites may require long-term surveillance because of the potential contamination of radionuclides from waste rock to the subsurface environment. In order to assess the conditions and controls on the migration in groundwater of waste-rock-derived contaminants and to evaluate the applicability of laboratory-measured parameters and of two contaminant migration models, an area of old waste rock on a sand aquifer at the abandoned Greyhawk uranium mine near Bancroft, Ontario, was monitored. The waste rock has been abandoned for more than two decades. The groundwater velocities in the aquifer were found to decrease progressively from a maximum at 70 m/yr below the waste rock to about 2 m/yr at approximately 125 m down gradient from the waste rock. Waste-rock-derived contaminant plumes of sulphate, bicarbonate, dissolved inorganic carbon, U-238, Ra-226, and Pb-210 were identified in the aquifer. The lateral extent of U-238 and U-234 contamination down gradient from the waste rock is less than 80 meters, whereas the lateral extent of Ra-226, Pb-210, Th-230, and Th-232 contamination is less than 20 meters. The observed frontal positions of U-238, Ra-226, Pb-210, and Th-230 contamination in the sand aquifer were simulated using the advection-retardation model with uniform groundwater velocity and chemistry and the cell model with nonuniform groundwater velocity and chemistry. Both models utilized laboratory-determined parameters. The results from both models indicated good agreement between the analytical and simulated frontal positions of Ra-226, Pb-210, and Th-230 in the aquifer. For the case of the uranium isotopes, the simulated results from the transport models only partly corresponded with that of the analytical results. The transport models were also used to predict the future spread of radionuclide contamination in the aquifer. The analytical U-234 activity in groundwater was found to increase progressively with respect to the analytical U-238 activity downflow from the waste rock. An explanation was given for this phenomenon based on the different percentages of the (IV) and (VI) oxidation states of the U-234 and U-238 atoms in the contaminated groundwater. The validity of the explanation was tested with the aid of the cell model. (CDS)

651

Vinckier, T.A., Colorado Geological Survey, Denver, CO

Hydrogeology of the Dakota Group Aquifer with Emphasis on the Radium-226 Content of its Contained Ground Water, Canon City Embayment, Fremont and Pueblo Counties, Colorado

USGS-OFR-82-3; 173 pp. (1982)

The Dakota Group aquifer of the Canon City embayment comprises two primary water-bearing units, the Lytle Sandstone Member at the base and the Dakota Sandstone at the top, separated by the semiconfining, arenaceous Glencairn Shale Member. The ground water in this area probably represents a mixture of some or all of the following genetic types: (1) ground water connate to the Dakota Group; (2) ground water, connate or otherwise, entering the aquifer as leakage from adjacent semiconfining strata; (3) deeply circulated meteoric ground water; and (4) hydrothermal fluids (magmatic or metamorphic ground water) purged from the crystalline basement complex underlying the embayment. The content of the radium-226 in ground water from 117 wells completed in part or all of the Dakota Group was determined by the dissolved radon-222 emanation method. Sixty-seven percent of the ground water samples have radium-226 activities greater than 5.0 pCi/l, the recommended maximum permissible concentration of radium-226 in drinking water established by the Environmental Protection Agency in 1973. Inspection of gamma-ray logs of about 20 wells revealed the presence of moderate to extremely high gamma radiation in strata of the Dakota Group, the Morrison Formation, the Fountain Formation, and in the crystalline basement rocks. High levels of radium-226 in drinking water supplies pose potentially serious health hazards to the users. Owners of wells producing such water supplies are advised to: (1) install, at the homesite, ion exchange (filtering units) capable of removing Ra-226(+2) ions and other aqueous radium species from the water; or (2) effectively case out those stratigraphic intervals in the borehole showing high gamma radiation preventing possible radium-rich ground water within these intervals from entering the well. (EDB)(EST)

652

Walters, W.H., Pacific Northwest Laboratory, Richland, WA

Overland Erosion of Uranium-Mill-Tailings Impoundments: Physical Processes and Computational Methods

NUREG/CR-3027; PNL-4523; 58 pp. (1983, March)

The surface runoff and erosional processes of watersheds caused by rainfall-runoff are reviewed. Soil properties, topography, and rainstorm distribution are discussed with respect to their effects on soil erosion. The effects of climate and vegetation are briefly presented. Regression models and physical process simulation models are reviewed. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

653
Ward, T.A., K.P. Hart, W.H. Morton, and D.M. Levins, Uranium Limited, Melbourne, Victoria, Australia; Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia; Australian Groundwater Consultants, Sydney, Australia

Factors Affecting Groundwater Quality at the Rehabilitated Mary Kathleen Tailings Dam, Australia

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 319-328) (1984, February)

The Mary Kathleen uranium mine and treatment plant ceased operation in late 1982 and a plan for the closure and rehabilitation of the area was developed. This paper describes some of the groundwater quality studies undertaken in support of the rehabilitation program, including sampling within the tailings dam to determine the profile of radionuclides, accelerated leaching tests on tailings to determine the rate of movement of contaminants, and disposal of acidic effluent by neutralization and ion exchange through infiltration trenches. From accelerated leaching tests, it is estimated that a maximum of 0.13% of Ra-226 will be leached from the tailings in the first 1000 years. There is no evidence that uranium or any of its daughters are moving away from the waste disposal area. The movement of heavy metals, radionuclides and acidity is strongly retarded by the alkaline soils. (Auth)(BDC)

654
Wethington, J.A., J. Razvi, C. Grier, and T.E. Myrick, International Atomic Energy Agency, Vienna, Austria; University of Florida, Gainesville, FL; Kansas State University, Manhattan, KS

Nuclear-Fuel-Cycle Education - Module 10: Environmental Consideration

DOE/SR/00952-T9; 183 pp. (1981, December)

This educational module is devoted to the environmental considerations of the nuclear fuel cycle. Eight chapters cover the National Environmental Policy Act, environmental impact statements, environmental survey of the uranium fuel cycle, the Barnwell Nuclear Fuel Reprocessing Plant, transport mechanisms, radiological hazards in uranium mining and milling operations, radiological hazards of uranium mill tailings, and the use of recycle plutonium in mixed oxide fuel. (EDB)(EST)

655
Whicker, F.W., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Radioecological Investigations of Uranium-Mill-Tailings Systems: Third Technical Progress Report, October 1, 1981-September 30, 1982

DOE/EV/10305-7; 124 pp. (1982, October 15)

This investigation quantitatively evaluates the potential release of important radionuclides from active and reclaimed uranium mill tailings and their entry into the food chain. For active mill tailings, attempts are made to quantify the degree of escape and dispersal, primarily by wind, and to measure the accumulation of U-238, Th-230, Ra-226, and Po-210 by various native plants. Of particular interest are the relationships between soil and vegetation at different sites, because the chemical environment of areas impacted by mill tailings are drastically different than undisturbed natural areas. Also of great interest is the relative importance of various mechanisms of radionuclide accumulation by plants, such as root uptake and aerial deposition, followed by some degree of foliar adsorption. In the case of reclaimed tailings, an experimental area was developed in which a slab of reasonably uniform tailings was covered with various depths of earthen materials and seeded with a native range mixture of forbs, grasses, and shrubs. The influence of overburden depth on radon flux at the soil surface and on uptake of radionuclides by plants is currently under study. In addition, a comparison of radon flux from vegetated and nonvegetated subplots is underway. (GRA)(NPK)

656
Whicker, F.W., and S.A. Ibrahim, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

Radioecological Investigations of Uranium-Mill-Tailings Systems: Fourth Technical Progress Report, October 1, 1982-September 30, 1983

DOE/EV/10305-11; 89 pp. (1983, October 15)

This document provides a status report on studies which address some of the problems and questions on the integrity and transport of several radionuclides in active and reclaimed uranium mill tailings. The studies reported are being conducted at the Shirley Basin Uranium Mine, located in southeastern Wyoming. The investigation quantitatively evaluates the potential release of important radionuclides from active and reclaimed uranium mill tailings and their entry into the food chain. For active mill tailings, an attempt has been made to quantify the degree of escape and dispersal, primarily by wind, and to measure the accumulation of U-238, Th-230, Ra-226, Pb-210, and Po-210 by various native plants. Of particular interest are the relationships between soil and vegetation at different sites, since the chemical environment of areas impacted by mill tailings are drastically different than undisturbed natural areas. Also of great interest is the relative importance of various mechanisms of radionuclide accumulation by plants, such as root uptake and aerial deposition, followed by some degree of foliar absorption. This investigation includes studies relating to the final disposal of mill tailings. Experiments on radon flux versus overburden depth showed that tailings covered with 1.5 m of revegetated or 0.3 m of bare overburden had exhalation rates comparable to background. A positive correlation was demonstrated between precipitation and radon flux. (EDB)

657

Wilder, R.J., and D.J. Goode, GCA Corporation, Technology Division, Bedford, MA; U.S. Nuclear Regulatory Commission, Washington, DC

Analysis of Groundwater Quality Data Near an Active Uranium Ore Processing Mill

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 61-70) (1984, February)

Management of uranium mill tailings requires a thorough understanding of the dynamics of chemical transport in groundwater from the facility. As part of the licensing requirements, many facilities have been required to collect extensive monitoring data. Analysis of data collected at an active uranium ore processing mill on the edge of the Arkansas River valley identified two trends: a long-term increase in chemical concentration and an annual cycle of increased concentration at residential wells in the area. A mixing cell model of the groundwater system applied to area wells showed that irrigation was not a source of chemical mass and estimated that 83% of summer recharge was from irrigation. Analysis of other model data indicated that advection and dispersion may control transport down to area wells but that mixing and dilution due to irrigation must be accounted for to capture the essential dynamics of groundwater quality. (Auth)(BDC)

658

Wiles, D.R., Carleton University, Department of Chemistry, Ottawa, Ontario, Canada

The Radiochemistry of Radium and Thorium in Uranium Mine Tailings

Water, Air and Soil Pollution 20(1):99-108 (1983)

The chemical leaching of radium and thorium from uranium mine tailings at Beaverlodge has been studied as part of an investigation into the chemical and mineralogical location of these radionuclides in the tailings particles. A mathematical model is described that combines these two processes and accounts for the experimental data. (EIX)

659

Witten, A.J., F.G. Pin, and R.D. Sharp, Oak Ridge National Laboratory, Oak Ridge, TN

The Effect of Drains on the Seepage of Contaminants from Subgrade Tailings Disposal Areas

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 167-176) (1984, February)

CHA'TER 6. URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

A numerical simulation study was performed to investigate the influence of ponded water and a bottom drain on the pathways for contaminant migration from a subgrade uranium mill tailings disposal pit. This numerical model was applied to a generic disposal pit constructed with a bottom clay liner and steep unlined sidewalls. The migration of a two-contaminant system was modeled assuming that neither contaminant decays and that only one contaminant is retarded. Two dominant pathways were identified: one associated with lateral sidewall leakage and the other associated with transport through the bottom clay liner. It was found that the drain serves to reduce migration through the sidewall which, in turn, prevents the retarded contaminant from reaching the aquifer. The ponded water provides increased head, which causes an accelerated vertical movement of moisture through the clay liner. (Auth)(NPK)

660

Young, J.A., P.O. Jackson, and V.W. Thomas, Pacific Northwest Laboratory, Richland, WA

Radiological Surveys of Properties Contaminated by Residual Radioactive Materials from Uranium Processing Sites

NUREG/CR-2954; PNL-4264; 140 pp. (1983, June)

This report examines methods for determining the extent and nature of contamination on properties contaminated by residual radioactive materials from uranium processing sites. Methods are also examined for verifying the success of remedial actions in removing the residual radioactive materials. Using literature reviews and practical experiences from the Edgemont, South Dakota, survey program, a critical review is made of sampling programs, instrumentation, analytical procedures, data reporting format, and statistical analyses of data. Protocols are recommended for measuring indoor and outdoor gamma-ray exposure rates, surface and subsurface radium-226 concentrations in soil, and radon daughter concentrations. (EDB)

661

Young, J.A., and V.W. Thomas, Pacific Northwest Laboratory, Richland, WA

Comparison of Radon Fluxes with Gamma-Radiation Exposure Rates and Soil Ra-226 Concentrations

NUREG/CR-3677; PNL-5016; 17 pp. (1984, April)

Radon fluxes and contact gamma-radiation exposure rates were measured at the grid points of rectangular grids on three properties in Edgemont, South Dakota that were known to have deposits of residual radioactivity relatively near to the surface. The coefficient of determination, r(E+2), between the radon fluxes and the contact gamma-radiation-exposure rates varied from 0.89 to 0.31 for the three properties. Correlations between fluxes and Ra-226 concentrations measured in boreholes that varied in depth from 60 to 195 cm were generally lower than those between fluxes and exposure rates, indicating that exposure rates are better than Ra-226 measurements for detecting elevated radon fluxes from near-surface deposits. Measurements made on one property at two different times indicated that if the average flux was determined from a large number of measurements (40) at one time, the average flux at a later time could be estimated from a few measurements using the assumption that the change in the flux at individual locations will be equal to the change in the average flux. Flux measurements around two buildings showing elevated indoor radon-daughter concentrations, but around which no residual radioactivity was discovered by Ra-226 and gamma-radiation measurements, provided no clear indication of the presence of such material. (Auth)(EST)

662

Young, J.A., V.W. Thomas, and P.O. Jackson, Pacific Northwest Laboratory, Richland, WA

Recommended Procedures for Measuring Radon Fluxes from Disposal Sites of Residual Radioactive Materials

NUREG/CR-3166; PNL-4597; 32 pp. (1983, March)

This report recommends instrumentation and methods suitable for measuring radon fluxes emanating from covered disposal sites of residual radioactive materials such as uranium-mill tailings. Problems of spatial and temporal variations in radon flux are discussed and the advantages and disadvantages of several instruments are examined. A year-long measurement program and a two-month measurement methodology are then presented based on the inherent difficulties of measuring average radon flux over a cover using the recommended instrumentation. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT
ENVIRONMENTAL STUDIES AND SITE SURVEYS

663

Zettwoog, P., N. Fourcade, F.E. Campbell, and H. Caplan, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France; Key Lake Mining Corporation, Saskatoon, Saskatchewan, Canada; University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Radon Concentration Profile and the Flux from a Pilot-Scale Layered Tailings Pile

Health Physics 43(3):428-433 (1982, September)

A pilot tailings model was constructed to demonstrate the feasibility of the sub-aerial technique of tailing deposition for the proposed uranium mine and mill at Key Lake, Saskatchewan. A series of radon measurements was made on the model and results obtained for the radon concentration profile in the tailings, and for the flux from the surface. The results were compared with the model calculations of Zettwoog. (EDB)(EST)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DECONTAMINATION STUDIES

664

Averill, D.W., J.W. Schmidt, D. Moffett, R.T. Webber, and E. Barnes, Environment Canada, Wastewater Technology Centre, Burlington, Ontario, Canada; Eldorado Nuclear Limited, Ottawa, Ontario, Canada; Denison Mines Limited, Elliot Lake, Ontario, Canada; Rio Algom Limited, Elliot Lake, Ontario, Canada

Development of a Precipitation and Filtration Process for Radium-226 Removal

CONF-820552; STI/PUB-622; IAEA-SM-262/10; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 353-364) (1982)

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 programme goals: 10 pCi/l (0.37 Bq/l) total radium-226 activity and 3 pCi/l (0.11 Bq/l) dissolved radium-226 activity. The first full-scale treatment process designed on the basis of this development programme is currently being built by Rio Algom Limited in Elliot Lake, Ontario, Canada. The Stanleigh Mine Tailings Effluent Treatment Plant will treat a maximum flow of 31.8 cu m/min (8400 U.S. gal/min). Its estimated capital cost is $7.2 million (Canadian), based on first quarter 1981 prices. (EDB)

665

Baird, M.H.I., A. Corsini, and S. Banerjee, McMaster University, Hamilton, Ontario, Canada; University of California, Santa Barbara, CA

Reduction of Radionuclide Levels in Uranium Mine Tailings

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 173-193) (1982)

This paper considers several alternatives to conventional acid-leach uranium milling as applied to ores from the Elliot Lake area of Ontario, Canada. The objective is to discharge bulk tailings containing no more than 20 pCi of Ra-226 per g of solids. Experimental work at the laboratory scale has been carried out on a flotation separation of the ore, ferric chloride leaching of both U and Ra from ore, and leaching of radium from acid-leached solids by means of a chelating agent (EDTA). Preliminary work has also been carried out on radium removal from solution by biosorption. The results of these studies are promising but in need of economic and engineering assessment. (EDB)

666

Dreesen, D.R., E.J. Cokal, E.F. Thode, L.E. Wangen, and J.M. Williams, Los Alamos National Laboratory, Los Alamos, NM

Uranium Mill Tailings Conditioning Research Summary

LA-9816-PR; (pp. 187-191) (1983, August)

The results of our studies on the characterization of uranium mill tailings, the potential for removal of radionuclides (Ra-226 and Th-230) from tailings, recovery of mineral values from tailings, immobilization of tailings contaminants by thermal stabilization, and an analysis of the engineering practicality and economic feasibility of both reprocessing for mineral recovery and thermal stabilization are summarized. In addition, the implications of these findings are discussed in relation to the overall remedial action program. If future standards are strict and require drastic reductions in contaminant release rates and long-term isolation then thermal stabilization technology offers the best presently known means for the long-term immobilization of these hazardous substances. Implementation of thermal stabilization effort to establish process parameters and emission controls would be required. If future standards are relaxed considerably then mineral recovery is justified for three of the six sites. If any tailings piles requires relocation as part of the remedial action, there are no technical or economic reasons to prevent reprocessing as an integral part of remedial action. (EDB)(PTO)

667

Levins, D.M., R.J. Ring, and G.A. Dunlop, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia; Mineral Development Laboratories, Thebarton, South Australia, Australia

Reducing the Environmental Impact of Uranium Tailings by Physical Segregation and Separate Disposal of Potentially Hazardous Fractions

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 159-171) (1982)

Flotation and hydrocycloning were tested as methods of splitting sulphide and radionuclide concentrates from the bulk of Australian uranium mill tailings. Conventional sulphide flotation removed 88-98% of the pyrite in 1-5% of the total mass. Hydrocycloning was more effective than flotation for concentrating radium into a loss mass fraction. It was found that most of the radium was contained in the very finest particles (below 5 microns). A combined flotation/hydrocycloning flowsheet is proposed for segregating tailings into three fractions for separate disposal. Possible disposal methods for each of these fractions are discussed. (EDB)

668

Nixon, A., D. Keller, K. Fritze, A. Pidruczny, and A. Corsini, McMaster University, Department of Chemistry, Hamilton, Ontario, Canada

Radium Removal from Elliot Lake Uranium Mill Solids by EDTA Leaching

Hydrometallurgy 10(2):173-186 (1983, May)

Ethylenediaminetetracetic acid (EDTA) in alkaline solution is effective in the extraction of radium-226 from uranium mill final Pachuca solid discharge at Elliot Lake, Ontario. Under optimal conditions, 80-85% of the radium was extracted. These conditions (temperature, EDTA concentration, liquid to solid ratio, contact time) were milder than those used in other studies. Even under vigorous conditions, however, only a part of the residual radium can be removed. The extraction can be described by an adsorption mechanism. Sulfate ion does not inhibit extraction. (EIX)

669

Opitz, B.E., M.E. Dodson, and R.J. Serne, Pacific Northwest Laboratory, Richland, WA

Laboratory Evaluation of Limestone and Lime Neutralization of Acidic Uranium Mill Tailings Solution, Progress Report

NUREG/CR-3449; 49 pp. (1984, February)

