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ORNL/ES-154/V8

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MARTIN MARIETTA

**NUCLEAR FACILITY
DECOMMISSIONING AND
SITE REMEDIAL ACTIONS**

**A SELECTED BIBLIOGRAPHY
VOL. 8**

Park T. Owen, Donna C. Michelson, and Nancy P. Knox

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ORNL/EIS--154-Vol. 8

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Biology Division

**NUCLEAR FACILITY DECOMMISSIONING
AND
SITE REMEDIAL ACTIONS
A SELECTED BIBLIOGRAPHY
Volume 8**

**Park T. Owen, Donna C. Michelson, and Nancy P. Knox
Remedial Action Program Information Center
Information Research and Analysis**

Date of Issue—September 1987

**Supported by the
U.S. Department of Energy
Division of Facility and Site Decommissioning Projects
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Division of Uranium Mill Tailings Projects**

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ABSTRACT

The 553 abstracted references on nuclear facility decommissioning, uranium mill tailings management, and site remedial actions constitute the eighth in a series of reports prepared annually for the U.S. Department of Energy's Remedial Action Programs. Foreign and domestic literature of all types—technical reports, progress reports, journal articles, symposia proceedings, theses, books, patents, legislation, and research project descriptions—has been included. The bibliography contains scientific, technical, economic, regulatory, and legal information 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) Facilities Contaminated with Naturally Occurring Radionuclides, (5) Uranium Mill Tailings Remedial Action Program, (6) Uranium Mill Tailings Management, (7) Technical Measurements Center, and (8) General Remedial Action Program Studies. Chapter sections for chapters 1, 2, 5, and 6 include Design, Planning, and Regulations; Environmental Studies and Site Surveys; Health, Safety, and Biomedical Studies; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. Within these categories, references are arranged alphabetically by first author. Those references having no individual author are listed by corporate affiliation or by publication description. Indexes are provided for author, corporate affiliation, title word, publication description, geographic location, and keywords. The appendix contains a list of frequently used acronyms and abbreviations.

This report is a product of the Remedial Action Program Information Center (RAPIC), which selects and analyzes information relevant to remedial action and radioactive waste management. RAPIC staff and resources are available to meet a variety of information needs. Contact the center 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 Facility and Site Decommissioning Projects and Division of Uranium Mill Tailings Projects to provide technical information support to DOE's remedial action program under the direct sponsorship of the following:

- **Surplus Facilities Management Program**
Lead Field Office—DOE Headquarters
Lead Technical Contractor—Office of Technical Services
- **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.
- **Technical Measurements Center**
Lead Office—DOE Grand Junction Area Office
Lead Technical Contractor—UNC Geotech

RAPIC, which is part of the Information Research and Analysis section, Biology Division, Oak Ridge National Laboratory, serves as an information resource for scientific, regulatory, and socioeconomic aspects of radioactively contaminated facility and site remedial actions. These remedial actions encompass such activities as:

- Performing characterization surveys of radioactively contaminated facilities and sites,
- Conducting ongoing security and surveillance programs,
- Performing preventive maintenance actions to ensure containment of radioactivity awaiting permanent facility disposition,
- Assessing environmental and engineering aspects of proposed remedial action alternatives.
- Drafting detailed remedial action project plans and procedures, and
- Performing remedial actions to make facilities and sites available for restricted or unrestricted use.

These 553 abstracted references constitute the eighth annual publication of the same title and subject coverage. The contents of this publication are stored in a comprehensive, computer-retrievable data file that undergoes periodic updating. Most researchers use the published bibliographies as their "first-line" reference tool; however, the cumulative data file can be accessed through RAPIC for the most current additions or for a comprehensive search.

SUBJECT COVERAGE

The subject matter of this bibliography is presented in eight chapters: Surplus Facilities Management Program, Nuclear Facilities Decommissioning, Formerly Utilized Sites Remedial Action Program, Facilities Contaminated with Natural Radioactivity, Uranium Mill Tailings Remedial Action Program, Uranium Mill Tailings Management, Technical Measurements Center, and General Remedial Action Program Studies.