Experiments were conducted to evaluate a two-step neutralization scheme for treatment of acidic uranium mill tailings solutions. Tailings solutions from the Lucky Mc Mill and Exxon Highland Mill, both in Wyoming, were neutralized with limestone, CaCO3, to an intermediate pH of 4.0 or 5.0, followed by lime, Ca(OH)2, neutralization to pH 7.3. The combination limestone/lime treatment methods, CaCO3 neutralization to pH 4 followed by neutralization with Ca(OH)2 to pH 7.3 resulted in the highest quality effluent solution with respect to EPA's water quality guidelines. The combination method is the most cost-effective treatment procedure tested in our studies. Neutralization experiments to evaluate the optimum solution pH for contaminant removal were performed on the same two tailings solutions using only lime Ca(OH)2 as the neutralizing agent. The data indicate solution neutralization above pH 7.3 does not significantly increase removal of pH dependent contaminants from solution. Column leaching experiments were performed on the neutralized sludge material (the precipitated solid material which forms as the acidic tailings solutions are neutralized to pH 4 or above). The sludges were contacted with laboratory prepared synthetic ground water until several effluent pore volumes were collected. Effluent solutions were analyzed for macro ions, trace metals and radionuclides in an effort to evaluate the long term effectiveness of attenuating contaminants in sludges formed during solution neutralization. Neutralized sludge leaching experiments indicate that Ca, Na, Mg, Se, Cl, and SO4 are the only constituents which show solution concentrations significantly higher than the synthetic ground water in the early pore volumes of long-term leaching studies. (EDB)

670

Raicevic, D., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Decontamination of Elliot Lake Uranium Tailings

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DECONTAMINATION STUDIES

Transactions of the Canadian Institute of Mining and Metallurgy Mining Society 82:131-137 (1979)

After more than 93% of the uranium is extracted from Elliot Lake uranium ores by a sulfuric 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 sulfuric 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. This paper describes a flotation approach for treatment of the Elliot Lake uranium tailings to produce new, decontaminated tailings practically free of pyrite and with radium, thorium, and uranium contents considerably reduced. The decontaminated tailings produced, which comprise about 75% by weight of the current uranium tailings, appear to be suitable for mine backfill. Because mine backfilling normally uses about 50% of the plant tailings, surface storage of about half of the uranium tailings, therefore, would be eliminated by this process. Mine backfilling would also increase the ore production and thus enlarge the over-all uranium resources due to recovery of the ore from pillars. The pyrite concentrate produced from the current tailings would be suitable for sulfuric acid production. The possibility of uranium recovery, and disposal of radium and thorium from the concentrates produced, is now being studied at CANMET. (EDB)(JMF)

671

Raicevic, D., M. Raicevic, and D.R. McCarthy, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Uranium Recovery from Ores to Produce Concentrates and Clean Tailings

Geos (Winter, 1980):10-11 (1980)

The steps involved in the processing and extraction of uranium ores from ore to concentrates are presented in the form of an illustrated flow chart. (BDC)(ARE)

672

Rogers, V.C., and K.K. Nielson, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Cost Effectiveness of Methods for Removing Radium and Thorium in Uranium Mining

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 262-265) (1981)

The potential health impact from uranium milling operations is mainly associated with the long-term release of radioactive contaminants from mill tailings. The major mechanisms for mitigating this potential release focus on strengthening the tailings containment with the addition of migration barriers such as thick earthen covers and clay liners. Some limited investigation has also focused on the reduction of radionuclide source terms. This alternative approach has some desirable features, but stringent cost requirements are placed upon source removal methods in order for them to be economically favorable. A cost effectiveness evaluation is presented in which costs for the containment methods are used to establish maximum cost guidelines for the source removal methods. (EDB)(EST)

673

Ryon, A.D., W.D. Bond, F.J. Hurst, F.M. Scheitlin, and F.G. Seeley, Oak Ridge National Laboratory, Oak Ridge, TN

Investigation of Nitric Acid for Removal of Noxious Radionuclides from Uranium Ore or Mill Tailings

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 139-147) (1982)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DECONTAMINATION STUDIES

A conceptual process using nitric acid, rather than the currently used sulfuric acid, to extract Ra-226 and Th-230 in addition to the uranium from ore is proposed in order to decrease the potential hazard from discharge of mill tailings to the environment. Nitric acid leaching of representative uranium ores and tailings from the principal mining districts of the United States removes up to 98% of the Ra-226 and Th-230, yielding a residue containing as low as 10 pCi of radium per gram. Leaching of uranium from ores is consistently greater than 99.5%. The residue after multistage leaching with nitric acid is resistant to further radium leaching with water. Radon emanation from nitric-acid-leached residues generally is low due to the low radium content. Heating to 800 deg C causes further reduction of radon emanation. Greater than 99% recovery of radium from nitric-acid-leach solutions is obtained by carrying on barium sulfate. Good adsorption of radium is also obtained on barite and Celite. Recovery of thorium and uranium by solvent extraction using tri-n-butyl phosphate (TBP) appears promising. Recycle of nitric acid may be accomplished by solvent extraction combined with evaporation and calcination. (EDB)

674

Sherwood, D.R., and R.J. Serne, Pacific Northwest Laboratory, Richland, WA

Tailings Treatment Techniques for Uranium Mill Waste: A Review of Existing Information - Neutralization Processes, Fixation Processes, and Specific Constituent Removal

NUREG/CR-2938; PNL-4453; 81 pp. (1983, July)

Of primary concern at uranium mill sites in the United States is the potential of ground-water contamination from mill wastes that are disposed in tailings impoundments. Although many systems have been used to control seepage from tailings impoundments, most of these systems are limited in their ability to handle an excess of tailings solution. Three general amelioration methods were identified: neutralization, fixation and specific constituent removal. During neutralization, a reagent is added to the tailings solution to neutralize the acidity and raise the pH to reduce the solubility of various pH sensitive contaminants. Fixation processes add materials such as lime, cement or asphalt to the waste to produce a physically stable composition that resists leaching of hazardous constituents. Specific constituent removal encompasses varying techniques, such as alternate ore leaching processes, effluent treatment with sorption, or ion exchange agents or selected precipitation that reduce specific constituent concentrations in tailings solution. Neutralization processes appear to be best suited for treating uranium mill tailings because they can, at a reasonable cost, limit the solution concentration of many contaminants. The effectiveness of the process depends on the reagent used as well as the waste being treated. Of the six reagents studied (lime, limestone, caustic soda, soda ash, combined limestone/lime and combined alumina/lime/soda), a combined treatment of limestone and lime seems best, especially for tailings containing ferric iron as the limestone economically buffers the solution acidity while the lime takes the pH to 8.0, an optimum level for heavy metal removal. For those tailings containing ferrous iron, lime alone works best. The costs for the lime/limestone or lime processes range from $0.20 to $1.00 per 1000 gallons of treated water, excluding capital equipment costs. (EDB)

675

Sherwood, D.R., and R.J. Serne, Pacific Northwest Laboratory, Richland, WA

Evaluation of Selected Neutralizing Agents for the Treatment of Uranium Tailings Leachates, Laboratory Progress Report

NUREG/CR-3030; PNL-4524; 36 pp. (1983, February)

Laboratory experiments were conducted to evaluate the performance of selected neutralizing agents for the treatment of uranium tailings solutions. Highly acidic tailings solutions (pH greater than 2) from the Lucky Mc Mill in Gas Hills, Wyoming, and the Exxon Highlands Mill near Casper, Wyoming were neutralized to a pH of 7 or greater using seven neutralizing agents. Reagents used included: fly ash from Boardman Coal Plant, Boardman, Oregon; fly ash from Wyodak Coal Plant, Gillette, Wyoming; calcium carbonate ($CaCO_3$) reagent grade; calcium hydroxide [$Ca(OH)_2$] reagent grade; magnesium oxide (MgO) reagent grade; sodium carbonate (Na_2CO_3) reagent grade; and sodium hydroxide (NaOH) reagent grade. Evaluation of the effectiveness for the treatment of uranium tailings solutions for the selected neutralizing agents under controlled laboratory conditions was based on three criteria: (1) treated effluent water quality; (2) neutralized sludge handling and hydraulic properties;

and (3) reagent costs and acid neutralizing efficiency. On the basis of these limited laboratory results calcium hydroxide or its dehydrated form CaO (lime) appears to be the most effective option for treatment of uranium tailings solutions. (EDB)(EST)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

676

Beedlow, P.A., Pacific Northwest Laboratory, Richland, WA

Designing Vegetation Covers for Long-Term Stabilization of Uranium Mill Tailings

NUREG/CR-3674; 98 pp. (1984, March)

The use of vegetation and vegetation-rock combinations for long-term stabilization of uranium mill tailings is discussed. Interactions between surface covers and the tailings containment system are identified and used as the basis for designing protective covers. The role of vegetation in erosional processes is reviewed, and the effectiveness of vegetation for controlling erosion in the western U.S. is discussed. Principles of revegetation are presented. Environmental influences on vegetation are reviewed. The effects of surface covers on water dynamics within the containment system are presented. A systematic approach is given for designing protective covers using vegetation. (EDB)

677

Beedlow, P.A., and D.W. Carlile, Pacific Northwest Laboratory, Richland, WA

Long-Term Stabilization of Uranium Mill Tailings: Effects of Rock Material on Vegetation and Soil Moisture

PNL-SA-11821; 23 PP.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 531-540) (1984, February)

A field-scale experiment was conducted to investigate the effects of pit-run rock and washed cobble covers on vegetation and soil moisture. The success of various seed mixtures, transplanting, and irrigation was evaluated. Total cover changed negligibly from the first growing season to the next, but the structure of the vegetation changed markedly. Moderate levels of irrigation increased the establishment of perennial grasses and shrubs. Rock placed on the surface prior to planting resulted in increased cover of weeds, shrubs, and forbs and decreased grass cover relative to soil without surface rock. The most successful seed mixture was one of predominately shrub and forb species adapted to the local environment. No significant differences in soil moisture were found between surface cover types. (Auth)

678

Brown, J.R., W.S. Fyfe, F. Murray, and B.I. Kronberg, University of Western Ontario, Department of Geology, London, Ontario, Canada

Immobilization of U-Th-Ra in Mine Wastes - Final report

Canadian Mining Journal 103(3):53-55 (1982, March)

By treating typical Elliot Lake uranium mine effluents with calcite and potassium phosphate solutions (300 ppm), radium leach levels have been reduced to below 0.1 pCi/l. Mine tailing permeabilities can be reduced by use of appropriate clay additives, in particular thin bentonite layers. (EDB)

679

Buelt, J.L., and S.M. Barnes, Pacific Northwest Laboratory, Richland, WA

Aging Test Results of an Asphalt Membrane Liner

PNL-4752; 134 pp. (1983, July)

The objective of the asphalt aging study described in this report was to determine the expected performance lifetime of a catalytically airblown asphalt membrane as a seepage barrier for inactive uranium mill tailings. The study, conducted by Pacific Northwest Laboratory for the Department of Energy's Uranium Mill Tailings Remedial Action Program, showed through chemical compatibility tests that the asphalt membrane is well suited for this purpose. The chemical compatibility tests were designed to accelerate the aging reactions in the asphalt and to determine the accelerated aging effect. Higher temperatures and oxygen concentrations proved to be effective acceleration parameters. By infrared spectral analysis, the asphalt was determined to have undergone seven years of equivalent aging in a three-month period when exposed to 40 deg C and 1.7 atm oxygen pressure. However, the extent of aging was limited to a maximum penetration of 0.5% of the total liner thickness. It was concluded that the liner could be expected to be effective as a seepage barrier for at least 1000 years before the entire thickness of the liner would be degraded. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

680

Elmore, M.R., and J.N. Hartley, Pacific Northwest Laboratory, Richland, WA

Field Testing of Fugitive Dust Control Techniques at a Uranium Mill Tailings Pile - 1982 Field Test, Gas Hills, Wyoming

NUREG/CR-3510; 75 pp. (1983, December)

A field test was conducted on a uranium tailings pile to evaluate the effectiveness of 15 chemical stabilizers for control of fugitive dust from uranium mill tailings. A tailings pile at the Federal American Partners (FAP) Uranium Mill, Gas Hills, Wyoming, was used for the field test. Preliminary laboratory tests using a wind tunnel were conducted to select the more promising stabilizers for field testing. Fourteen of the chemical stabilizers were applied with a field spray system pulled behind a tractor; Hydro Mulch was applied with a hydroseeder. A portable weather station and data logger were installed to record the weather conditions at the test site. After 1 year of monitoring (including three site visits), all of the stabilizers degraded to some degree; but those applied at the manufacturers' recommended rate are still somewhat effective in reducing fugitive emissions. The following synthetic polymer emulsions appear to be the more effective stabilizers: Wallpol 40-133 from Reichold Chemicals, S P-400 from Johnson and March Corporation, and CPB-12 from Wen Don Corporation. Installed costs for the test plots ranged from $8400 to $11,300/ha; this range results from differences in stabilizer costs. Large-scale stabilization costs of the test materials are expected to range from $680 to $3600/ha based on FAP experience. Evaluation of the chemical stabilizers will continue for approximately 1 year. (EDB)

681

Elmore, M.R., and J.N. Hartley, Pacific Northwest Laboratory, Richland, WA

Laboratory Testing of Chemical Stabilizers for Control of Fugitive Dust Emissions from Uranium Mill Tailings

NUREG/CR-3697; PNL-5025; 48 pp. (1984, April)

PNL is investigating techniques to control fugitive dust emissions from active uranium mill tailings piles. This report describes laboratory tests conducted to evaluate 45 commercially available chemical stabilizers. Tests were conducted in a wind tunnel to evaluate the effectiveness and durability of the stabilizers under similar conditions. The effects of application rate, temperature (freeze/thaw) cycling, wet/dry cycling, and wind speed were determined. In addition, tests were conducted to determine the effects of ultraviolet light and water erosion on the durability of the stabilizers. Permeability tests were also conducted to determine the potential effect of each stabilizer on the overall stability of the tailings pile. Results of these laboratory tests indicated that 16 of the stabilizers were equally effective and more durable than the others. (Auth)

682

Elmore, M.R., and J.N. Hartley, Pacific Northwest Laboratory, Richland, WA

Fugitive Dust Control at Uranium Mill Tailings Piles

PNL-SA-11680; 10 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 51-59) (1984, February)

This paper presents the results of both laboratory and field studies relating to the effects of possible wind erosion of uranium mill tailings. The laboratory studies included wind tunnel testing of 43 commercial chemical stabilizers. Fifteen of the more promising stabilizers were applied to test plots on a tailings pile at the American Nuclear Corporation's Gas Hills Project mill site, Gas Hills, Wyoming, and were monitored for approximately one year. Of the stabilizers tested, three synthetic polymer (latex) emulsions (Wallpol 40-133 from Reichold Chemicals, SP-400 from Johnson-March Corporation, and CPB-12 produced by Wen Don Corporation) were more effective than the other stabilizers. A summary of ongoing assessments of these chemical stabilizers and an evaluation of the effectiveness and durability of commercial wind screens in reducing fugitive dust on tailings piles are also presented. (Auth)(PTO)

683

Filion, M.P., Eldorado Resources Limited, Environment and Technology, Ottawa, Ontario, Canada

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

Decommissioning and Reclamation of Beaverlodge Tailings - Environmental and Radiological Considerations

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 349-358) (1984, February)

After 30 yr of nearly continuous mining at Beaverlodge, Saskatchewan, approximately 6 X 10(E+6) tons of uranium mill tailings have been deposited, using shallow lake disposal. This paper discusses the environmental and radiological assessments undertaken to achieve an acceptable plan to close-out the mill tailings. Choice of close-out concepts were limited to water cover of all tailings to a nominal depth of 2 m, vegetation and physical cover, or removal of tailings with underground disposal. Feasibility studies resulted in recommendations that tailings be covered to a depth of 600 mm with rock or sand and gravel and that natural outlet elevations be restored in two of the lakes; that another of the lakes be restored by removing a dam and moving the sludges to a central location, with subsequent removal in a frozen state; and that the remaining lake be drained and tailings and sludges disposed of underground. (Auth)(BDC)

684

Foley, M.G., W.J. Deutsch, G.W. Gee, J.N. Hartley, D.R. Kalkwarf, M.J. Fayer, R.W. Nelson, B.E. Opitz, S.R. Peterson, R.J. Serne, V.W. Thomas, W.H. Walters, and N.A. Wogman, Pacific Northwest Laboratory, Richland, WA

Uranium Recovery Research Sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory: Quarterly Progress Report, January-March 1984

PNL-5015-2; 39 pp. (1984, May)

This report documents progress for major research projects at PNL that have the primary purpose of providing information to help the NRC license uranium recovery facilities. The tasks involve long-term stabilization, interim stabilization, tailings dewatering techniques, neutralization and other alternatives for immobilizing toxic materials in tailings, evaluation of seepage and leachate transport from tailings, effluent and environmental monitoring, attenuation of radon emissions, assessment of leachate movement, and methods of minimizing groundwater contamination. (BDC)

685

Foley, M.G., W.J. Deutsch, G.W. Gee, J.N. Hartley, D.R. Kalkwarf, D.W. Mayer, R.W. Nelson, B.E. Opitz, S.R. Peterson, R.J. Serne, V.W. Thomas, W.H. Walters, and N.A. Wogman, Pacific Northwest Laboratory, Richland, WA

Uranium Recovery Research Sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory: Quarterly Progress Report, June-September 1983

PNL-4608-4; 48 pp. (1983, November)

This quarterly report documents progress for four major research projects at PNL, which include nine research tasks and a management task being conducted for the Nuclear Regulatory Commission. These tasks include: stabilization of mill tailings piles; dewatering techniques; tailings neutralization; disposal techniques allowing contact with groundwater; monitoring methods and equipment; attenuation of radon emissions; assessment of leachate movement; and program management. (BDC)

686

Foley, M.G., B.E. Opitz, W.J. Deutsch, S.R. Peterson, G.W. Gee, R.J. Serne, J.N. Hartley, V.W. Thomas, D.R. Kalkwarf, and W.H. Walters, Pacific Northwest Laboratory, Richland, WA

Uranium Recovery Research Sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory: Annual Progress Report, May 1982-May 1983

PNL-4608-3; 104 pp. (1983, June)

The Pacific Northwest Laboratory (PNL) is currently conducting research for the U.S. Nuclear Regulatory Commission (NRC) on uranium recovery process wastes for both active and inactive operations. NRC-sponsored uranium recovery research at PNL is focused on NRC regulatory responsibilities for uranium-recovery operations. They are to: (1) license active milling and in situ extraction operations; (2) concur on the acceptability of U.S. Department of Energy (DOE) remedial-action plans for inactive sites; and (3) license DOE to maintain inactive sites following remedial actions. PNL's program consists of four coordinated projects comprised of a program management task and nine research tasks that address the critical technical and safety issues for uranium recovery. Specifically, the projects endeavor to find and evaluate methods to: prevent erosion of tailings piles and prevent radon release from tailings piles; evaluate the effectiveness of interim stabilization techniques to prevent wind erosion and transport of dry tailings from active piles; estimate the dewatering and consolidation behavior of slurried tailings to promote early cover placement; design a cover-protection system to prevent erosion of the cover by expected environmental stresses; reduce seepage into groundwater and prevent groundwater degradation; control solution movement and reaction with groundwater in in situ extraction operations; evaluate natural and induced restoration of groundwater in in situ extraction operations; and monitor releases to the environment from uranium recovery facilities. (EDB) (NPK)

687

Gates, T.E., Pacific Northwest Laboratory, Richland, WA

Physical Stability of Asphalt Emulsion Admix Seal Radon Barrier for Uranium Mill Tailings

DOE/UMT-0215; 42 pp. (1983, September)

Pacific Northwest Laboratory is investigating the use of an asphalt emulsion admix seal to reduce the release of radon from uranium mill tailings. A key requirement of any cover system is its long-term stability; the cover must withstand failure over very long periods of time. An important determinant of overall cover system stability is the integrity of the 6.35-cm (2.5-in.) thick asphalt admix seal. Therefore, the physical stability of this seal was examined. The investigation considered the mechanical interaction between the tailings pile and cover. The potential effect of differential settlement of the tailings pile on the integrity of the seal system was also examined. Results indicate that the minimum span length the seal could withstand without failing is 0.34 m (1.1 ft). This assumes a differential settlement of 4.92 cm (1.94 in.) at the center resulting from the application of a 0.76-m (2.5-ft) cover. At spans greater than 0.60 m (1.97 ft), no tensile strain would develop. (EDB)

688

Gee, G.W., J.T. Zellmer, M.E. Dodson, R. Kirkham, B.E. Opitz, D.R. Sherwood, and J. Tingey, Pacific Northwest Laboratory, Richland, WA

Radon Control by Multilayer Earth Barriers - Part 2: Field Tests

PNL-SA-9819 (1981)

Field tests of multilayer earthen covers for radon control have been conducted for the past two years at Grand Junction, Colorado, as part of the Department of Energy's Uranium Mill Tailings Remedial Action Project (UMTRAP) technology development. The initial tests conducted in 1980 used relatively thin (less than 20 cm), compacted layers of clay mixed with gravel as the control layer to limit radon escape from uranium tailings. The first multilayer system was applied in August 1980 and has been monitored for over one year. Results have indicated that the compacted clay/gravel layers have been relatively effective in reducing radon flux. Flux reductions on one of the compacted plots ranged from 98 to 99.9%, but during the first year flux levels at all monitoring points were observed to exceed 2 pCi/sq m/s. The 1981 field test was designed to test multilayer earth cover systems that could reduce surface radon flux to less than 2 pCi/sq m/s. Materials used in the clay/gravel layer for radon control were tested in the laboratory prior to field application. Laboratory measured diffusion coefficients for the wet, compacted clay/gravel mixtures ranged from 2 to 8 X 10(E-6) sq cm/s. Field measurements of clay/gravel layers indicate that compactions greater than 1.9 g/cu cm could be achieved by conventional earth-moving equipment. The compacted layers were hydraulically isolated from the surface soil by a 0.2 m thick capillary barrier composed of 3-cm-diameter washed rock. The capillary barrier was determined to be effective in retarding upward migration of water and salts. (EDB)(PTO)

689

Kalkwarf, D.R., and D.W. Mayer, Pacific Northwest Laboratory, Richland, WA

Influence of Cover Defects on the Attenuation of Radon with Earthen Covers

NUREG/CR-3395; 33 pp. (1983, November)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

Experimental and theoretical evaluations of radon flux through laboratory-scale defective soil columns are presented together with a survey of literature on the formation and prevention of defects in soil covers. This report focuses on air-filled, centimeter-scale defects that are most probable in earthen covers for attenuating radon emission from uranium-mill tailings. Examples include shrinkage and erosion cracks, erosion piping, animal burrows, and air channels formed by the biodegradation of vegetation roots. Calculations based on mathematical models indicate that collections of defects which could increase the radon flux from an earthen cover by a factor of two would be easily detected by visual inspection. However, these models ignore air turbulence in the defect and drying of the soil around the defect. Laboratory measurements showed that turbulent diffusion of radon occurred through defects as narrow as 0.3 cm when subjected to a transverse air velocity of 1 to 6 miles per hour at the surface. Both turbulence and more-rapid drying of soil can accelerate radon flux to the cover surface. Consequently, recommended methods to inhibit defect formation should be applied. (EDB)

690

Kalkwarf, D.R., and W.B. Silker, Pacific Northwest Laboratory, Richland, WA

Diffusion of Radon in Candidate Soils for Covering Uranium Mill Tailings

PNL-SA-11610; 10 pp.; CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 297-305) (1984, February)

Diffusion coefficients were measured for radon in 34 soils that had been identified by uranium mill personnel as candidate soils for covering their tailings piles in order to reduce radon emission. The coefficients referred to diffusion in the total pore space of the soils. They were measured by a steady-state method using soil columns compacted to greater than 80% of their Proctor maximum packing densities but with moisture contents generally less than would be expected at a tailings site. Three published empirical equations relating diffusion coefficients to soil moisture and porosity were tested with these data. The best fit was obtained with the equation D = 0.70 sup [-4(m-mPsq+m(E+5))] in which P is the dry porosity of the soil and m is its moisture saturation (i.e., the fraction of pore volume filled with water). This equation was used to extrapolate measured coefficients to values expected at soil-moisture contents representative of tailings sites in the western United States. Extrapolated values for silty sands and clayey sands ranged from 0.004 to 0.06 sq cm/s, where w, the weight ratio of water to dry soil, is expected to vary from 0.04 to 0.09. Values for inorganic silts and clays ranged from 0.001 to 0.02 sq cm/s, where w is expected to vary from 0.10 to 0.13. (Auth)

691

Lindsey, C.G., J. Mishima, S.E. King, and W.H. Walters, Pacific Northwest Laboratory, Richland, WA

Survivability of Ancient Man-Made Earthen Mounds: Implications for Uranium Mill Tailings Impoundments

NUREG/CR-3061; PNL-4541; 37 pp. (1983, June)

As part of a study for the Nuclear Regulatory Commission (NRC), the Pacific Northwest Laboratory (PNL) is investigating long-term stabilization techniques for uranium mill impoundments. Part of this investigation involves the design of a rock armoring blanket (riprap) to mitigate wind and water erosion of the underlying soil cover, which in turn prevents exposure of the tailings to the environment. However, the need for the armoring blanket, as well as the blanket's effectiveness, depends on the stability of the underlying soil cap (radon suppression cover) and on the tailings themselves. Compelling evidence in archaeological records suggests that large man-made earthen structures can remain sound and intact for time periods comparable to those required for the stabilization of the tailings piles if properly constructed. Archaeological evidence is presented on the existence and survivability of man-made earthen and rock structures. Factors contributing to their survival or destruction are reviewed, and the influence of climate, building materials, and construction techniques on survivability are addressed. (EDB)(CAJ)

692

Mayer, D.W., and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Multidimensional Simulation of Radon Diffusion Through Earthen Covers

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

DOE/UMT-0212; PNL-4458; 28 pp. (1983, January)

Pacific Northwest Laboratory (PNL) is actively involved in the design and analysis of cover systems for uranium mill tailings. The cover systems are intended to reduce the release of radon gas from mill tailings to an environmentally acceptable level. Because it is costly to construct and monitor such systems and it is difficult to control certain parameters in field environments, computer aided analyses have been proposed to evaluate these systems. The purpose of this report is to document applications of the RADMD model used at PNL to perform analyses of radon diffusion through uranium mill tailings cover systems. The accuracy of the numerical formulation of the RADMD model was demonstrated through a comparison with a two-dimensional analytic solution to the radon diffusion equation. Excellent agreement was obtained between two-dimensional radon concentration profiles predicted by RADMD and those obtained with the analytic solution. A simulation was made of radon diffusion into a test canister using the two-dimensional capabilities of RADMD. The radon flux profile was computed and illustrates the effects of the canister on the surface radon flux. The influence of the canister on the radon flux was shown to be significant under certain circumstances. Defects in earthen cover systems were evaluated using the three-dimensional capabilities of RADMD. The results support the expectation that defective covers can increase the surface flux from a covered tailings pile. The effects of temporal and spatial variations in moisture content have been modeled by coupling RADMD with a variable saturated flow model. Two-dimensional simulations were made of the time dependence of radon flux from a tailings site before and after cover placement. The results demonstrated the expected flux reduction produced by a thick earthen cover. Field results from Grand Junction, Colorado, were compared with one-dimensional model simulations. Some field tests were in good agreement with the model predictions, but most of the tests showed large flux variations and were, in general, not predicted by the one-dimensional simulations. (Auth)(MFB)

693

Nelson, J.D., R.L. Volpe, R.E. Wardwell, S.A. Schumm, and W.P. Staub, Colorado State University, Fort Collins, CO; Volpe (Richard L.) and Associates, Los Gatos, CA; Oak Ridge National Laboratory, Oak Ridge, TN

Design Consideration for Long-Term Stabilization of Uranium Mill Tailings Impoundments

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 495-498) (1984, February)

Long-term reclamation plans for uranium mill tailings impoundments must include engineering designs to protect against disruption of the tailings and the potential release of radioactive materials. The goals for such engineering designs should be to provide overall site stability for long-term periods with no need for planned ongoing maintenance and to provide a repository for the tailings that will not place a burden on future generations. Although the goal is to provide a maintenance-free system that does not require monitoring, it must be recognized that some period of surveillance would be reasonable. This paper presents results of an investigation using explicit time periods of evaluation. Applicable failure modes, and the corresponding engineering methodology for design of appropriate reclamation plans with no planned ongoing maintenance, were reviewed for time periods of 200, 500, and 1000 yr. The additional effort required to extend the design period from one long-term period to a longer one was addressed. (Auth)(BDC)

694

Nelson, J.D., R.L. Volpe, R.E. Wardwell, S.A. Schumm, and W.P. Staub, Oak Ridge National Laboratory, Oak Ridge, TN

Design Considerations for Long-Term Stabilization of Uranium Mill Tailings Impoundments

NUREG/CR-3397; ORNL-5979; 163 pp. (1983, September)

This report discusses the factors affecting the design of a reclamation scheme for long-term stability of uranium mill tailings impoundments. An initial design stability period of 200 years is addressed, and the incremental effort required to extend this design stability period to 500 and 1000 years is investigated. The report considers the hydrologic, geomorphic, and geotechnical engineering aspects of long-term stability. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

695

Nelson, J.D., R.E. Wardwell, S.R. Abt, and W.P. Staub, Oak Ridge National Laboratory, Oak Ridge, TN

Consolidation of Tailings

NUREG/CR-3204; ORNL/TM-8690; 35 pp. (1983, September)

The integrity of cover systems placed on tailings impoundments will be affected by the potential for differential settlement of the tailings surface. Settlement of the sand fraction will occur relatively rapidly. The slimes will take longer time for consolidation and will produce greater settlement. This report reviews the phenomenon of consolidation for saturated and unsaturated tailings. The effect of load application by cover placement and the extent to which dewatering of tailings will cause consolidation are considered. In addition, the feasibility of inducing consolidation by alternative means and the potential applicability of these methods to tailings impoundments reclamation are discussed. Differential settlement of the tailings will cause tensile strain to develop in covers. This strain could be large enough to cause cracking within a relatively brittle compacted clay. Dewatering of tailings by drainage can cause settlement even greater than that by placement of a cover material. Dewatering of the tailings would also increase the stability of the tailings surface, thereby enhancing reclamation operations. Consequently, in view of the enhanced surface stability and the fact that a portion of the differential settlement can be accomplished prior to cover placement, dewatering of tailings impoundments during operations may have beneficial effects. (EDB)

696

Pacific Northwest Laboratory, Richland, WA

Uranium Recovery Research Sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory: Quarterly Progress Report, October-December 1983

PNL-5015-1; 65 pp. (1984, February)

This report documents progress for four major research projects which include nine discrete research tasks and a management task. The primary purpose of these tasks is to provide information to help the Nuclear Regulatory Commission license uranium recovery facilities. The tasks underway include: long-term and interim stabilization of mill tailings piles, tailings dewatering techniques; tailings neutralization, and other alternatives in immobilizing toxic materials in tailings; evaluation of seepage and leachate transport from tailings disposal facilities; evaluation of environmental monitoring methods, equipment, and instrument testing; attenuation of radon emissions; assessment of leachate movement; and methods of minimizing groundwater contamination associated with in situ leach uranium mining. (Auth)(ARE)

697

Peterson, S.R., R.L. Erikson, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

Long-Term Stability of Earthen Materials in Contact with Acidic Tailings Solutions

NUREG/CR-2946; 75 pp. (1982, November)

The objectives of the studies documented in this report were to use experimental and geochemical computer modeling tools to assess the long-term environmental impact of leachate movement from acidic uranium mill tailings. Liner failure (i.e., an increase in the permeability of the liner material) was not found to be a problem when various acidic tailings solutions leached through liner materials for periods of up to 3 years. On the contrary, materials that contained over 30% clay showed a decrease in permeability with time in the laboratory columns. The high clay materials tested appear suitable for lining tailings impoundment ponds. The decreases in permeability are attributed to pore plugging resulting from the precipitation of minerals and solids. This precipitation takes place due to the increase in pH of the tailings solution brought about by the buffering capacity of the soil. Geochemical modeling predicts, and x-ray characterization confirms, that precipitation of solids from solution is occurring in the acidic tailings solution/liner interactions studied. In conclusion, the same mineralogical changes and contaminant reactions predicted by geochemical modeling and observed in laboratory studies were found at a drained evaporation pond having a 4 year history of acid attack (Lucky Mc in Wyoming). (EDB) (EST)

698

Silker, W.B., and D.R. Kalkwarf, Pacific Northwest Laboratory, Richland, WA

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

Radon Diffusion in Candidate Soils for Covering Uranium Mill Tailings

NUREG/CR-2924; PNL-4434; 60 pp. (1983, April)

Diffusion coefficients were measured for radon in 34 soils that had been identified by mill personnel as candidate covers for their tailings piles in order to reduce radon emission. These coefficients referred to diffusion in the total pore space of the soils. They were measured in the laboratory by a steady-state method using soil columns compacted to greater than 80% of their Proctor maximum packing densities but with moisture contents generally less than would be expected at a tailings site. An empirical equation was used to extrapolate measured coefficients to value expected at soil-moisture contents representative of tailings sites in the western United States. Extrapolated values for silty sands and clayey sands ranged from 0.004 to 0.06 sq cm/s, while values for inorganic silts and clays ranged from 0.001 to 0.02 sq cm/s. (EDB)

699
Silker, W.B., and V.C. Rogers, Pacific Northwest Laboratory, Richland, WA

Factors Influencing Radon Attenuation by Tailing Covers

PNL-SA-9791; CONF-810814; Proceedings of the American Institute of Chemical Engineers 91st National Meeting, Detroit, MI, August 16, 1981; (10 pp.) (1981, July)

The U.S. Nuclear Regulatory Commission (NRC), in its Generic Environmental Impact Statement on uranium milling has specified that the radon flux escaping a uranium mill tailings pile will be reduced by application of covering layers of soils and clays. These covers present a radon diffusion barrier, which sufficiently increases the time required for radon passage from the tailings to the atmosphere to allow for decay of Rn-222 within the cover. The depth of cover necessary to reduce the escaping radon flux to the prescribed level is to be determined by calculation, and requires precise knowledge of the radon diffusion coefficient in the covering media. A Radon Attenuation Test Facility was developed to determine rates of radon diffusion through candidate cover materials. This paper describes this facility and its application for determining the influence of physical properties of the soil column on the radon diffusion coefficient. (EDB)

700
Steinhaeusler, F., J. Pohl-Rueling, and E. Pohl, University of Salzburg, Salzburg, Austria

Control of Radon Daughter Concentration in Mine Atmospheres with the Use of Radon Diffusion Barriers

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 127-130) (1981)

Effective control of the radon flux from rock surfaces prevents the initial contamination of the mine air, stopping that contamination directly at its source. In the past, several materials have been tested as sealants for controlling the emanation of radon from surfaces of rock and building materials. The following results are reported from investigations on the suitability of various materials as radon diffusion barriers. These include rubber, polyethylene and polyvinylchloride. (EDB)(EST)

701
Strong, K.P., D.M. Levins, and A.G. Fane, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Radon Diffusion Through Uranium Tailings and Earth Cover

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY; (pp. 713-719) (1981)

The safe disposal of tailings is the most important environmental question facing the uranium mining industry today. The design of rehabilitation schemes is aided by a knowledge of radon transport through tailings piles. In this paper the results are presented of a theoretical analysis and experimental study of radon diffusion through selected Australian tailings and cover material. The minimum cover criteria of 3 meters is reexamined in the light of these findings. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

702

Swanson, S., and Z. Abouguendia, Saskatchewan Research Council, Saskatoon, Saskatchewan, Canada

Problem of Abandoned Uranium Tailings in Northern Saskatchewan: An Overview

SRC-C-805-48-C-81; 108 pp. (1981, November)

Two Saskatchewan tailings sites, Lorado and Gunnar, covering approximately 89 ha, were abandoned in the early 1960s leaving untreated tailings in lakes and depressions. This report reviews the literature on environmental conditions in abandoned uranium tailings with available management and mitigation options, and identifies research requirements essential for proper treatment of these two sites. The recommended management plan includes: isolation of the exposed tailings area from surface waters; stabilization of the exposed tailings surfaces; diversion of runoff around tailings; treatment of overflow water before release; and implementation of an environmental monitoring program. Revegetation appears to be a promising stabilization measure, but research is needed on propagation methods for appropriate native species. Studies of the existing geological and hydrological conditions at both sites, detailed characterization of the wastes, field testing of different surface treatment methods, and nutrient cycling investigations are also needed. (EDB)(EST)

703

Thamer, B.J., E. Cannon, J.J. Keithley, J.R. Duncan, F. Hill, and L. Rattigan, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Assessments of Stabilization Methods for Uranium Mill Tailings

FBDU 359; 184 pp. (1982, January)

Factors relating to diffusional aspects of radon motion were studied using uranium tailings, sand, and bentonite. Radon solubility was studied in solids and liquids that relate to prospective covers. The radon flux from bare uranium tailings was measured as a function of evaporating moisture. Experimental covers of films and mastics were studied for their effectiveness in reducing radon flux. The technique of applying an alternative cover, foamed asphalt, was developed further. Dewatering of tailings was investigated, and a well point technique was tried at the Vitro site. (Auth)

704

Thamer, B.J., K.K. Nielson, and K. Felthauser, Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT

Effects of Moisture on Radon Emanation Including the Effects on Diffusion

PB-83-136358; Bureau of Mines Open File Report 184-82; 214 pp. (1981, November)

Radon emanation coefficients of 0.02 to 0.55 were measured at moisture contents ranging from dry to saturation in 18 different ores. The emanation coefficients rose from a minimum when dry to a plateau usually starting at 5 to 20 percent of saturation. A model, using measured pore-size distributions, suggested that the radium mineralization may be confined to annular layers about 0.02 micrometers thick around pores. Radon's diffusion coefficient was determined as a function of moisture. The techniques involved comparing a disk's exhalation as a function of time whether or not the disk had a distributed source. The model was free of approximations and included the effects of porosity and adsorption. An increase of diffusion coefficient with moisture for one or two ores was explained in terms of a model's equation for the diffusion coefficient in terms of both volume and surface diffusion. Radon's adsorption coefficient was determined on a uranium ore. (EDB)

705

Voorhees, L.D., M.J. Sale, J.W. Webb, and P.J. Mulholland, Oak Ridge National Laboratory, Oak Ridge, TN

Long-Term Stabilization of Uranium Mill Tailings

CONF-830523; Radioactive Waste Management, Proceedings of an International Conference, Seattle, WA, May 16, 1983; (15 pp.) (1983)

The primary hazard associated with uranium mill tailings is exposure to a radioactive gas, radon-222, the concentration of which has been correlated with the occurrence of lung cancer. Previous studies on radon attenuation conclude that the placement of earthen cover materials over the tailings is the most effective technique for reducing radioactive emissions and dispersal of tailings. The success of such a plan, however, is dependent on ensuring the long-term integrity of these cover materials. Soil erosion from water and wind is the major natural cause of destabilizing earthen cover materials. Field data related to the control of soil loss are limited and only indirectly apply to the problem of isolation of uranium mill tailings over very long time periods (up to 80,000 years). However, sufficient information is available to determine benefits that will result from the changes in specific design variables and to evaluate the need for different design strategies among potential disposal sites. The three major options available for stabilization of uranium mill tailings are: rock cover, soil and revegetation, or a combination of both on different portions of the tailings cover. The optimal choice among these alternatives depends on site-specific characteristics such as climate and local geomorphology and soils, and on design variables such as embankment, heights and slopes, modification of upstream drainage, and revegetation practices. Generally, geomorphic evidence suggests that use of soil and vegetation alone will not be adequate to reduce erosion on slopes greater than about 5 to 9%. (EDB)

706

Voorhees, L.D., M.J. Sale, J.W. Webb, and P.J. Mulholland, Oak Ridge National Laboratory, Oak Ridge, TN

Guidance for Disposal of Uranium-Mill Tailings: Long-Term Stabilization of Earthen Cover Materials

NUREG/CR-3199; ORNL/TM-8685; 103 pp. (1983, June)