The Surplus Facilities Management Program (SFMP) chapter contains references pertaining to the SFMP, program sites (located primarily on federal reservations), and specific decontamination and decommissioning (D&D) technology developed by the program.

The Nuclear Facilities Decommissioning chapter presents foreign D&D information as well as any D&D technology and domestic site-specific information that is not a part of the SFMP.

The Formerly Utilized Sites Remedial Action Program (FUSRAP) chapter lists publications 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 chapter on Facilities Contaminated with Natural Radioactivity contains information detailing remedial action work at industrial or research facilities (other than at FUSRAP sites) that are contaminated with naturally occurring radioactive materials.

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

The chapter on Uranium Mill Tailings Management contains foreign site-specific information, as well as any basic or applied research and domestic site-specific mill tailings information that is not part of UMTRAP.

The Technical Measurements Center (TMC) chapter lists reports published by the Technical Measurements Center (TMC) Grand Junction, Colorado, on the subject of detection and measurement of radioactive/hazardous contaminants, instrument calibration, and field calibration facilities.

The chapter on General Remedial Action Program Studies contains references pertinent to DOE's Division of Facility and Site Decommissioning Projects, Division of Uranium Mill Tailings Projects, or activities associated with two or more of the DOE remedial action programs.

Because of the size and diversity of chapters 1, 2, 5 and 6, they have been subdivided into the following sections: Design, Planning, and Regulations; Environmental Studies and Site Surveys; Health, Safety, and Biomedical Studies; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. All nine sections are not necessarily contained in each of the four chapters listed above, only those sections for which citations were assigned.

INDEXES

The color-coded indexes are a quick guide to finding needed information. The numbers appearing after each listing in the indexes are citation numbers. The author index (pink pages) lists all authors for each citation. The corporate affiliation index (blue pages) is an alphabetical listing of the institution performing the work. The yellow pages provide a permuted index of all major words in each title (except such pervasive words as *decommissioning*, *decontamination*, *mill*, and *tailings*). The publication description index (green pages) lists alphabetically all journal names, conference descriptions, report numbers, or other unique document descriptions that would identify the publication. The gold pages provide an alphabetical index of the geographic descriptions of sites referenced in the bibliography. These are divided into domestic sites and foreign sites. The keyword index (buff pages) is an alphabetical index of terms selected from a controlled thesaurus to characterize specific concepts.

CITATION FORM

The references within each chapter are arranged alphabetically by first author, corporate affiliation, or publication description of the document. When an author is not given for a document, the corporate affiliation will appear first. If these two levels of authorship are not given, the title of the document will appear first, but the citation is integrated into the chapter by the alphabetical position of its publication description.

Certain printing conventions have been established for this bibliography to express superscripts and subscripts:

1. X sub t means X_t or X subscript t.
2. For chemical compounds and elements, NaIO_3 (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 are shown as, for example, 6 cu cm for 6 cubic centimeters or 3 sq km for 3 square kilometers.
5. 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})

6. The following abbreviations have been used in this publication for unit measurements:

A	ampere	l	liter
a	acre	lb	pound
Bq	becquerel	m	meter
C	Celsius	MeV	megaelectron volt
c.d.	current density	min	minute
Ci	curie	oz	ounce
cpm	counts per minute	ppm	parts per million
cps	counts per second	R	roentgen
deg	degree	rad	radiation absorbed dose
dpm	disintegrations per minute	rem	roentgen-equivalent-man
dps	disintegrations per second	s	second
F	Fahrenheit	Sv	sievert (dose equivalent)
ft	feet	V	volt
g	gram	W	watt
gal	gallon	W(e)	watt (electrical)
ha	hectare	W(t)	watt (thermal)
hr	hour	WL	working level
in.	inch	yd	yard
keV	kiloelectron volt	yr	year

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

SERVICES

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 Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, Tennessee 37831.

RAPIC provides information support to a large number of researchers involved in the field of remedial action and radioactive waste management. Certain services such as providing information from RAPIC resources, performing literature searches of computerized 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 staff and their subcontractors.