The primary hazard associated with uranium-mill tailings is exposure to a radioactive gas, Rn-222, the concentration of which has been correlated with the occurrence of lung cancer. Previous studies on radon attenuation conclude that the placement of earthen cover materials over the tailings is the most effective technique for reducing radioactive emissions and dispersal of tailings. The success of such a plan, however, depends on long-term protection of these cover materials. Th-230, which decays to Rn-222, has a half-life of about 80,000 years. The three major options available for stabilization of uranium-mill tailings are: (1) rock cover; (2) soil and revegetation; and (3) a combination of both on different portions of the tailings cover. The option selected from these alternatives depends on site-specific characteristics such as: climate; local geomorphology; and soils. Other design variables include: embankment heights and slopes; modification of upstream drainage; and revegetation practices. Generally, geomorphic evidence suggests that use of soil and vegetation alone will not be adequate to reduce erosion on slopes greater than about 5 degrees. For these steeper slopes, riprap will be necessary to maximize the probability of long-term stability. The use of vegetation to control erosion on the flatter portions of the site may be practicable in regions with sufficient rainfall and suitable soil types, but revegetation practices must be carefully evaluated. (EDB)

707

Wardwell, R.E., J.D. Nelson, S.R. Abt, and W.P. Staub, Colorado State University, Department of Civil Engineering, Geotechnical Engineering Program, Fort Collins, CO; Oak Ridge National Laboratory, Oak Ridge, TN

Review of In Situ Dewatering and Consolidation of Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 499-509) (1984, February)

State-of-the-art methods for the in-place dewatering and resulting consolidation of uranium mill tailings are described. The application of various drainage techniques is discussed with regard to their effectiveness in minimizing the amount of water remaining in an impoundment during long-term reclamation. The phenomenon of consolidation of saturated and unsaturated tailings also is reviewed. The effect of load application by cover placement and the extent to which dewatering of tailings will cause consolidation are considered. (Auth) (BDC)

708

Wardwell, R.E., J.D. Nelson, S.R. Abt, and W.P. Staub, Oak Ridge National Laboratory, Oak Ridge, TN; Colorado State University, Fort Collins, CO

In-Situ Dewatering Techniques for Uranium Mill Tailings

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

NUREG/CR-3203; ORNL/TM-8689; 72 pp. (1983, September)

The state-of-the-art regarding methods for the in-place dewatering of uranium mill tailings is described. Since large amounts of water in tailing impoundments can cause long-term seepage problems, drainage of the tailings both during operations and during the reclamation stage is highly desirable. Dewatering of tailings also provides for settlement prior to the placement of the cover and increases the pile's stability for earth-moving equipment during site reclamation and cover placement. The application of various drainage techniques is discussed with regard to their effectiveness in minimizing the amount of water remaining in an impoundment during long-term reclamation. Drainage techniques that are reviewed include underdrain gravity-flow systems, single wells and well-points, electro-osmosis, vertical drains, and evapotranspiration. It has been shown that the underdrain gravity systems provide an effective and reliable means of dewatering tailings. If feasible, they will probably prove to be the best option for the in situ dewatering of tailings because of their practicality and relatively low cost. The other methods would be recommended only as backup systems or in existing impoundments that do not have underdrain systems. (EDB)

709

Watkin, E.M., and J.A. Watkin

Keep Reclamation Costs Low with Effective Revegetation

Canadian Mining Journal 104(8):33, 35-36 (1983, August)

Revegetation and dust control on tailings and other mining wastes are described. Five mineral tailings disposal sites were treated with limestone to obtain plant growth on sample material. The effects of five dust control products on the stabilization of tailings, concentrates, soils, and industrial wastes are compared. (EDB)

710

Watkin, E.M., and J.A. Watkin, Mine Waste Reclamation Limited, Guelph, Ontario, Canada

Tailings Reclamation in Eastern Canada

World Mining 35(12):61-65 (1982, December)

Laboratory and field experience has established general principles for developing a tailings reclamation program. The article describes several reclamation projects. (EIX)

711

Wong, T., R.E. Wardwell, and D. van Zyl, Union Carbide Corporation, Gas Hills, WY; Water, Waste and Land, Inc., Fort Collins, CO; University of Arizona, Department of Civil Engineering and Engineering Mechanics, Tucson, AZ

Methodology to Evaluate Reclamation Stability of an Inactive Uranium Mill Tailings Impoundment

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 511-519) (1984, February)

The inactive tailings area in Gas Hills, Wyoming, consists of three impoundments whose surfaces vary in elevation by approximately 50 ft. The reclamation plan requires the cutting of downstream embankments and the filling of upstream areas to achieve an overall reclaimed slope of 10H:1V. Because of these requirements and the method of initial tailings deposition, up to 50 ft of surcharge fill material will be placed over pool areas, which will be underlain by soft, fine-grained slime material. Preliminary investigations indicate that the large volume of surcharge placed on these slime areas will result in slope failure unless techniques to consolidate the slimes are implemented prior to fill placement. The following plan was implemented to determine the most feasible techniques and to estimate the time required for stabilizing the area: (1) conduct additional field and laboratory investigations needed to characterize the impoundment areas and evaluate their engineering behavior during reclamation; (2) determine the most feasible technique(s) that will improve stability of the impoundment and reduce the time required for reclamation; (3) evaluate the effects of the proposed plans on final reclamation and long-term stability of the area; and (4) develop a monitoring plan to verify the progress of tailings stability and to monitor the final construction phase of the reclamation plan. (Auth)(BDC)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT
SITE STABILIZATION AND RECLAMATION

712

Worthington, S.J., and D.W. Bollig, Water, Waste and Land, Inc., Fort Collins, CO; Conoco Inc., Minerals Department, Denver, CO

Stability Analysis of a Re-established Stream Channel Over an In-Pit Uranium Tailings Disposal Area

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 339-347) (1984, February)

The reclamation plan for a proposed in-pit uranium tailings disposal area included the re-establishment of an existing stream channel over the site. A stability analysis was performed using the HEC-2 model to evaluate the effect of various channel geometries and alternative stream channel stabilization options on the long-term stability of the reclaimed area. Flow velocities, as they relate to erosion thresholds, under several design storm events were the primary criteria by which stability was evaluated. Included in the analysis was modeling of upstream and downstream reaches of the stream. (Auth)

713

Yamamoto, T., U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO

Review of Uranium Spoil and Mill Tailings Revegetation in the Western United States

Forest Service General Technical Report RM-92; 27 pp. (1982, October)

The following aspects of uranium mine and mill tailings management are reviewed and discussed: (1) history of the uranium mill tailings remedial action program; (2) magnitude of the uranium spoils problem; (3) uranium deposits, mining, and milling; (4) status of reclamation; (5) problems in revegetation of uranium spoils and tailings; and (6) health and safety considerations. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

714

Baldwin, R.D.

Lining a Pond to Contain Uranium Tailings

ASCE Journal of the Civil Engineering Division 53(1):77 (1983, January)

To demonstrate the impermeability of pond linings combined with geotextile fabric for the containment of uranium mill tailings, a pond site in Grants, New Mexico, owned by Anaconda Minerals Company, is described. The liner is expected to last 20 yr with minimum maintenance, but it is vulnerable to ultraviolet radiation. Smaller ponds, instead of one large one, allow a longer life for each pond through the reduction of wave erosion around the edge of the pond. (ENVIR)

715

Rubber Membrane Liner Confines Low Level Radioactive Material

Chemical Processing 45(3):110 (1982, March)

One of the most sophisticated membrane-lining projects in the world was undertaken in 1979 by the Cotter Corporation, Canon City, Colorado, producers of vanadium and uranium, when a new tailings pond was built to handle mill tailings and effluents. To comply with local, state, and federal regulations, Cotter sought maximum protection for downstream residents. The lining was designed to keep leakage near zero and to withstand tailings and water pressure at the deepest part of the pond. Other considerations were compatibility with alkalies and acids, durability, and effectiveness of the lining beyond the life of the mill. It was necessary to ensure that the impoundment would outlast the mill because of the need for long-term isolation of the tailings. Cotter chose an industrial-grade sheeting made of Hypalon synthetic rubber, a chlorosulfonated polyethylene, that has an exposed life expectancy of 40 years; however, once covered with earth and tailings, it should last much longer. The sheeting consists of a reinforced scrim sandwiched between two sheets of Hypalon. The rubber comprises nearly 50% of the total weight. The reinforcement is a 1000D polyester scrim with open weave to allow the rubber to penetrate the fabric and create excellent adhesion between the layers. After two years of operation, the impoundment contains approximately 1400 acre-ft of liquid. Currently, about one half of the pond contents are run-off, with tailings and liquids comprising the rest. (EDB)

716

Clifton, A.W., R.G. Barsi, and L.A. Melis, Clifton Associates Limited, Regina, Saskatchewan, Canada; Environment Canada, Mines Pollution Control Branch, Prince Albert, Saskatchewan, Canada

Uranium Mill Tailings Management Practices in Saskatchewan, Canada

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 37-47) (1984, February)

Uranium was discovered in Saskatchewan in 1934. The first major mill began operating at Beaverlodge in 1953; two other mills began production in the same area in 1955 and 1957. Waste management measures were limited at the early mills. A new generation of mills was brought into production beginning in 1975, utilizing engineered waste management systems. This paper presents a brief description of the geography and physical environment of northern Saskatchewan, Canada; a review of milling operations and waste management systems; a description of the evolution of waste management systems; and comments on environmental control measures regulating the industry. (Auth)(NPK)

717

Davis, J.B., R.A. Knapp, MacLaren. J.F., and K.W. Sinclair, Golder Associates, Toronto, Ontario, Canada

Control of Seepage from Uranium Mill Tailings Ponds in the Elliot Lake Area

CONF-7905106; Proceedings of the First International Mine Drainage Symposium, Denver, CO, May 20-23, 1979; (pp. 726-775) (1979)

Since the beginning of mining operations in 1955, 105 million tons of uranium mill tailings have been produced in the Elliot Lake area of Ontario, Canada. Current contracts will result in the production of an additional 300 million tons of tailings, and presently uncommitted reserves could result in the production of another 250 million tons. This paper reviews the history of past mining activities and tailings management in the area,

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

describes the seepage control measures at two tailings management areas (one developed in the late 1960s and the other presently under construction), and considers possible techniques to control seepage from future tailings areas. (EIX)(JMF)

718
Tailing Reclamation: New Profits for Ergo and Others

Engineering Mining Journal 183(11):132-133 (1982, November)

The South African East Rand Gold and Uranium Company Limited (ERGO), has developed an operation that reclaims gold, uranium, and sulfuric acid from old tailings impoundments. The treatment plant consists of: (1) pyrite flotation; (2) acid leaching of the pyrite concentrate and recovery of ammonium diuranate in a solvent extraction plant; (3) fluid-bed roasting of the gas in two Lurgi acid plants with an oleum facility; and (4) a gold plant, equipped for grinding and cyanide leaching of roaster calcine followed by zinc dust precipitation of gold, and a smelt house for pouring bullion. The reclamation project has been a financial success. (EIX)

719
Grant, M.W., G.B. Merrell, V.C. Rogers, and K.K. Nielson, Rogers and Associates Engineering Corporation, Salt Lake City, UT

Performance and Cost of Uranium Mill Tailings Containment Systems

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 27-36) (1984, February)

A systems performance and cost model for tailings containment has been developed for the Uranium Mill Tailings Remedial Action Program. The model provides a mathematical framework for evaluating and comparing the contaminant containment capability and conceptual costs of various uranium mill tailings disposal systems. The major pathways for impacts from a uranium mill tailings containment system are radon migration, gamma ray exposure, and groundwater contamination. Physical stability and water balance affect radon diffusion, radon emanation, and water release characteristics of the system. (Auth)(BDC)

720
Haylen, M.E., Office of the Supervising Scientist, Alligator Rivers Region, Regulatory and Assessment Branch, Sydney, Australia

Potential for Long-Term Disposal of Uranium Mill Tailings in the Ranger Tailings Dam

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 397-409) (1984, February)

The tailings from the Ranger Project are to be disposed of in the worked out mine pits, subject to review by the Office of the Supervising Scientist. A preliminary assessment of pit disposal suggests a potential for significant groundwater contamination (high-permeability carbonate conduits) if tailings are deposited into an 'unprepared' No. 1 pit. This paper outlines a rehabilitation option for disposing of tailings in the tailings dam, determines physical criteria which will need to be satisfied (e.g., seepage, radon exhalation, and long-term integrity), and identifies gaps in the information base. (Auth)(ARE)

721
Hileman, B.

Nuclear Waste Disposal: A Case of Benign Neglect

Environmental Science and Technology 16(5):271A-275A (1982, May)

Problems associated with safe disposal of spent fuel rods, uranium mill tailings, and high and low-level nuclear waste are reviewed. The pros and cons of reprocessing, low-level sites, geologic repositories, and use of borosilicate waste forms are discussed. (EDB)(JMT)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

722

Johnson, H.V., S.J. Spigolon, and R.J. Lutton, U.S. Army Waterways Experiment Station, Vicksburg, MS

Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities

NUREG/CR-3356; 108 pp. (1983, June)

The report presents geotechnical quality control practices by identifying the geotechnical parameters that should be considered along with appropriate laboratory and field testing and observation techniques. Advantages and disadvantages of the tests are discussed. Preference is given to those standard testing techniques (e.g., ASTM and AASHTO) that are in widespread use and easily accessible by industry. In addition, guidance is provided on establishing a geotechnical quality program. The frequency of testing is discussed along with specifications for appropriate field and observation control. Methods of relating laboratory testing and field testing are recommended. Various factors influencing quality control and reports/documentation control are discussed. Verification studies for confirming site characteristics and soil engineering properties related to design assumptions are explained. A summary is presented of the elements necessary to properly implement a quality control plan. (Auth)(MFB)

723

Junge, W.R., and L.E. Dezman, Colorado Geological Survey, Denver, CO; Colorado Division of Water Resources, Denver, CO

An Analysis of Control Standards for the Long-Term Containment of Uranium Mill Tailings

CONF-840245; Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Proceedings of the Sixth Symposium, Fort Collins, CO, February 1-3, 1984, 681 pp.; (pp. 485-493) (1984, February)

U.S. Environmental Protection Agency (EPA) standards require the control of uranium mill tailings for 1000 yr (to the extent reasonably achievable) and, in any case, for at least 200 yr. Probabilities of hydrologic and/or geologic events associated with meeting these standards for long-term containment of tailings indicate: (1) design events with a return period of 10,000 yr or more must be used to achieve a containment standard of 200 or 1000 yr, and (2) maximum-credible events must be used in the facility design to achieve a low risk of failure over the containment life. Maximum-credible events include natural disasters that do not have a specified return period or associated probability of occurrence. The size of the event is determined from historic data combined with an analysis of the geologic, hydrologic, and meteorologic setting. Such events define the reasonable upper limit of a natural event in a given area. Beyond this limit the probability of a larger event occurring is low. Facilities designed using a maximum-credible event have a low risk of failure and meet EPA standards. (Auth)(BDC)

724

Lucia, P.C., University of California, Berkeley, CA

Review of Experiences with Flow Failures of Tailings Dams and Waste Impoundments

Thesis (1982)

Flow failures of the mine waste impoundments have caused considerable damage to life, property, and the environment over distances as great as 75 miles downstream. In the past decade there has been a dramatic increase in the size of mine waste impoundments and in the quantity of waste produced. In 1980 it was estimated that over 3 billion tons of mine waste was produced in the United States. Case histories of flow failures were evaluated as means of developing procedures for estimating the consequences of possible tailings flow failures. In most of the cases studied, data on the post failure geometry were available. Information on the material properties, construction techniques, and events leading up to failure was available in a few of the cases studied. The study shows some liquefied tailings have appreciable values of residual strength after liquefaction, and they will come to rest at slopes of one to four degrees. A procedure is presented by which the distance liquefied tailings may flow can be estimated. (PA)

725

Peterson, S.R., A.R. Felmy, R.J. Serne, and G.W. Gee, Pacific Northwest Laboratory, Richland, WA

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

Geochemical Modeling of Uranium Mill Tailings: A Case Study

PNL-SA-11603; CONF-8308118; Annual Geochemistry Review, Proceedings of a Conference, Washington, DC, August 29, 1983; (29 pp.) (1983, August)

Liner failure was not found to be a problem when various acidic tailings solutions leached through liner materials for periods of up to 3 years. On the contrary, materials that contained over 30% clay showed a decrease in permeability with time in the laboratory columns. Decreases in permeability are attributed to pore plugging resulting from the precipitation of minerals and solids. This precipitation takes place due to the increase in pH of the tailings solution brought about by the buffering capacity of the soil. Geochemical modeling predicts, and x-ray characterization confirms, that precipitation of solids from solution is occurring in the acidic tailings solution/liner interactions studied. X-ray diffraction identified gypsum and alunite group minerals, such as jarosite, as having precipitated after acidic tailings solutions reacted with clay liners. The geochemical modeling and experimental work described above were used to construct an equilibrium conceptual model consisting of minerals and solid phases. This model was developed to represent a soil column. A computer program was used as a tool to solve the system of mathematical equations imposed by the conceptual chemical model. The combined conceptual model and computer program were used to predict aqueous phase compositions of effluent solutions from permeability cells packed with geologic materials and percolated with uranium mill tailings solutions. An initial conclusion drawn from these studies is that the laboratory experiments and geochemical modeling predictions were capable of simulating field observations. The same mineralogical changes and contaminant reductions observed in the laboratory studies were found at a drained evaporation pond having a 10-year history of acid attack (Lucky Mc in Wyoming). (EDB)(EST)

726

Pradel, J., Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France

Management of Solid Wastes from Uranium Mining and Milling in France

CONF-820552; STI/PUB-622; IAEA-SM-262/64; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 55-68) (1982)

The paper lists storage locations for the different types of solid wastes generated in France since the start of mining and milling activities in 1950. Experimental results obtained at various French sites for the transport of radioactivity in the atmosphere, surface waters and the food chain are also presented. The purpose of compiling these results is to identify geologic, geographic, and climatic problems associated with the French deposits. Conclusions are drawn which can reasonably be proposed to mining companies, taking into consideration the existing conditions and ICRP recommentdations. (EDB) (PTO)

727

Rafferty, P.J., Nuclear Energy Agency, Organization for Economic Cooperation and Development, Paris, France

Background to the Nuclear Energy Agency Programme on the Long-Term Aspects of the Management and Disposal of Uranium Mill Tailings

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 11-18) (1982)

This paper provides a summary of the background and the terms of reference of the Nuclear Energy Agency program on the long-term aspects of the management and disposal of uranium mill tailings. In particular the paper discusses various background perspectives to the Workshop on Geomorphological Evaluation of the Long-Term Stability of Uranium Mill Tailings Disposal Sites. (EDB)

728

Relyea, J.F., Pacific Northwest Laboratory, Richland, WA

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

Decision-Tree Approach to Evaluating Inactive Uranium-Processing Sites for Liner Requirements

PNL-4436; 66 pp. (1983, March)

Recently, concern has been expressed about potential toxic effects of both radon emission and release of toxic elements in leachate from inactive uranium mill tailings piles. Remedial action may be required to meet disposal standards set by the states and the U.S. Environmental Protection Agency (EPA). In some cases, a possible disposal option is the exhumation and reburial (either on site or at a new location) of tailings and reliance on engineered barriers to satisfy the objectives established for remedial actions. Liners under disposal pits are the major engineered barrier for preventing contaminant release to ground and surface water. The purpose of this report is to provide a logical sequence of action, in the form of a decision tree, which could be followed to show whether a selected tailings disposal design meets the objectives for subsurface contaminant release without a liner. This information can be used to determine the need and type of liner for sites exhibiting a potential groundwater problem. The decision tree is based on the capability of hydrologic and mass transport models to predict the movement of water and contaminants with time. The types of modeling capabilities and data needed for those models are described, and the steps required to predict water and contaminant movement are discussed. A demonstration of the decision tree procedure is given to aid the reader in evaluating the adequacy of a liner. (EDB)

729

Robinsky, E.I., University of Toronto, Toronto, Ontario, Canada

Uranium Tailing Disposal by the Thickened Tailing Discharge System

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 215-228) (1982)

It is shown that the Thickened Tailing Disposal System results in less environmental impact than most other systems used in the mining industry today. The initial and operative costs are generally lower and the system can be adapted to any given topography. The most damaging aspect of tailing disposal is usually seepage into the surrounding environment. Such seepage cannot be prevented entirely, but the thickened tailing disposal system creates less contamination than conventional methods by maximizing evaporation, optimizing runoff and eliminating dusting. The construction of costly confining dikes and dams is eliminated. Finally, it is shown that the tailing disposal area can be readily rehabilitated. One case study is given to show how topographical features can be used to advantage to dispose of tailings safely and economically, using the thickened tailing disposal system. (EDB)

730

SECOR, Inc., Montreal, Quebec, Canada

Cost of Implementing AECB Interim Criteria for the Closeout of Uranium Tailings Sites: A Report Prepared for the Atomic Energy Control Board

INFO-0023-3; 30 pp. (1981, April)

The purpose of this study was to make a gross approximation of the costs to the Canadian uranium mining industry of meeting the proposed closeout criteria established by the Atomic Energy Control Board (AECB) for tailings deposits. Two options have been investigated: on-land disposal, and under-lake disposal. Overall cost figures for the Canadian uranium mining industry are linear extensions from a hypothetical base case. The results of a conference held in Ottawa on February 25-26, 1981 to discuss the proposed AECB interim criteria for the closeout of uranium tailings sites are also included. Representatives from mining firms, provincial regulatory authorities, universities and the AECB attended the conference. (EDB)

731

Shields, D.H., University of Manitoba, Winnipeg, Manitoba, Canada

Innovation Required in the Disposal of Uranium Mine Wastes

INIS-mf-8473; CONF-8106200; Proceedings of 21st Annual International Conference of Canadian Nuclear Association and Second Annual Conference of Canadian Nuclear Society, Part 1, Ottawa, Ontario, Canada, June 8, 1981. Atomic Energy of Canada Limited, Ottawa, Ontario, Canada; (pp. 276-283) (1981)

The following questions concerning the safe disposal of uranium mine and mill wastes remain unanswered after the hearings of the British Columbia Royal Commission of INquiry into Uranium Mining: (1) how can the natural background levels of radioactivity and toxic substances be determined at a potential mine site; (2) should wastes from uranium mines be disposed of below or above ground; (3) how should waste piles and tailings ponds be covered; (4) should an attempt be made to dry out the mill tailings as they are deposited; (5) how should the ground surface be prepared to receive radioactive waste; (6) how do contaminants migrate through soil or rocks; (7) how do you analyze seepage through unsaturated soil; (8) how should natural groundwater flows be considered during the siting and design of waste disposal; (9) when should the design team give way to the operating team during the construction of a mine; and (10) who is responsible for the long-term, safe management of uranium mine wastes. Recommendations are made in each case to answer the questions posed. Both research and innovative design solutions are required. (EDB)

732

Thomson, B.M., and R.J. Heggen, University of New Mexico, Department of Civil Engineering, Albuquerque, NM

Uranium Mill Tailings Backfill Management, Final Report

NMERDI-2-69-1107; 120 pp. (1984, January)

Backfilling, the disposal of spent uranium mill tailings in empty mine stopes, has been practiced in the Grants Mineral Belt of New Mexico for nearly 20 years. The principal objective of backfilling is the prevention of roof collapse and hydraulic connection with overlying aquifers, increasing mine dewatering requirements. Backfilling is accomplished by gravity feed of a slurry of sand-fraction tailings and treated mine water into the slope. The effects of backfilling on surface discharge of mine wastewater are negligible due to the small fraction of the total flow represented by slurry decant. Furthermore, quality of the decant is not significantly below that of other mine waters. Groundwater effects of backfilling may be classified as short-term (while the mine is operational) and long-term (after dewatering operations have been terminated). Short-term effects are insignificant because of rapid and continuous flow to the mine sump. Long-term effects on aquifer water quality are predicted to be minimal due to (1) the small amount of slurry liquor present after drainage, (2) the precipitation of SO4 and CO3 phases, and (3) the reestablishment of reducing conditions and subsequent precipitation of major contaminants including U, As, Mo, Se, and V. (EDB)

733

U.S. Geological Survey, Denver, CO

Potential Sites Suitable for Relocation and/or Reprocessing of the Grand Junction and Rifle Uranium-Mill-Tailings Piles

USGS-OFR-82-2; 188 pp. (1982)

The procedure and results of a regional search for sites that appear to be suitable for the relocation and/or reprocessing of the Grand Junction and Rifle uranium mill tailings piles are described. This search identified nine potential sites within the study area that were offered to the Candidate Site Review Committee for further consideration. All nine sites could be used for joint disposal of the uranium tailings in both Grand Junction and Rifle. Disposal of any individual pile at any of the nine sites may also be considered by the committee. It is the responsibility of the committee to determine which of these sites should be recommended to the U.S. Department of Energy for detailed evaluation of their suitability for uranium tailings disposal. This should include consideration of sites for joint disposal as well as disposal in separate sites. All sites are entirely on federal lands administered by the Bureau of Land Management. The sites fall within five general geographic locations. Two Road, McDonald Creek, and 6 and 50 Reservoir sites lie west of Mack near the Utah-Colorado border. East Salt Creek and Camp Gulch sites are north of Mack near the Mesa-Garfield County Line. Halls Basin and Cheney Reservoir sites are found southeast of Grand Junction, west of and below Grand Mesa. Lucas Mesa site lies east of DeBeque across the Colorado River. Flatiron Mesa site is south of Rifle on the northeast flank of Battlement Mesa. A comprehensive site selection process was used to identify the recommended potential sites. None of the sites is completely ideal when all relevant factors are considered. The committee must compare and weigh the advantages and disadvantages of each site to determine

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

which sites are the most favorable for continued evaluation for long-term containment of the uranium tailings. It must be emphasized that this investigation is of a regional nature and therefore is preliminary. (EDB)

734

U.S. House of Representatives, Washington, DC

Management of Commingled Uranium Mill Tailings

Hearing Before the Subcommittee on Procurement and Military Nuclear Systems of the Committee on Armed Services, United States House of Representatives, 97th Congress, 2nd Session, August 17-18, 1982; 673 pp. (1982)

These hearings were called to examine the U.S. Department of Energy's plan for the stabilization and management of commingled mill tailings residue piles. A commingled mill tailings pile is one which results when the residues from government milling contracts for uranium, primarily for defense purposes, are mixed with similar tailings from other milling activities. The plan is intended to detail fair share costs for government participation in any remedial action efforts necessary to reduce known risks to public health and safety and to the environment. (Auth)(BDC)

735

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Proposes to Suspend Certain Provisions of the Regulations Concerning the Disposal of Uranium Mill Tailings to Comply with Recently Enacted EPA Legislation

Federal Register 48(103):23649 (1983, May 26)

The Nuclear Regulatory Commission (NRC) is proposing to suspend selected portions of its regulations dealing with the disposal of uranium mill tailings. The provisions, for which suspension is proposed, are those which would be affected by recently published proposed Environmental Protection Agency (EPA) standards for protection of the environment from these wastes. The result of the suspension will be to place in abeyance certain commission regulations that could have a significant cost impact on its licensees if the regulations are implemented before the Commission makes the anticipated rule changes necessary to conform the regulations to the EPA standard when it is finalized. This action is necessary to comply with recently enacted legislation. (Auth) (LFG)

736

U.S. Nuclear Regulatory Commission, Washington, DC

NRC Suspends Certain Portions of Its Regulations on Disposal of Uranium Mill Tailings Which Would be Affected by Recently Published EPA Regulations for Protection from These Wastes

Federal Register 48(151):35350 (1983, August 4)

The Nuclear Regulatory Commission (NRC) is suspending selected portions of its regulations dealing with the disposal of uranium mill tailings. The provisions suspended are those which would be affected by recently published proposed Environmental Protection Agency (EPA) standards for protection of the environment from these wastes. The result of the suspension will be to place in abeyance certain NRC regulations that could have a significant cost impact on its licensees if the regulations are implemented before NRC makes the anticipated rule changes necessary to conform the regulations to the EPA standard when finalized. The proposed suspension was published for public comment and comments received have been considered in this action. This action is necessary to comply with recently enacted legislation. (Auth) (EST)

737

Van Dyke, J., Oak Ridge National Laboratory, Oak Ridge, TN

Benefit-Cost Aspects of Long-Term Isolation of Uranium Mill Tailings

ORNL/TM-8686; 35 pp. (1983, November)

The Uranium Mill Tailings Radiation Control Act of 1978 provides for regulations for control of radon diffusion from uranium mill tailings to protect the public welfare. In developing these regulations, the Office of Nuclear Material Safety and Safeguards of the Nuclear Regulatory Commission has attempted to establish benefits and costs for alternative regulatory criteria. This report provides a perspective on some economic issues associated with long-term radiation effects from disposal of uranium mill tailings. The general problem of developing an economic rationale for regulating this activity is complicated by the very long-term and widespread effects which could result from radon gas diffusion associated with tailings piles. The economic issues are also complex because of the trade-offs between costs of disposal and intangible social values. When intergenerational implications were considered, the traditional basis for discounting in a benefit-cost framework was found to shift. The appropriate rate of discount was found to depend on ethical assumptions and expectations about the relative welfare of future generations. (EDB)

738

Warner, R.F., and G. Pickup, University of Sydney, Sydney, Australia; Commonwealth Industrial and Scientific Research Organization, Alice Springs, Australia

Geomorphology of the Wet and Dry Tropics and Problems Associated with the Storage of Uranium Tailings in Northern Australia

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 729 pp.; (pp. 45-67) (1982)

This paper describes the principal landforms of the Alligator Rivers Region Uranium Province of Northern Australia, reviews work on landforms and processes common to this wet and dry tropical environment, and discusses the kinds of geomorphological hazards which might be encountered in disposing of uranium tailings at the Nabarlek, Ranger, Koongarra and Jabiluka Uranium Project Sites. (EDB)(EST)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT
REMEDIAL ACTION EXPERIENCE

739

Atomic Energy Control Board, Ottawa, Ontario, Canada; DSMA Atcon Limited, Toronto, Ontario, Canada; Acres Consulting Services Limited, Toronto, Ontario, Canada

Report on Investigation of Remedial Measures for the Radiation Reduction and Radioactive Decontamination of Elliot Lake, Ontario

AECB-1211-4; 56 pp. (1981, February)

This is the fourth annual report on a program to monitor and reduce radon daughter exposures in the town of Elliot Lake, Ontario. Twelve months' WL survey measurements were completed in 1980 and showed that 22 houses exceeded the remedial action criterion of 0.02 WL. In a few cases gamma radiation levels were high enough to require remedial action in driveways and public areas but not inside houses. During 1980 remedial work was carried out on 85 buildings; work was completed on 58. The most frequent routes of entry for radon and radon daughters were untrapped weeping tile, connected to a floor drain or sump, and the wall to floor joint. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT GENERAL STUDIES

740
Campbell, R.H., J.R. Coady, R.M. Fry, J. Howieson, J. Pradel, and R.A. Scarano

Panel Discussion on Waste Management in the Uranium Mining and Milling Industry - Objectives, Problems and Solutions

CONF-820552; STI/PUB-622; IAEA-SM-262; Management of Wastes from Uranium Mining and Milling, *Proceedings of an IAEA and OECD/NEA* International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 703-705) (1982)

In an appraisal of the solutions for the long-term management of wastes from uranium mining and milling, in particular uranium mill tailings, three categories were considered: (1) containment by various methods (in above- or below-grade facilities), which can be so engineered to reduce the dispersion of contaminants to acceptable levels and prevent the dispersion of tailings material for as long as possible; (2) dispersion of contaminants at a limited rate, so long as no unacceptable public health and environmental problems result (not a feasible option); and (3) removal of contaminants for more secure management (concentration, containment and disposal), a course which would provide an immediate solution to the problem, but one for which the necessary commercial technologies have not yet been developed. Technical solutions for tailings should therefore consider the entire range of options and circumstances and should preferably aim at establishing passive control mechanisms. Potential public health and environmental problems that may, in general, result from the dispersal of contaminants from tailings are not likely to be of a very serious nature. However, should passive control mechanisms not perform adequately, contaminant releases may create unacceptable problems in certain circumstances. Should institutional controls be relied upon to ensure control in such circumstances, some reliance needs to be placed on the continuation of the institutional control mechanism. In time, as contaminants are removed from a tailings pile by dispersion, the problem will perhaps cease to exist and institutional controls can be phased out. (MFB)

741
Coffman, F.E., U.S. Department of Energy, Washington, DC

The Management of Radioactive Waste from Uranium Mining and Milling

CONF-820552; STI/PUB-622; IAEA-SM-262; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 3-6) (1982)

The historical basis for the approach to the long-term management of uranium mill tailings is presented. Also included is an outline of programs underway and a discussion of key issues still to be resolved. Some basic issues in the debate on standards for the UMTRA program include: (1) the potential health effects from unstabilized tailings, (2) the cost-benefit of reductions of these health effects, (3) the period of time needed for stabilization, and (4) the period of time for institutional surveillance and control. (MFB)

742
Costello, J.M., and J.F. Boas, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Radioactive Waste Management with Special Reference to Mining and Milling of Radioactive Ores

ARL/TR-043 (Vol. 2); Radiation Protection in the Mining and Milling of Radioactive Ores, Proceedings of an Australian Radiation Laboratory Course, Lucas Heights, Australia, February 2-13, 1981; (pp. 324-350) (1982, January)

The principles and objectives of general radioactive waste management are outlined. The nature and composition of wastes from mining and milling of uranium and thorium ores are described; alternative management procedures, engineering technologies and new developments for disposal of mill tailings are discussed. International studies on the disposal of uranium mill tailings are described with particular reference to long term performance objectives. Mining and milling uranium ores in Australia is reviewed briefly and problems arising from some former practices noted. The status of development of major Australian uranium resources is reviewed together with relevant legislative developments and environmental requirements. (EDB)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT
GENERAL STUDIES

743

Fourcade, N., and P. Zettwoog, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France

Evaluation of Various Scenarios for the Management of Uranium Mill Tailings

CONF-820552; STI/PUB-622; IAEA-SM-262/18; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 169-196) (1982)

A mine located in the Bois Noirs (Forez) granitic massif in the center of France was closed down in 1980, after 20 years of operation, and the associated milling plant was dismantled. More than two million tons of tailings (dry mass) were produced, of which 1.3 million, containing 2200 g of Ra-226, were stored behind a retaining barrier. The storage site is described and the radioactive, chemical, and granulometric composition of the material stored is given. A quantitative evaluation is made of the Ra-226 transferred to the environment via the aquatic pathway (currently about 30 mg/yr) and of the radon-222 transported by diffusion in the atmosphere (currently about 10(E+12) atoms/s). The concentrations of Ra-226 in the physical and biological environments and in the food chain were measured. In the food chain it was observed that the concentrations upstream were higher than those downstream by a factor generally not greater than 10, except in the case of vegetables where no significant effect was noted. The potential alpha energy from Rn-222 daughter products was measured continuously. The values obtained are of the same order of magnitude as those recorded in other uranium regions before working. Calculations indicate that the few members of the public who comprise the critical group may receive maximum dose equivalent of about 10 uSv/atom through incorporation of Ra-226 and of about 500 uSv/atom through inhalation of Rn-222 daughter products. It is not possible to assess experimentally the exact contribution of the storage site since indications of strong external exposure had been recorded before the operation began but no survey was made of the original conditions. It is the wish of the French public authorities that when operations to extract materials from the subsoil have been completed, every precaution should be taken to eliminte danger to the population and that the area be landscaped and the soil restored for reuse. Various possible management and stabilization scenarios are examined from the point of view of feasibility and environmental impact. (Auth)(PTO)

744

Gomez, M.

Radiation Hazards in Mining: Control, Measurement, and Medical Aspects

CONF-8110111; Radiation Hazards in Mining: Control, Measurement, and Medical Aspects, Proceedings of a Conference, Golden, CO, October 4, 1981. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, NY (1981)

During the symposium, 163 papers were presented on radiation measurements, hazards, and controls associated with the mining industry. (PTO)

745

Haw, V.A., G.M. Ritcey, J.M. Skeaff, N.K. Dave, and M. Silver, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Uranium Tailings Research at the Canada Centre for Mineral and Energy Technology

CONF-820914; IAEA-CN-42/137; Nuclear Power Experience, Volume 3 - Nuclear, Fuel Cycle, Proceedings of an International Conference, Vienna, Austria, September 13-17, 1982. International Atomic Energy Agency, Vienna; (pp. 269-287) (1983)

Over 100 million tons of uranium tailings have been generated in Canada, an amount that is expected to triple by the end of the century. Because of the potential hazard to the environment and man, the Canada Centre for Mineral and Energy Technology (CANMET) began a major program ten years ago to examine the problem of uranium tailings management. Research has shown that: (1) vegetation of uranium tailings has been successful using seed mixtures planted on the tailings surface pretreated by lime and fertilizers; (2) lysimeter tests on uranium tailings have demonstrated that surface treatment and

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT GENERAL STUDIES

the presence or absence of bacteria have a marked effect on the flow and chemistry of seepage water; (3) hydrochemical studies of the tailings have shown that acid conditions prevail in the upper zone of the tailings (i.e., above the water table) and that both radioactive and other toxic chemicals are concentrated near the bottom of the tailings; (4) control of the total radium content of water discharged to drainage systems can be achieved by precipitation and removal of Ra-226 from tailings water effluent by $BaCl_2$; and (5) acid leaching studies have demonstrated that virtually all radionuclides and sulfides can be concentrated into a fraction amounting to from 30% to 40% of the original feed, leaving relatively clean tailings. (EDB)(EST)(PTO)

746

Henry, L.C., Atomic Energy Control Board, Ottawa, Ontario, Canada

Environmental Impact of Ongoing Operation: Uranium Mine, Mill Tailings

AECB-1180-10; 16 pp. (1980, July)

Present technology in the management of uranium mine and mill wastes, coupled with appropriate site selection, quality construction, and good operating procedures, can ensure that impacts on health, safety, and the environment will be acceptably low over the period of operation. The methods of chemical and physical stabilization of the tailings and retention structures are also compatible with close-out procedures and will ensure that any releases to the environment will continue to be within the requirements, assuming the continued availability of surveillance. (EDB)

747

Henry, L.C., Atomic Energy Control Board, Ottawa, Ontario, Canada

Environmental Effects of the Long Term Management of Wastes

AECB-1180-11; 14 pp. (1980, August)

Criteria for interim application in uranium mill tailings management, pending the outcome of a thorough investigation of the tailings problem, are outlined. For a closed-out tailings site, only passive or natural barriers are to be used to control releases; surface water recharge is to be limited to that from direct natural precipitation, and no permanent water pool will be allowed; all designed systems must be evaluated in terms of their long-term durability; long-term performance and economic guarantees will be required; access must be limited to the maximum extent practical; and pathway analyses should be performed to determine the health, safety, and environmental impacts of the expected level of releases. Releases to water should be no greater than those experienced during the operating phase of the facility. Radon emanation should not exceed 10 pCi/sq m/s, and gamma radiation should be reduced to 10-50 uR/hr at 1 m above the surface. Particulate emissions originating from the tailings material should be virtually nonexistent. (EDB)

748

Scarano, R.A., U.S. Nuclear Regulatory Commission, Washington, DC

Management of Wastes from Uranium Mining and Milling - Closing Remarks

CONF-820552; IAEA-SM-262; Management of Wastes from Uranium Mining and Milling, Proceedings of an IAEA and OECD/NEA International Symposium, Albuquerque, NM, May 10-14, 1982. International Atomic Energy Agency, Vienna; (pp. 707-710) (1982)

The papers presented at this conference demonstrate a more refined understanding of the hazards presented by uranium tailings and the development of reasonable, technically sound control measures to minimize the hazards. There seems to be general agreement on a number of primary objectives to be met by an acceptable tailings management program. The first of these objectives that have been generally accepted is that groundwater should be protected. Methods utilized to accomplish this objective, as we have seen during this symposium, vary greatly depending on climate and ore types. In the United States, impermeable liners are utilized to prevent seepage from the impoundment to the groundwater table. In Canada, a very innovative scheme to utilize a highly permeable liner is being considered to channel groundwater around the impoundment. Evidence of other advances in technology that have been discussed throughout the course of this symposium and would facilitate the accomplishment of ground and surface water protection relates to areas such as: groundwater contaminant transport