All inquiries for information services should be addressed to:

*Remedial Action Program Information Center
Oak Ridge National Laboratory
P.O. Box X, Building 2001
Oak Ridge, Tennessee 37831-6050*

Telephone: FTS 626-0568, 615/576-0568

or

FTS 624-7764, 615/574-7764

Telefax: Send FTS 626-2912, Verify FTS 624-6068

or

Send 615/576-2912, Verify 615/574-6068

Telex: 854511 (ORNL IRA-HMI)

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The authors wish to acknowledge Scott Troy, Julia Reynolds, and Cathy Chase for abstracts contributed to this publication and Larry Voorhees, Environmental Sciences Division, and Woody Cottrell, Health and Safety Research Division, for time contributed in reviewing this report.

SAMPLE REFERENCE

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

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

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

³191

⁴Anderson, R.C., and D. T. Dexheimer

⁵Bechtel Power Corporation, San Francisco, CA

⁶Incorporating Decommissioning Requirements into the Design Process for Nuclear Power Plants

⁷CONF-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)

⁹As 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**
- **Health, Safety, and Biomedical Studies**
- **Dismantlement and Demolition**
- **Site Stabilization and Reclamation**
- **Waste Disposal**
- **Remedial Action Experience**
- **General Studies**

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

1

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

Design Report for the Interim Waste Containment Facility at the Niagara Falls Storage Site, Lewiston, NY

DOE/OR/20722-21; 97 pp. (1986, May)

Low-level radioactive residues from pitchblende processing and thorium- and radium-contaminated sand, soil, and building rubble are presently stored at the Niagara Falls Storage Site (NFSS) in Lewiston, New York. These residues and wastes derive from past NFSS operations and from similar operations at other sites in the United States conducted during the 1940s by the Manhattan Engineer District (MED) and subsequently by the Atomic Energy Commission (AEC). The U.S. Department of Energy (DOE), successor to MED/AEC, is conducting remedial action at the NFSS under two programs: on-site work under the Surplus Facilities Management Program and off-site cleanup of vicinity properties under the Formerly Utilized Sites Remedial Action Program. On-site remedial action consists of consolidating the residues and wastes within a designated waste containment area and constructing a waste containment facility to prevent contaminant migration. The service life of the system is 25 to 50 years. Near-term remedial action construction activities will not jeopardize or preclude implementation of any other remedial action alternative at a later date. Should DOE decide to extend the service life of the system, the waste containment area would be upgraded to provide a minimum service life of 200 years. This report describes the design for the containment system. Pertinent information on site geology and hydrology and on regional seismicity and meteorology is also provided. Engineering calculations and validated computer modeling studies based on site-specific and conservative parameters confirm the adequacy of the design for its intended purposes of waste containment and environmental protection. (SET)

2

Briggs, P.M., General Electric Company, Shippingport, PA

A Quality Assurance Program for Decommissioning

Transactions of the American Nuclear Society 54:50; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (p. 50) (1987)

General Electric Company defined a quality assurance program for the Shippingport Station Decommissioning Project (SSDP) that provided adequate control, yet was stripped down to the essentials. The program is designed to provide a flexible degree of monitoring of subcontractor work, built around a core of radiation safety monitoring, detailed planning, inspection, and auditing, and operated with a minimum of dedicated personnel. This paper concentrates on the traditional quality assurance activities, leaving radiation and environmental monitoring for another day. The SSDP quality assurance program is based on ANSI/ASME NQA-1, applied to the degree necessary to assure safe operation and a high probability of project success. As a demonstration project, it was also important that SSDP quality assurance be cost-effective. Since nothing at the defueled facility remained nuclear safety related by the time the decommissioning operations contractor, General Electric and its integrated subcontractor MK-Ferguson, took over the plant for decommissioning, there was substantial latitude to design a quality assurance program that was adequate but not excessive in its degree of controls. The documented program addresses all 18 NQA-1 criteria, but is focused on detailed advanced planning, surveillance of ongoing work, and quality audits. (Auth)(DCM)

3

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

ORNL Surplus Facilities Management Program Maintenance and Surveillance Plan for Fiscal Year 1984

ORNL/TM-10268; 133 pp. (1986, October)

The Surplus Facilities Management Program (SFMP) at Oak Ridge National Laboratory (ORNL) is part of the Department of Energy's (DOE) National SFMP, administered by the Richland Operations Office. The purpose and objectives of the national program are set forth in the current SFMP Program Plan and include (1) the maintenance and surveillance of facilities awaiting decommissioning, (2) planning for the orderly decommissioning of these facilities, and (3) implementation of a

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

program to accomplish the facility disposition in a safe, cost-effective, and timely manner. As outlined in the national program plan, participating SFMP contractors are required to prepare a formal plan that documents the maintenance and surveillance (M and S) programs established for each site. This report has been prepared to provide this documentation for those facilities included in the ORNL SFMP.