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT GENERAL STUDIES

modeling, investigation of various types of natural and synthetic liners, consideration of in situ and process dewatering techniques, and consideration of specific constituents in ore bodies such as pyrite. Another objective that seems to have been generally accepted is that siting and reclamation design should be such that containment can be assured for a long time frame. The length of time agreed on internationally is hundreds if not thousands of years. The third objective is that tailings should be reclaimed such that continuous active care is minimized. As discussed in numerous papers, research is underway related to final tailings stabilization covers such as vegetation and rock layers, which are intended to contribute to the walk-away, no-maintenance objective. (MFB)

749

Tsivoglou, E.C., R.L. O'Connell, and R.A. Taft, U.S. Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, OH

Nature, Volume and Activity of Uranium Mill Wastes

CONF-104; Radiological Health and Safety in Mining and Milling of Nuclear Materials, Vol. 2, Proceedings of a Symposium, Vienna, August 26-31, 1963. International Atomic Energy Agency with International Labour Organization and the World Health Organization, Vienna; (pp. 101-122) (1963)

A series of intensive and detailed in-plant surveys of six U.S. uranium mills was conducted for the purpose of characterizing the waste products of this industry. These surveys were designed and the particular mills selected for study to permit evaluation of the exact qualitative and quantitative nature of the waste flows to be expected from each of the types of uranium extraction processes commonly used. These include acid and alkaline leaching, ion-exchange, and solvent extraction. Starting with the ore as it enters the mill, a materials balance was made at each major processing step. It was found that significantly greater quantities of Ra-226 were dissolved in the alkaline leaching than in the acid leaching process. Subsequent process steps result in higher concentrations of dissolved Ra-226 in the waste streams for the acid leach mills. The relative quantities of dissolved and suspended Ra-226 in wastes from various processes and the effects of waste impoundments, waste recirculation, and neutralization are described. (Auth)(BDC)

Chapter 7

TECHNICAL MEASUREMENTS CENTER

CHAPTER 7. TECHNICAL MEASUREMENTS CENTER

750

Chessmore, R.B., P.R. Engelder, and C.W. Sill, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO; EG&G Idaho, Inc., Idaho Falls, ID

Development of Solid Radium-226 Reference Materials

GJ/TMC-10(83); 27 pp. (1983, November)

Radium-226 reference materials have a matrix similar to soil or tailings samples but are not available in sufficient quantity for use by remedial-action contractors to calibrate their laboratory gamma-ray spectrometers. Such reference materials are needed to provide uniform standardization among measurements made by remedial-action contractors. A task was undertaken to prepare about 200 lb each of three different concentrations of radium-226 reference materials by diluting tailings with high-purity silica. Target values for radium-226 content were 50, 15, and 5 pCi/g. (Auth)(BDC)

751

George, D.C., and L. Knight, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Field Calibration Facilities for Environmental Measurement of Radium, Thorium, and Potassium

GJ/TMC-01(82); 53 pp. (1982, November)

For 25 years, the U.S. Department of Energy and its predecessors have been developing facilities for calibrating gamma-ray instruments for uranium exploration. The facilities are suitable for calibration of gamma-ray instruments used in remedial action measurements, specifically, in situ assays for natural radionuclides. The primary facility is located at Grand Junction, Colorado, and secondary facilities are located at: Casper, Wyoming; Grants, New Mexico; George West, Texas; Reno, Nevada; Spokane, Washington; and Morgantown, West Virginia. The facilities contain distributed sources of radium, thorium, and/or potassium. In general, they were constructed by enriching a concrete mix with uranium ore, monazite sands, and/or orthoclase sand. The facilities consist of borehole models and pads. The principal objective of this report is to present the data sheets which show dimensional descriptions of the models and pads, values for radioelement concentrations within the models and pads, and maps of all of the calibration sites. (Auth)(PTO)

752

George, D.C., and R.K. Price, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Abbreviated Total-Count Logging Procedures for Use in Remedial Action

GJ/TMC-03(82); 21 pp. (1982, December)

This report presents procedures useful for borehole logging in the Remedial Action Program. The procedures are adapted from well-established practices existing in the uranium exploration industry. Although the procedures given here have been tested in only a few remedial action applications, they are presented now because of an immediate need for remedial action measurements. The scope of this report is limited to addressing two specific needs: (1) determination of the depth at the base of a well-defined layer of contamination; and (2) determination of whether or not any 15-cm thick layer contains more radium-226 than 15 pCi/g. Section 2 of this report presents the basis and analytical relationships for calibrating and reducing log data. Sections 3 and 4 give brief discussions of some important factors to consider when configuring hardware and making measurements. Sections 5 and 6 give highly abbreviated procedures for calibration and data reduction. Section 7 identifies and discusses some difficulties which can degrade the final results. (Auth)(PTO)

753

Korte, N.E., and D. Ealey, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Procedures for Field Chemical Analyses of Water Samples

GJ/TMC-07(83); 52 pp. (1983, December)

This document describes procedures for field measurements of pH, carbonate and bicarbonate, specific conductance, dissolved oxygen, nitrate, Eh, and uranium.

Each procedure section includes an extensive discussion regarding the limitations of the method as well as brief discussions of calibration procedures and available equipment. A key feature of these procedures is the consideration given to the ultimate use of the data. Quality assurance documentation for each measurement is addressed in detail. (Auth)(BDC)

754

Korte, N.E., and P.M. Kearl, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells

GJ/TMC-08(84); 58 pp. (1984, January)

This document describes procedures for installing monitoring wells and for collecting samples of surface water and groundwater. The discussion of monitoring wells includes mention of multilevel sampling and a general overview of vadose-zone monitoring. Guidelines for well installation are presented in detail. The discussion of water-sample collection contains evaluations of sampling pumps, filtration equipment, and sample containers. Sample-preservation techniques are reviewed. Step-by-step procedures for collection of water samples which address such considerations as equipment, field operations, and written documentation are provided. The report concludes with a brief discussion of adverse sampling conditions that may affect the quality of the data. An appendix presents a rationale for the development and use of statistical considerations in water sampling to ensure a more complete water quality monitoring program. (Auth)(BDC)

755

Langner, G.H., J.C. Pacer, V.G. Johnson, and M.A. Gillings, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Evaluation of Methods for the Estimation of Indoor Radon Daughter Concentrations for Remedial Action Programs

GJ/TMC-04(83); 89 pp. (1983, June)

The methods considered for estimating indoor radon daughter concentration levels were those that use the Radon Progeny Integrating Sampling Unit (RPISU) technique, grab sampling, radon exhalation rate, alpha track registration, time-integrated radon measurements, continuous measurements, gamma exposure rates, and radium measurement. The methods were evaluated to determine whether they satisfied two criteria: (1) that the method provide reasonable assurance of compliance with the standards for cleanup as set by the Environmental Protection Agency and codified in federal regulations; and (2) that the method minimize the cost of verifying that the standards had been met. The RPISU method and the alpha track method, as used by the Colorado Department of Health, were found to satisfy these criteria and are therefore recommended for use in remedial action programs. Methods that use grab sampling of radon and radon daughters gamma exposure rates, radium measurements, and continuous measurements were found to be unacceptable. Data obtained for grab sampling of radon and radon daughters had unacceptable coefficients of variation (close to 80%). Grab sampling appeared to be most useful for highly ventilated structures or for structures where immediate assessments are required. The estimation of the radon daughter concentration, by the indoor gamma exposure rate or the radium content of construction material, was found to be influenced by too many variables to be reliable. (GRA)(NPK)

756

Marutzky, S.J., W.D. Steele, B.N Key, and K. Kosanke, Bendix Field Engineering Corporation, Technical Measurements Center, Grand Junction, CO

Surface Gamma-Ray Measurement Protocol

GJ/TMC-06(84); 91 pp. (1984, July)

This protocol prescribes a set of guidelines for performing radiometric measurements in work conducted for the U.S. Department of Energy (DOE) Division of Remedial Action Projects. These guidelines will assist the remedial action contractor in performing work in a logical, cost-effective manner with a reasonable assurance of meeting the U.S. Environmental Protection Agency (EPA) standard of 5 pCi(Ra-226)/g above background in the upper 15 cm of soil, averaged over any area of 100 square meters. This protocol presents an overall plan for the use

CHAPTER 7. TECHNICAL MEASUREMENTS CENTER

of in-situ measurement techniques in a remedial action program followed by descriptions of surface scanning, exposure rate measurement, and radium concentration measurements. Each of these descriptions includes subsections detailing instrumentation, calibration, field procedures, and calculations for required corrections. (Auth)(PTO)

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

AUTHOR INDEX

CORPORATE AFFILIATION INDEX

CORPORATE AFFILIATION INDEX

CORPORATE AFFILIATION INDEX

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CORPORATE AFFILIATION INDEX

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TITLE INDEX

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PUBLICATION DESCRIPTION INDEX

PUBLICATION DESCRIPTION INDEX

PUBLICATION DESCRIPTION INDEX

PUBLICATION DESCRIPTION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

GEOGRAPHIC LOCATION INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

KEYWORDS INDEX

APPENDIX

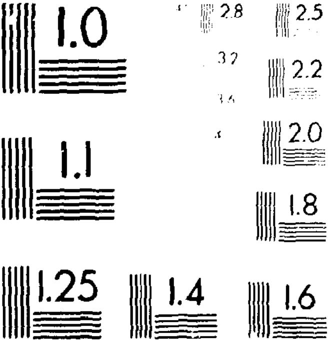
Acronyms and Abbreviations

ACRONYMS

AAEC	Australian Atomic Energy Commission
AAECRE	Australian Atomic Energy Commission Research Establishment
AARR	Argonne Advanced Research Reactor
ACUS	Atlantic Council of the United States
ACWP	actual cost for work performed
ADM	action description memorandum
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
AECB	Atomic Energy Control Board (Canada)
AECL	Atomic Energy of Canada Limited
AEE	Atomic Energy Establishment, United Kingdom Atomic Energy Authority, Winfrith, United Kingdom
AEMB	Alabama Energy Management Board
AEP	see AEPSC
AEPSC	American Electric Power Service Corporation
AERE	Atomic Energy Research Establishment, United Kingdom Atomic Energy Authority, Harwell, United Kingdom
AETF	Advanced Equipment Test Facility
AETR	Advanced Engineering Test Reactor, Idaho Falls, ID
AFL	Advanced Fuel Laboratory, General Electric Company, Sunnyvale, CA
AFL	Advanced Fuels Laboratory, Westinghouse Electric Company, Madison, PA
AFR	annual fuel requirement
AFR	away from reactor
AFRIMET	African Metals
AFRRI	Armed Forces Radiobiology Research Institute, Bethesda, MD
AFSR	Argonne Fast Source Reactor, National Reactor Testing Station, Idaho Falls, ID
AFWL	Air Force Weapons Laboratory
AG	Aktiengesellschaft
AGC	Aerojet General Corporation
AGN	Aerojet-General Nucleonics (designation for university research and teaching reactors)
AGNS	Allied-General Nuclear Services, Barnwell, SC
AGR	advanced gas-cooled reactor
AHCF	Aqueous Homogeneous Critical Facility (Japan)
AHFR	Argonne High Flux Reactor, Argonne National Laboratory, Argonne, IL
AHR	Aqueous Homogeneous Reactor
AI	Atomics International Division, Rockwell International Corporation
AICHE	American Institute of Chemical Engineers (also AICE)
AIEE	American Institute of Electrical Engineers
AIF	Atomic Industrial Forum, Bethesda, MD
AL	Ames Laboratory, Ames, IA
ALAP	as low as practical
ALARA	as low as reasonably achievable
ALO	Albuquerque Operations Office, U.S. Department of Energy, Albuquerque, NM
ALPRR	Argonne Low Power Research Reactor, Argonne National Laboratory, Argonne, IL
ALRR	Ames Laboratory Research Reactor, Ames, IA
AMRAW	assessment method for radioactive waste (computer code)
AMS	Aerial Measuring Systems [Aerial Monitoring System]

ANC	Aerojet Nuclear Company, Idaho Falls, ID
ANDRA	Agence National pour la Gestion des Deschets Radioactifs, Commissariat a l'Energie Atomique (France)
ANI	American Nuclear Insurers, Farmington, CT
ANL	Argonne National Laboratory, Argonne, IL
ANP	Aircraft Nuclear Propulsion
ANPS	Agesta Nuclear Power Station (Sweden)
ANS	American Nuclear Society, LaGrange, IL
ANSI	American National Standards Institute, New York, NY
ANSPD	Advanced Nuclear Systems and Project Division, Mound Facility, Miamisburg, OH
AP&L	Arkansas Power and Light Company
APG	Aberdeen Proving Ground, Aberdeen, MD
APPA	American Public Power Association, Washington, DC
ARBOR	Argonne Boiling Water Reactor, National Reactor Testing Station, Idaho Falls, ID
ARCL	allowable residual contamination level
ARD	Advanced Reactor Division, Westinghouse Electric Corporation, Cheswick, PA
ARE	Aircraft Reactor Experiment, Oak Ridge National Laboratory, Oak Ridge, TN
ARHCO	Atlantic Richfield Hanford Company, Richland, WA
ARMS	Aerial Radiological Monitoring System
ARR	see AARR
ARSD	Advanced Reactor Systems Department, General Electric Company, Sunnyvale, CA
ART	Aircraft Reactor Test, Oak Ridge National Laboratory, Oak Ridge, TN
ARVFS	Army Re-entry Vehicle Facility Site
ASDP	Assistant Secretary for Defense Programs, U.S. Department of Energy
ASEP	Assistant Secretary for Environmental Protection, U.S. Department of Energy
ASME	American Society of Mechanical Engineers
ASNE	Assistant Secretary for Nuclear Energy, U.S. Department of Energy
ASPEN	Advanced System for Process Engineering (computer model)
ASTM	American Society of Testing Materials
ATAE	Aare-Tessin, Aktiengesellschaft fur Elektrizitat, Olten, Switzerland (also ATEL)
ATBI	Applied Technology of Barnwell, Inc., Barnwell, SC
ATHMA	U.S. Army Toxic and Hazardous Materials Agency
ATR	Advanced Test Reactor, Idaho National Engineering Laboratory, Idaho Falls, ID
AVR	Arbeitsgemeinschaft Versuchsreaktor, GmbH, Federal Republic of Germany
AWRE	Atomic Weapons Research Establishment (United Kingdom)
B&R	Burns and Roe Industrial Services Corporation, Paramus, NJ
B&V	Black and Veatch Consulting Engineers
B&W	Babcock and Wilcox Company, Lynchburg, VA
BAPL	Bettis Atomic Power Laboratory, West Mifflin, PA
BAPU	see CNRS
BARC	Bhabha Atomic Research Centre, Bombay, India
BBC	Brown, Boveri, and Cie., Baden, Switzerland
BBCO	Bridgeport Brass Company, Bridgeport, CT

BCL	Battelle Columbus Laboratories, Columbus, OH
BCWS	budgeted cost for work scheduled
BEC	Boeing Engineering and Construction Company
BEIR	biological effects of ionizing radiation
BFEC	Bendix Field Engineering Corporation, Grand Junction, CO
BFNPS	Browns Ferry Nuclear Power Station, Decatur, AL
BG&E	Baltimore Gas and Electric, Baltimore, MD
BGA	Bundesgesundheitsamt [German Federal Health Office] (Federal Republic of Germany)
BI	Battelle Institute, Frankfurt, Federal Republic of Germany
BIH	Bundesminister des Innern, Bonn, Federal Republic of Germany
BMFT	Bundesministerium fur Forschung und Technologie, Bonn, Federal Republic of Germany
BMI	Battelle Memorial Institute, Columbus, OH
BNF	Barnwell Nuclear Fuel Plant, Barnwell, SC
BNFL	British Nuclear Fuels Limited (United Kingdom)
BNFP	Barnwell Nuclear Fuel Plant, Barnwell, SC
BNI	Bechtel National, Inc.
BNL	Berkeley Nuclear Laboratories, Central Electricity Generating Board, Berkeley, United Kingdom
BNL	Brookhaven National Laboratory, Upton, NY
BNWL	Battelle Northwest Laboratories, Richland, WA (now PNL)
BOM	U.S. Bureau of Mines
BONUS	Boiling Nuclear Superheater Power Station, Punta Higuera, PR
BORAX	Boiling Reactor Experiment, National Reactor Testing Station, Idaho Falls, ID
BPC	Bechtel Power Corporation, San Francisco, CA
BRE	Boiling Reactor Experiment, Idaho National Engineering Laboratory, Idaho Falls, ID
BRISC	Burns and Row Industrial Services Corporation
BRP	Breeder Reactor Program
BRPNS	Big Rock Point Nuclear Plant, Big Rock Point, MI
BVPS	Beaver Valley Power Station, Shippingport, PA
BWAG	Bayernwerk AG, Muenchen, Federal Republic of Germany
BWR	boiling-water reactor
C	Celsius (temperature)
CAA	Clean Air Act
CAB	Commonwealth Agricultural Bureau (United Kingdom)
CAMEN	Centro Autonomo Militari Energia Nucleare (Italy)
CANDU	Canadian Deuterium Uranium reactor type (natural uranium heavy water moderated and cooled power reactor)
CANMET	Canada Centre for Mineral and Energy Technology
CAS	Chemical Abstracts Service (abstract journal and database) Columbus, OH
CCE	Commission des Communautes Europeennes, Brussels, Belgium
CCE	Commissione delle Comunita Europee, Ispra, Italy
CCR	Centro Comunie di Ricerca, Commissione delle Comunita Europee, Ispra, Italy
CDR	conceptual design report
CE	Combustion Engineering, Inc., Windsor, CT
CEA	Commissariat a l'Energie Atomique (France)
CEAN	Centre d'Etudes pour les Applications de l'Energie Nucleaire (Belgium)
CEC	Commission of the European Communities



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS

STANDARD REFERENCE MATERIAL 1010a

(ANSI and ISO TEST CHART No. 2)

CEC	Commonwealth Edison Company
CEDRA	Societe Cooperative Nationale pour l'Entreposage de Dechets Radioactifs, Baden, Federal Republic of Germany
CEEN	see CEN
CEER	Center for Energy and Environment Research (Puerto Rico)
CEGB	Central Electricity Generating Board (United Kingdom)
CEN	Centre d'Etude de l'Energie Nucleaire, Brussels, Belgium (also CEEN)
CEP	Controls for Environmental Pollution, Inc., Santa Fe, NM
CEQ	Council on Environmental Quality
CERF	contaminated equipment repairs facility
CERMET	ceramic and metal
CERN	European Organization for Nuclear Research (English translation)
CEVR	contaminated equipment volume reduction
CEW	Clinton Engineer Works, Clinton, TN (MED)
CFR	Code of Federal Regulations
CHO	U.S. Department of Energy, Chicago Operations Office, Argonne, IL
CIINE	Interministerial Commission for the Basic Nuclear Facilities (France)
CIS	Congressional Information Service
CISE	Centro Informazioni Studi Esperienze (Italy)
CISRA	Societa Cooperativa Nationale per l'Immagazzinamento di Scorie Radioattive, Baden, Federal Republic of Germany
CIT	California Institute of Technology
CMSA	Chamber of Mines of South Africa, Auckland Park, South Africa
CNEA	Comision Nacional de Energia Atomica (Mexico, Argentina)
CNEN	Comision Nacional de Energia Nuclear (Mexico)
CNEN	Comitato Nazionale per l'Energia Nucleare (Italy)
CNRN	Comitato Nazionale per le Ricerche Nucleari (Italy)
CNRS	Centre National de la Recherche Scientifique (France)
CNRS	Comitato Nazionale per la Ricerca e per lo Sviluppo, Rome, Italy
COEGMA	Compagnie Generale des Matieres Nucleaires (France)
COMB	see CNRS
COMMED	Commonwealth Edison Company
COMPENDEX	Computerized Engineering Index (bibliographic database)
CONED	Consolidated Edison Company
CP	Chicago Pile, Chicago, IL
CP&L	Carolina Power and Light Company, Raleigh, NC
CPAF	cost plus award fee
CPC	Consumers Power Corporation or Company
CPFF	cost plus fixed fee
CPPD	Consumers Public Power District (Nebraska)
CPUC	California Public Utilities Commission, San Francisco, CA
CRBRP	Clinch River Breeder Reactor Project, Oak Ridge, TN
CREC	see CNRS
CRIEPI	Central Research Institute of Electric Power Industry (Japan)
CRNL	Chalk River Nuclear Laboratories, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada
CRT	cathode-ray tube
CSM	Colorado School of Mines, Golden, CO
CSU	Colorado State University, Fort Collins, CO
CTH	Chalmers Tekniska Hoegskola, Institutionen foer Energiteknik, Goeteborg, Sweden
CVTR	Carolinas-Virginia Tube Reactor, Parr, SC

CY	calendar year
D&D	decontamination and decommissioning
D&M	Dames and Moore, Inc.
D2O	heavy water (deuterium oxide [H-2])
DAC	U.S. Department of Energy, Dayton Area Office, Dayton, OH
DAS	data acquisition system
DBMS	database management system
DDS	decommissioning data system
DECO	Detroit Edison Company, Detroit, MI
DECON	immediate decontamination option
DEIS	draft environmental impact statement
DEMR	Department of Energy, Mines and Resources, Canada Centre for Mineral and Energy Technology, Canada
DERE	Dounreay Experimental Reactor Establishment (United Kingdom)
DF	decontamination factor
DFR	Dounreay Fast Reactor (United Kingdom)
DGA	Delegation Generale pour l'Armement, Paris, France
DHHS	Department of Health and Human Services, National Institutes of Health, Public Health Service, Bethesda, MD
DISP	see ENEA
DMA	Division of Military Application
DNA	Defense Nuclear Agency, Washington, DC
DNA	data not available
DNPDE	Dounreay Nuclear Power Development Establishment, United Kingdom Atomic Energy Authority, Dounreay, United Kingdom
DNS	Dresden Nuclear Station, Morris, IL
DO	dismantling operations
DOC	U.S. Department of Commerce
DOC	decommissioning operations contractor
DOE	Department of the Environment (United Kingdom)
DOE	U.S. Department of Energy
DOE-AL	U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM
DOE-ALO	U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM
DOE-CH	U.S. Department of Energy, Chicago Operations Office, Argonne, IL
DOE-CHO	U.S. Department of Energy, Chicago Operations Office, Argonne, IL
DOE-DP	U.S. Department of Energy, Defense Programs
DOE-EP	U.S. Department of Energy, Environmental Protection
DOE-HDQ	U.S. Department of Energy, Washington, DC
DOE-ID	U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID
DOE-IDO	U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID
DOE-NE	U.S. Department of Energy, Nuclear Energy
DOE-NV	U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV
DOE-NVO	U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV
DOE-OGC	U.S. Department of Energy, Office of General Counsel, Washington, DC
DOE-OR	U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN
DOE-ORO	U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN
DOE-RL	U.S. Department of Energy, Richland Operations Office, Richland, WA
DOE-RLO	U.S. Department of Energy, Richland Operations Office, Richland, WA
DOE-SAN	U.S. Department of Energy, San Francisco Operations Office, Oakland, CA
DOE-SF	U.S. Department of Energy, San Francisco Operations Office, Oakland, CA

DOE-SFO	U.S. Department of Energy, San Francisco Operations Office, Oakland, CA
DOE-SR	U.S. Department of Energy, Savannah River Operations Office, Aiken, SC
DOE-SRO	U.S. Department of Energy, Savannah River Operations Office, Aiken, SC
DOE-WVPO	U.S. Department of Energy, West Valley Project Office, West Valley, NY
DORF	Diamond Ordnance Radiation Facility, Forest Glen, MD
DOT	U.S. Department of Transportation
DPM	disintegrations per minute
DPS	disintegrations per second
DPTE	double door for hermetic transfer (translation from French)
DRAP	Division of Remedial Action Projects, U.S. Department of Energy
DRI	Desert Research Institute, Las Vegas, NV
DWBM	Defense Waste and Byproducts Management, U.S. Department of Energy
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EAEC	European Atomic Energy Community (Italy)
EBR	Experimental Breeder Reactor, Idaho National Engineering Laboratory, Idaho Falls, ID
ECN	Energieonderzoek Centrum Nederland, Petten, The Netherlands (see NERF)
EDB	Energy Data Base (abstract journal and database by TIC)
EDP	environmental development plan
EDTA	ethylene diaminetetracetic acid
EE	Economisez l'Energie, Lausanne, Switzerland
EEI	Edison Electric Institute
EFAPP	Enrico Fermi Atomic Power Plant, Newport, MI
EG&G	EG&G Idaho, Inc., Idaho Falls, ID (Edgerton, Germeshausen and Grier)
EGCR	Experimental Gas Cooled Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
EI	see EIX
EIA	environmental impact assessment
EIC	Eberline Instrument Corporation
EIHNP	Edwin I. Hatch Nuclear Plant, Baxley, GA
EIR	Eidgenoessisches Institut fuer Reaktorforschung (Switzerland)
EIS	environmental impact statement
EIX	Engineering Index (abstract journal and database)(also EI)
EMG	Energy Measurements Group, EG&G, Inc., Las Vegas, NV
EML	Environmental Measurement Laboratory, New York, NY
ENC	Exxon Nuclear Corporation
ENEA	European Nuclear Energy Agency
ENEL	Ente Nazionale per l'Energia Elettrica (Italy)
ENFDP	evaluation of nuclear facility decommissioning projects
ENICO	Exxon Nuclear Idaho Company, Inc., Idaho Falls, ID
ENS	European Nuclear Society
ENTOMB	entombment option
ENUSA	Energie Nucleaire S.A. Lausanne, Switzerland
EOCR	Experimental Organic Cooled Reactor, Idaho National Engineering Laboratory, Idaho Falls, ID
EOS	S.A. l'Energie de l'Ouest Suisse, Lausanne, Switzerland
EOSSA	see EOS
EP	environmental protection
EPA	U.S. Environmental Protection Agency
EPA	engineering, planning, administration
EPDM	ethylene propylene diene monomers (cover materials)

EPP	exportable pyrochemical process
EPRI	Electric Power Research Institute, Palo Alto, CA
EPS	Environmental Protection Service, Environment Canada, Ottawa, Ontario, Canada
EPTR	Experimental Propulsion Test Reactor, Nevada Test Site, Mercury, NV
ERC	Evaluation Research Corporation, Oak Ridge, TN
ERDA	U.S. Energy Research and Development Administration
ERR	Elk River Reactor, Elk River, MN
ESG	Energy Systems Group, Rockwell International Corporation
ETEC	Energy Technical Engineering Center (formerly LMEC)
ETR	Engineering Test Reactor, Idaho National Engineering Laboratory, Idaho Falls, ID
EURATOM	European Atomic Energy Community
EUROCHEMIC	European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium
F	Fahrenheit (temperature)
FAPIG	First Atomic Power Industry Group, Tokyo, Japan
FBDU	Ford, Bacon and Davis Utah, Inc., Salt Lake City, UT
FBR	fast breeder reactor
FEMA	Federal Emergency Management Administration, Washington, DC
FERC	Federal Energy Regulatory Commission, Washington, DC
FES	final environmental statement
FFTF	Fast Flux Test Facility, Richland, WA
FGD	flue gas desulfurization
FIRR	Federal Institute for Reactor Research (Switzerland)
FLPMA	Federal Land Policy Management Act
FMPC	Feed Materials Production Center, NLO, Inc., Fernald, OH
FNAL	Fermi National Accelerator Laboratory, Batavia, IL
FONSI	finding of no significant impact
FP&L	Florida Power and Light Company
FPDL	Fission Products Development Laboratory, Oak Ridge National Laboratory, Oak Ridge, TN
FPPP	Fission Product Pilot Plant, Oak Ridge National Laboratory, Oak Ridge, TN
FPS	Fluor Power Services, Inc.
FRC	Federal Radiation Council (now part of EPA)
FRG	Federal Republic of Germany
FRN	Forschungsreaktors Neuherberg (reactor)(Federal Republic of Germany)
FTC	Fuels Technology Center, Argonne National Laboratory, Argonne, IL
FUSRAP	Formerly Utilized Sites Remedial Action Program, U.S. Department of Energy
FWPCA	Federal Water Pollution Control Administration (now FWQA)
FWQA	Federal Water Quality Administration (formerly FWPCA)
FY	fiscal year
G&H	Gibbs and Hill, Inc.
GA	General Atomic Company, San Diego, CA
GAC	Goodyear Aerospace Corporation, Akron, OH
GAO	U.S. General Accounting Office, Washington, DC
GCHWR	gas cooled heavy water reactor
GDCD	Generation, Development, and Construction Division, Central Electricity Generating Board (United Kingdom)
GDR	German Democratic Republic
GE	General Electric Company

GECR	Geochemistry and Environmental Chemistry Research, Inc., Rapid City, SD
GEEE	Ground Experimental Engine Experiment, Nuclear Rocket Development Station, Nevada Test Site, NV
GEFL	General Electric Fuels Laboratory, Pleasanton, CA
GEIS	generic environmental impact statement
GESMO	Generic Environmental Statement on Mixed Oxides
GETR	General Electric Testing Reactor, Pleasanton, CA
GI	gastro-intestinal
GJAO	Grand Junction Area Office, U.S. Department of Energy, Grand Junction, CO
GJO	see GJAO
GJRAP	Grand Junction Remedial Action Program, U.S. Department of Energy
GJVP	Grand Junction Vicinity Properties
GKSS	Gesellschaft fur Kernenergieverwertung in Schiffbau und Schiffahrt (Federal Republic of Germany)
GM	Geiger-Muller (radiation counter)
GMAW	gas metal (spray) arc welding
GPO	U.S. Government Printing Office
GPU	General Public Utilities
GRA	Government Reports Announcements (abstract journal and database by NTIS)
GRS	Gesellschaft fuer Reaktorsicherheit mbH, Koeln, Federal Republic of Germany
GSA	General Services Administration
GST	Gunite Storage Tanks, Oak Ridge National Laboratory, Oak Ridge, TN
GTAW	gas tungsten arc welding
GUW	Gesellschaft fur Umweltuberwachung mbH, Aldenhoven, Federal Republic of Germany
HAPO	Hanford Atomic Products Operations, Richland, WA
HBPP	Humboldt Bay Power Plant, Eureka, CA
HCDWNP	Hazardous Chemical Defense Waste National Program
HEC	Hooker Electrochemical Company
HEDL	Hanford Engineering Development Laboratory, Richland, WA
HEPA	high efficiency particulate air
HEW	Hanford Engineer Works, Richland, WA (MED)
HFIR	High Flux Isotope Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
HIT	Hauptabteilung Ingenieurtechnik, Federal Republic of Germany
HL&P	Houston Light and Power Company, Houston, TX
HLW	high-level (radioactive) waste
HMIC	Hazardous Materials Information Center, Oak Ridge National Laboratory, Oak Ridge, TN
HNL	Holifield National Laboratory (now ORNL)
HNPF	Hallam Nuclear Power Facility, Hallam, NE
HP	health physics or health physicist
HPS	Health Physics Society
HRE	Homogeneous Reactor Experiment, Oak Ridge National Laboratory, Oak Ridge, TN
HRT	Homogeneous Reactor Test, Oak Ridge National Laboratory, Oak Ridge, TN
HSK	Hauptabteilung fur die Sicherheit der Kernanlagen, Wurenlingen, Switzerland (see SFOE)
HT	high tensile

HTGR	High-Temperature Gas-Cooled Reactor
HTR	Hanford Test Reactor, Richland, WA
HTRE	Heat Transfer Reactor Experiment, Idaho National Engineering Laboratory, Idaho Falls, ID
HVAC	heating, ventilation air conditioning
HWCTR	Heavy Water Components Test Reactor, Savannah River Laboratory, Aiken, SC
HX	heat exchanger
IAEA	International Atomic Energy Agency, Vienna, Austria
ICC	Information Center Complex, Oak Ridge National Laboratory, Oak Ridge, TN
ICONS	Information Center on Nuclear Standards (ANS)
ICPP	Idaho Chemical Processing Plant, Idaho Falls, ID
ICRP	International Commission on Radiological Protection
ID	inside diameter
IDB	Integrated Data Base
IDO	Idaho Operations Office, U.S. Department of Energy, Idaho Falls, ID
IEA	International Energy Agency
IEC	Intera Environmental Consultants, Inc., Houston, TX
IEEE	Institute of Electrical and Electronics Engineers
IET	Initial Engine Test, Idaho National Engineering Laboratory, Idaho Falls, ID
IHX	intermediate heat exchanger
ILW	intermediate-level (radioactive) waste
INC	Idaho Nuclear Corporation, Idaho Falls, ID
INEL	Idaho National Engineering Laboratory, Idaho Falls, ID
INIS	International Nuclear Information System
INPO	Institute of Nuclear Power Operations, Atlanta, GA
INSPEC	Information Services in Physics, Electrotechnology, Computers and Control (database)
IPS	Indian Point Station, Buchanan, NY
IPSN	Institute de Protection et de Surete Nucleaire, Commissariat a l'Energie Atomique (France)
ISFSI	independent spent fuel storage installations
ITRI	Inhalation and Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, Albuquerque,NM
JAERI	Japan Atomic Energy Research Institute
JAFNPP	James A. FitzPatrick Nuclear Power Plant, Scriba, NY
JCP&L	Jersey Central Power and Light Company
JEG	Jacobs Engineering Group, Inc., Albuquerque, NM
JEN	Junta de Energia Nuclear, Madrid, Spain
JMFNP	Joseph M. Farley Nuclear Plant, Dothan, AL
JMTR	Japan Material Testing Reactor
JNRC	Joint Nuclear Research Center, Ispra, Italy
JPDRF	Japan Power Demonstration Reactor, Ibaraki, Tokai-Mura, Japan
JPL	Jet PropulsionLaboratory, U.S. National Aeronautics and Space Administration, Palo Alto, CA
JRC	Jet Research Corporation
K	Kelvin (temperature)
K-25	former site designation of Oak Ridge Gaseous Diffusion Plant, Oak Ridge, TN
KA	Kraftanlagen Aktiengesellschaft, Heidelberg, Federal Republic of Germany

KAFB	Kirtland Air Force Base, Albuquerque, NM
KAPL	Knolls Atomic Power Laboratory, Schenectady, NY
KBG	Kernkraftwerk-Betriebsgesellschaft (Federal Republic of Germany)
KEMA	Keuring van Electrotechnische Materialen, N.V., Arnhem, Netherlands
KEPCO	Kansas Electric Power Cooperative, Inc., Topeka, KS
KEWB	Kinetic Experiment on Water Boilers, Santa Susana Field Laboratories, Canoga Park, CA
KFA	Kernforschungsanlage Julich GmbH, Julich, Federal Republic of Germany
KFK	Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany
KGB	Kernkraftwerk Gundremmingen Betriebsgesellschaft mbH, Gundremmingen, Federal Republic of Germany
KIWI	Nuclear Rocket Engine Reactor Experiment, Nuclear Rocket Development Station, Nevada Test Site, NV
KKN	Kernkraftwerk Niederaichbach (Federal Republic of Germany)
KKN-PB	Kernkraftwerk Niederaichbach Projektbereich (Federal Republic of Germany)
KLAG	Kernkraftwerk Leibstadt AG, Leibstadt, Federal Republic of Germany
KRB	Kernkraftwerk-RWE-Bayernwerk, Gundremmingen, Federal Republic of Germany
KUA	Kraftwerk Union Aktiengesellschaft, Offenbach, Federal Republic of Germany
LAMPRE	Los Alamos Molten Plutonium Reactor Experiment, Los Alamos National Laboratory, Los Alamos, NM
LANL	Los Alamos National Laboratory, Los Alamos, NM (formerly LASL)
LAP	Linde Air Products Company, Tonawanda, NY (also LAPC)
LAPRE	Los Alamos Plutonium Reactor Experiment, Los Alamos National Laboratory, Los Alamos, NM
LASL	Los Alamos Scientific Laboratory, Los Alamos, NM (now LANL)
LATA	Los Alamos Technical Associates, Inc., Los Alamos, NM
LBERI	Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM
LBL	Lawrence Berkeley Laboratory, Berkeley, CA (now LBNL)
LBNL	Lawrence Berkeley National Laboratory, Berkeley, CA (formerly LBL)
LC	Library of Congress
LER	Lucens Experimental Reactor, Lucens, Switzerland
LER	licensee event report
LILCO	Long Island Lighting Company
LITR	Low Intensity Test Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
LLD	lower limit of detection
LLL	Lawrence Livermore Laboratory, Livermore, CA (now LLNL)
LLNL	Lawrence Livermore National Laboratory, Livermore, CA (formerly LLL)
LLRW	low-level radioactive waste
LLW	low-level (radioactive) waste
LLWPA	Low Level Waste Policy Act (1980)
LMFBR	liquid metal fast breeder reactor
LNPS	Lingen Nuclear Power Station, Lingen, Federal Republic of Germany
LNS	London Nuclear Services, Inc., Niagara Falls, NY
LOCA	loss of coolant accident
LOFT	Loss of Fluid Test, Idaho National Engineering Laboratory, Idaho Falls, ID
LOOW	Lake Ontario Ordnance Works, Lewiston, NY
LOSA	Lake Ontario Storage Area, Lewiston, NY

LRC	Lewis ResearchCenter, U.S. National Aeronautics and Space Administration, Cleveland, OH
LSA	low specific activity
LT	long ton
LTFL	Low Temperature Fissiochemical Loop (Japan)
LWBR	light-water breeder reactor
LWR	light-water reactor
MCS	management control system
MCW	Mallinckrodt Chemical Works, St. Louis, MO
MDA	minimum detectable activity
MDC	minimum detectable concentration
MED	Manhattan Engineer District (1942-1947)
MIT	Massachusetts Institute of Technology, Cambridge, MA
MITI	Ministry of International Trade and Industry (Japan)
MK	Morrison-Knudsen Company, Inc. (also MKC)
MMD	mass median diameter
MNGP	Monticello Nuclear Generating Plant, Monticello, MN
MOU	memorandum of understanding
MOX	mixed oxide (fuel)
MRC	Monsanto Research Corporation
MRF	Metal Recovery Facility, Oak Ridge National Laboratory, Oak Ridge, TN
MSL	Molten Salt Loop, Oak Ridge National Laboratory, Oak Ridge, TN
MSM	master-slave manipulator
MSP	Middlesex Sampling Plant, Middlesex, NJ
MSPS	Middlesex Sampling Plant Site, Middlesex, NJ
MSR	molten salt reactor (see MSRE)
MSRE	Molten Salt Reactor Experiment, Oak Ridge National Laboratory, Oak Ridge, TN
MSRL	Maritime Ship Reactor Loop, Oak Ridge National Laboratory, Oak Ridge, TN
MSU	Middle South Utilities
MT	metric ton
MTR	Materials Testing Reactor, Idaho National Engineering Laboratory, Idaho Falls, ID
MTR	Materials Testing Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
MTU	millions tons of uranium
MWT	megawatt thermal
NAEG	Nevada Applied Ecology Group, U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV
NAEIC	Nevada Applied Ecology Information Center, Oak Ridge National Laboratory, Oak Ridge, TN
NAGRA	Nationale Genossenschaft fur die Lagerung Radioaktiver Abfalle, Baden, Federal Republic of Germany
NAIG	Nippon Atomic Industry Group (Japan)
NAK	sodium-potassium alloy
NAL	National Accelerator Laboratory, Batavia, IL (see FNAL)
NAPS	North Anna Power Station, Mineral, VA
NAS	National Academy of Sciences
NASA	U.S. National Aeronautics and Space Administration
NBL	New Brunswick Laboratory, New Brunswick, NJ
NBS	National Bureau of Standards
NCRP	National Council on Radiation Protection

NCSL	National Conference of State Legislatures, Denver, CO
NCSR	National Council for Scientific Research, Lusaka, Zambia
NEA	Nuclear Energy Agency, Paris, France
NEPA	National Environmental Policy Act
NERC	Centre d'Etudes de l'Energie Nucleaire (Belgium)
NERF	Netherlands Energy Research Foundation, Petten, Netherlands (see ECN)
NERVA	Nuclear Engine for Rocket Vehicle Application (see NRX)
NES	Nuclear Energy Services, Inc.
NFO	Nuclear Fuel Operations
NFS	Nuclear Fuel Services, Inc.
NFSS	Niagara Falls Storage Site, Niagara Falls, NY
NIAC	Nuclear Information and Analysis Center (DOD)
NIH	National Institutes of Health, Bethesda, MD
NII	Nuclear Installations Inspectorate (United Kingdom)
NIRA	National Institute of Research Advancement (Japan)
NIRP	National Institute of Radiation Protection, Stockholm, Sweden
NIS	Nuklear-Ingenieur-Service GmbH (Federal Republic of Germany)
NLCO	National Lead Company of Ohio, Cincinnati, OH (now NLO)
NLO	National Lead of Ohio, Cincinnati, OH (see NLCO)
NMEID	New Mexico Environmental Improvement Division
NMPNS	Nine Mile Point Nuclear Station, Scriba, NY
NNCL	National Nuclear Corporation Limited, Risley, United Kingdom
NNPS	Niederaichbach Nuclear Power Station (Federal Republic of Germany) (see KKN)
NOK	Nordostschweizerische Kraftwerke AG, Baden, Federal Republic of Germany
NORM	naturally occurring radioactive materials
NOTS	Naval Ordnance Test Station
NPMC	NEPA Process Management Contractor
NPP	nuclear power plant
NPPD	Nebraska Public Power District
NPR	nuclear power reactor
NPS	nuclear power station
NPS	nuclear powered ship
NRC	U.S. Nuclear Regulatory Commission
NRDS	Nuclear Rocket Development Station, Nevada Test Site, NV
NREST	Nuclear Rocket Engine System Test, Nuclear Rocket Development Station, Nevada Test Site, NV
NRL	Naval Research Laboratory, Washington, DC
NRO	Naval Reactors Operations Office
NRP	nuclear reactor program
NRPB	National Radiological Protection Board (United Kingdom)
NRR	nuclear rocket reactor
NRTS	National Reactor Testing Station, Idaho Falls, ID
NRX	Nuclear Rocket Engine Reactor Experiment, Nuclear Rocket Development Station, Nevada Test Site, NV
NS	nuclear ship
NSA	Nuclear Science Abstracts (abstract journal and computerized database)
NSAC	Nuclear Safety Analysis Center, Electric Power Research Institute. Palo Alto, CA
NSIC	Nuclear Safety Information Center, Oak Ridge National Laboratory, Oak Ridge, TN

NSMH	Nuclear Systems Materials Handbook
NSP	Northern States Power, Minneapolis, MN
NSPP	Nuclear Safety Pilot Plant, Oak Ridge National Laboratory, Oak Ridge, TN
NSW	New South Wales, Australia
NTIS	National Technical Information Service, Springfield, VA
NTS	Nevada Test Site, Mercury, NV
NU	Northeast Utilities, Hartford, CT
NUKEM	Nuklear-Chemie und Metallurgie GmbH (Federal Republic of Germany)
NUMEC	Nuclear Materials and Equipment Corporation, Apollo, PA
NUREG	publications of the U.S. Nuclear Regulatory Commission
NUS	National Utility Service, Inc.
NVO	Nevada Operations Office, U.S. Department of Energy, Las Vegas, NV
NWPA	Nuclear Waste Policy Act of 1982
NWTS	National Waste Terminal Storage
NWVP	Nuclear Waste Vitrification Project
OCDE	Organisation de Cooperation et de Developpment Economiques, Paris, France (see OECD)
OCNPP	Oyster Creek Nuclear Power Plant, Toms River, NJ
ODWBM	see DWBM
OECD	Organization for Economic Cooperation and Development, Paris, France
OFS	Osterreichisches Forschungszentrum Seibersdorf GmbH, Seibersdorf, Austria
OGC	Office of General Counsel, U.S. Department of Energy
OGR	Old Graphite Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
OHF	Old Hydrofracture Facility, Oak Ridge National Laboratory, Oak Ridge, TN
OKG	Oskarshamnsverkets Kraft Grupp Aktiebolag (Sweden)
OMA	Office of Military Applications, U.S. Department of Energy
OMR	organic moderated reactor
OMRE	Organic Moderated Reactor Experiment, Idaho National Engineering Laboratory, Idaho Falls, ID
ONP	Oconee Nuclear Plant, Seneca, SC
ONTHYD	Ontario Hydro
ONWI	Office of Nuclear Waste Isolation, Battelle Columbus Laboratories, Columbus, OH
ORAU	Oak Ridge Associated Universities, Oak Ridge, TN
ORGDP	Oak Ridge Gaseous Diffusion Plant, Oak Ridge, TN
ORNL	Oak Ridge National Laboratory, Oak Ridge, TN
ORO	Oak Ridge Operations Office, U.S. Department of Energy, Oak Ridge, TN
ORP	Office of Radiation Programs, U.S. Environmental Protection Agency
ORR	Oak Ridge Research Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
OSFM	Office of Surplus Facilities Management, UNC Nuclear Industries, Richland, WA
OSHA	Occupational Safety and Health Administration
OWI	Office of Waste Isolation (now ONWI)
PAC	plasma arc cutting
PASNY	Power Authority of the State of New York
PBAPS	Peach Bottom Atomic Power Station, Peach Bottom, PA
PBRF	Plum Brook Reactor Facility, Sandusky, OH
PCD	polymeric carrier delivery
PDR	program requirements document
PEAG	Preussen Elektrazitats-Aktiengesellschaft, Hannover, Federal Republic of Germany

PECO	Philadelphia Electric Company, Philadelphia, PA
PEP	power expansion program
PERM	passive environmental radon monitor
PFDL	Plutonium Fuel Division Laboratories, Westinghouse Electric Corporation, Cheswick, PA
PFF	Plutonium Fabrication Facility, Argonne National Laboratory, Argonne, IL
PFR	prototype fast reactor
PG&E	Pacific Gas and Electric Company
PGE	Portland General Electric
PGS	Pathfinder Generating Station, Sioux Falls, SD
PGS	Pickering Generating Station, Lake Ontario, Ontario, Canada
PHS	Public Health Service, National Institutes of Health, Bethesda, MD
PHWR	pressurized heavy water reactor
PIC	pressurized ion chamber
PINGP	Prairie Island Nuclear Generating Plant, Red Wing, MN
PIRG	Public Interest Research Group
PMC	project management contractor
PNC	Power Reactor and Nuclear Fuel Development Corporation (Japan)
PNL	Pacific Northwest Laboratory, Richland, WA (formerly BNWL)
PNPF	Piqua Nuclear Power Facility, Piqua, OH
PNPS	Pilgrim Nuclear Power Station, Plymouth, MA
PNRO	Pittsburgh Naval Reactor Office, U.S. Department of Energy, Pittsburgh, PA
PP	plutonium processing
PP&L	Pennsylvania Power and Light Company
PPFP	Palos Park Forest Preserve, Palos Park, IL
PRCF	Plutonium Recycle Critical Facility, PNL, Richland, WA
PRNC	Puerto Rico Nuclear Center
PRTR	Plutonium Recycle Test Reactor, Richland, WA
PRWRA	Puerto Rico Water Resources Authority, San Juan, PR
PSAR	Preliminary Safety Analysis Report
PSE&G	Public Service Electric and Gas, Salem, NJ
PSI	Public Service of Indiana
PTIF	Pneumatic Tube Irradiation Facility, Oak Ridge National Laboratory, Oak Ridge, TN
PUK	Pechiney Ugine Kuhlmann, Paris, France
PWR	pressurized-water reactor
PWTF	Plutonium-contaminated Waste Treatment Facility (Japan)
QA	quality assurance
QAA	quality assurance assessment
QAP	quality assurance plan
QC	quality control
R&D	research and development
R&T	research and test
RA	remedial action
RAC	remedial action contractor
RAEC	Rogers and Associates Engineering Corporation, Salt Lake City, UT
RAECO	radon attenuation effectiveness and cost optimization (computer code)
RAL	Rio Algom Limited, Elliot Lake, Ontario, Canada
RAP	Remedial Action Program, U.S. Department of Energy
RAPIC	Remedial Action Program Information Center, Oak Ridge National Laboratory, Oak Ridge, TN

RAPO	Remedial Action Program Office, U.S. Department of Energy (now DRAP)
RASA	Radiological Survey Activities (formerly RASCA)
RASCA	Remedial Action Survey and Certification Activities (now RASA)
RATF	Radon Attenuation Test Facility
RCRA	Resource Conservation and Recovery Act
RDC	radon daughter concentration
RED	referencable engineering document
REECO	Reynolds Electrical and Engineering Company, Inc., Las Vegas, NV
REM	radiometric emanation method
RFP	Rocky Flats Plant, Rockwell International, Golden, CO
RFP	request for proposal
RHO	Rockwell Hanford Operations, Richland, WA
RI	Rockwell International Corporation
RKS	Radet for Karnkraftsakerhet (Sweden)
RLO	Richland Operations Office, U.S. Department of Energy, Richland, WA
RMC	Radiation Management Corporation
RMDF	Radioactive Materials Disposal Facility, Atomics International Division, Rockwell International, Canoga Park, CA
RMEC	Rocky Mountain Energy Company (Colorado)
RNPDE	Risley Nuclear Power Development Establishment, United Kingdom Atomic Energy Authority, Risley, United Kingdom
RNPS	Ringhals Nuclear Power Station (Sweden)
RPISU	radon progeny integrating sampling unit
RPV	reactor pressure vessel
RRR	reference research reactor
RSL	Remote Sensing Laboratory, EG&G, Inc., Energy Measurements Group, Las Vegas, NV
RTI	Research Triangle Institute, Research Triangle Park, NC
RWE	Rheinisch-Westfaelisches Elektrizitaetswerk AG (Federal Republic of Germany
RWMC	Radioactive Waste Management Complex, Idaho National Engineering Laboratory, Idaho Falls, ID
S&L	Sargent and Lundy
S&W	Stone and Webster Engineering Corporation
SA	specific activity
SAEOS	see EOS
SAFSTOR	safe storage option followed by deferred decontamination
SAI	Science Applications, Inc.
SAPS	Shippingport Atomic Power Station, Shippingport, PA
SAR	safety analysis report
SCA	single-channel analyzer
SCK	Studiecentrum voor Kernenergie (part of CEEN)
SCNEDR	Societe Cooperative Nationale pour l'Entreposage de Dechtets Radioactifs (Switzerland)
SCPRI	Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France
SEAB	Studsvik Energiteknik AB, Nykoping, Sweden
SEB	Source Evaluation Board
SEFOR	Southwest Experimental Fast Oxide Reactor, Fayetteville, AR
SEFR	Shielding Experiment Facility Reactor
SEM	scanning electron microscopy
SER	safety evaluation report

SETCCI	Societe Europeenne paur le Traitement Chimique des Combustibles Irradies, Mol, Belgium
SFMP	Surplus Facilities Management Program, U.S. Department of Energy
SFMPO	Surplus Facilities Management Program Office, U.S. Department of Energy, Richland Operations Office, Richland, WA
SFO	San Francisco Operations Office, U.S. Department of Energy, Oakland, CA
SFOE	Swiss Federal Office of Energy, Wurenlingen, Switzerland (see HSK)
SISA	Siege Social, Paris, France
SKA	Studienkommission fur Atomenergie (Switzerland)
SKAB	Svensk Kaernbraenslefoersoerjning AB, Stockholm, Sweden
SKBF	see SKAB and SNFSC
SKI	Statens Kaernkraftinspektion (Sweden)
SLAC	Stanford Linear Accelerator Center (California)
SLAPS	St. Louis Airport Site, St. Louis, MO
SLB	shallow land burial
SLCRC	Salt Lake City Research Center, U.S. Bureau of Mines, Salt Lake City, UT
SM	special metallurgical
SMDC	Saskatchewan Mining Development Corporation, Saskatoon, Saskatchewan, Canada
SMUD	Sacramento Municipal Utility District, Sacramento, CA
SNAP	Systems for Nuclear Auxiliary Power (space applications)
SNEC	Saxton Nuclear Experimental Corporation (Pennsylvania)
SNFSC	Swedish Nuclear Fuel Supply Company, Stockholm, Sweden(see SKAB and SKBF)
SNGS	Salem Nuclear Generating Station, Salem, NJ
SNL	Sandia National Laboratories, Albuquerque, NM
SNLA	Sandia National Laboratories - Albuquerque, Albuquerque, NM
SNLL	Sandia National Laboratories - Livermore, Livermore, CA
SNM	special nuclear materials
SNPP	Skagit Nuclear Power Project, Sedro Woolley, WA
SNPS	Saxton Nuclear Power Station, Saxton, PA
SNPS	Shoreham Nuclear Power Station, Brookhaven, NY
SNRO	Schenectady Naval Reactors Office, U.S. Department of Energy, Schenectady, NY
SNS	Seabrook Nuclear Station, Seabrook, NH
SONGS	San Onofre Nuclear Generating Station, San Clemente, CA
SPAC	surface plasma arc cutting
SPERT	Special Power Excursion Reactor Test, Idaho National Engineering Laboratory, Idaho Falls, ID
SRDC	Stieff Research and Development Company
SRE	Sodium Reactor Experiment, Santa Susana Field Laboratories, Canoga Park, CA
SRI	Stanford Research Institute, Menlo Park, CA
SRK	Steffen, Robertson and Kirsten, Inc.
SRL	Savannah River Laboratory, Aiken, SC
SRO	Savannah River Operations Office, U.S. Department of Energy, Aiken, SC
SRP	Savannah River Plant, Aiken, SC
SS	stainless steel
SSDP	Shippingport Station Decommissioning Project
SSES	Susquehanna Steam Electric Station, Berwick, PA
SSFL	Santa Susana Field Laboratories, Rockwell International, Atomics International Division, Canoga Park, CA

SSIE	Smithsonian Science Information Exchange, Washington, DC
STF	Statens Tekniska Forskningscentral (Finland) (see VTT)
STIR	Shield Test Irradiation Reactor, Santa Susana, CA
STMI	Service Technique Mistere Industrie (France)
STP	standard temperature and pressure
STT	Shielded Transfer Tanks, Oak Ridge National Laboratory, Oak Ridge, TN
SUNY	State University of New York
SWEC	Stone and Webster Engineering Corporation
SWRA	see WRA
TAC	Technology Application Center (University of New Mexico)
TAC	technical assistance contractor
TAN	Test Area North, Idaho National Engineering Laboratory, Idaho Falls, ID
TDS	Technical Services Division, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN
TEC	Technology for Energy Corporation, Oak Ridge, TN
TEC	total estimated cost
TES	Teledyne Energy Systems
TIC	Technical Information Center, U.S. Department of Energy, Oak Ridge, TN
TLD	thermoluminescent dosimeter
TMC	Technical Measurements Center, Bendix Field Engineering Corporation, Grand Junction, CO
TMI	Three Mile Island Nuclear Power Station, Middletown, PA
TMI-2	Three Mile Island Nuclear Power Station, Unit-2, Middletown, PA
TMISP	see TMI
TNP	Trojan Nuclear Plant, Prescott, OR
TOLED	Toledo Edison Company
TRCF	Technical Research Centre of Finland
TRIGA	Training Reactor-Isotope Production-General Atomics (reactor design)
TRU	transuranic
TSCA	Toxic Substances Control Act
TSF	Technical Support Facility, Nevada Test Site, Mercury, NV
TSR	Tower Shielding Reactor, Oak Ridge National Laboratory, Oak Ridge, TN
TTG	Termomeccanica-nucleare e Turbogas, Fiat, Torino, Italy
TUV	Technischer Uberwachungs-Verein (Federal Republic of Germany)
TVA	Tennessee Valley Authority
UBC	uniform building code
UCCL	Union Carbide Canada Limited, Toronto, Ontario, Canada
UCCLD	Union Carbide Corporation, Linde Division
UCCND	Union Carbide Corporation, Nuclear Division, Oak Ridge, TN
UCI	Uranium Corporation of India, Singhbhum, Bihar, India
UCLR	University of California, Lawrence Radiation Laboratory
UEC	United Engineers and Constructors, Inc.
UHTREX	Ultra High Temperature Reactor Experiment, Los Alamos National Laboratory, Los Alamos, NM
UK	United Kingdom
UKAEA	United Kingdom Atomic Energy Authority
UMTRA	Uranium Mill Tailings Remedial Action (project office for UMTRAP)
UMTRAP	Uranium Mill Tailings Remedial Action Program, U.S. Department of Energy
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
UNC	UNC Nuclear Industries, Inc., Richland, WA (also United Nuclear Corporation)

UNCNI	see UNC
UNI	United Nuclear Industries
UOR	unusual occurrence report
USAEC	U.S. Atomic Energy Commission, Washington, DC (predecessor of ERDA)
USBOM	U.S. Bureau of Mines, Washington, DC
USDOE	U.S. Department of Energy, Washington, DC
USEPA	U.S. Environmental Protection Agency, Washington, DC
USERDA	U.S. Energy Research and Development Administration, Washington, DC (predecessor of DOE)
USGAO	U.S. General Accounting Office, Washington, DC
USNRC	U.S. Nuclear Regulatory Commission, Washington, DC
USPB	Urusan Seri Paduka Baginda (Malaysia)
USSR	Union of Soviet Socialist Republics
VAK	Kahl Nuclear Power Plant (Federal Republic of Germany)
VBWR	Vallecitos Boiling Water Reactor, Pleasanton, CA
VDEW	Vereinigung Deutscher Elektrizitatswerke E.V., Frankfurt, Federal Republic of Germany
VDEW	West German Association of Power Stations (translated from German)
VEBR	Virginia Experimental Boiling Reactor
VEPCO	Virginia Electric Power Company
VESR	Vallecitos Experimental Superheat Reactor, Pleasanton, CA
VNC	Vallecitos Nuclear Center, Vallecitos, CA (General Electric Company)
VRMP	Vitro Rare Metals Plant, Canonsburg, PA
VTT	Valtion Teknillinen Tutkimuskeskus (Finland) (see STF)
VYNPC	Vermont Yankee Nuclear Power Corporation
VYNPS	Vermont Yankee Nuclear Power Station, Vernon, VT
WAESD	Westinghouse Advanced Energy Systems Division (formerly WARD)
WAGR	Windscale Advanced Gas-cooled Reactor (United Kingdom)
WAHE	Water-Air Heat Exchanger, Oak Ridge National Laboratory, Oak Ridge, TN
WANL	Westinghouse Astronuclear Laboratory, Pittsburgh, PA
WAPD	Westinghouse Atomic Power Division
WARD	Westinghouse Advanced Reactor Division (now WAESD)
WARDFL	Westinghouse Advanced Reactor Division Fuel Laboratories, Cheswick, PA
WBNS	Water Boiler Neutron Source, Santa Susana Field Laboratories, Canoga Park, CA
WBS	work breakdown schedule
WDF	Waste Dismantling Facility
WEC	Westinghouse Electric Corporation
WEF	Waste Evaporator Facility, Oak Ridge National Laboratory, Oak Ridge, TN
WHB	Waste Holding Basin, Oak Ridge National Laboratory, Oak Ridge, TN
WHC	Westinghouse Hanford Company, Richland, WA
WIPP	Waste Isolation Pilot Plant (New Mexico)
WL	working level
WLL	West Lake Landfill, St. Louis, MO
WNPDL	Windscale Nuclear Power Development Laboratories, United Kingdom Atomic Energy Authority, Sellafield, United Kingdom
WNRE	Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited, Pinawa, Manitoba, Canada
WNYNSC	Western New York Nuclear Service Center, West Valley, NY
WPAFB	Wright-Patterson Air Force Base (Ohio)
WPPSS	Washington Public Power Supply System, Richland, WA
WRA	Water Resources Abstracts

WSCP	Weldon Spring Chemical Plant, Weldon Spring, MO
WSQ	Weldon Spring Quarry, Weldon Spring, MO
WSS	Weldon Spring Site, Weldon Spring, MO
WTR	Westinghouse Testing Reactor, Waltz Mill, PA
WVDA	West Valley Demonstration Act (1980)
WVNSC	West Valley Nuclear Services Company, Inc., West Valley, NY
X-10	former site designation of Oak Ridge National Laboratory
Y-12	Y-12 Plant, Oak Ridge, TN
YCNP	Yellow Creek Nuclear Plant, Corinth, MS
YNPS	Yankee Nuclear Power Station, Rowe, MA
ZNP	Zion Nuclear Plant, Zion, IL

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