4

Crimi, F.P., and R.E. Skavdahl, General Electric Company, Nuclear Energy Operations, San Jose, CA

Shippingport Atomic Power Station Decommissioning Program and Applied Technology

CONF-850469; Proceedings of the Japan Atomic Industrial Forum 18th Annual Conference, Tokyo, Japan, April 9, 1985; (pp. 201-219); Gensan Nenji Taikai Hobunshu 18:201-219 (1985)

The Shippingport Station decommissioning project is the first decommissioning of a large scale nuclear power plant. Shippingport is also the first nuclear power plant to be decommissioned which has continued the power operation as long as 25 years. The nuclear facilities which have been decommissioned so far have operated for a shorter period and were small as compared with commercial power reactors. However, the experience gained by those decommissionings as well as that gained by reactor plant maintenance and modification has helped to establish the technology and cost basis for Shippingport and future decommissioning projects. In this paper, the current status of the preparation being made by the General Electric Co., its subcontractor and the U.S. Department of Energy for starting the decommissioning phase of the Shippingport Atomic Power Station is described. Also, remote metal cutting, decontamination, concrete removal, the volume reduction of liquids and solids and robotics which will be applied to the project are discussed. The Shippingport Station is a 72 MW(e) PWR plant which started operation in 1957. The plant was permanently shut down in 1982, after having generated over 7.4 billion kWh of electricity.

5

DeSantis, P.V., and H.G. McNamee

ANSYS Analyses on the Shippingport Station Decommissioning Project Report

SSDP-0013; 1 p. (1986)

A key to the decommissioning of the nuclear power plant at Shippingport, Pennsylvania was the removal of the reactor vessel, in one piece, from the containment building and the transporting of it to a federal government facility in Washington state for permanent disposal. This paper gives details of the ANSYS analyses used to evaluate the lifting beam and skirt which raised the 1.9 million pound reactor vessel up from its containment structure and placed it onto the transport cradle. There were two phases in the analysis procedure. First, a study of the entire system as the vessel was lifted and then lowered was conducted. Secondly, a half section model was run on the CDC/UIS Cray 1S computer to determine if the design provided sufficient protection from radiation. (Auth)(SET)

6

DeSantis, P.V., and H.G. McNamee

ANSYS Analyses on the Shippingport Station Decommissioning Project

SSDP-0017; Proceedings of an ANSYS User's Conference, Los Angeles, CA, April 1987; 10 pp. (1987)

The nuclear reactor vessel from the Shippingport Station, located in Shippingport, Pennsylvania, will be removed as part of the overall Decommissioning Project. The reactor vessel along with a specially designed lifting beam and skirt were modeled to examine the stresses and behavior of the combined structure. Both the PC/Linear Version (4.2) of ANSYS and the Cray Version (4.1) were used in the two phases of the analysis. This paper describes the modeling and analytical techniques used to evaluate the design of this one-of-a-kind structure. The combination of the two versions of ANSYS provided the design team with excellent results in a timely and cost effective manner. (Auth)

7

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

Development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning

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

EGG-2400; 100 pp. (1986, August)

Criteria have been developed for release of Idaho National Engineering Laboratory (INEL) facilities and land areas following decontamination and decommissioning (D&D). Development of criteria for release of INEL facilities following D&D comprised four study areas: pathways analysis; dose and concentration guidelines; sampling and instrumentation; and implementation procedures. Transport of residual radionuclides from a released facility to a potentially exposed member of the public can be calculated by methods presented in the Pathways Analysis section. Critical scenarios for exposure were identified for INEL by using site-specific pathways analyses, and instrumentation capabilities and sampling techniques were evaluated. The objective of this task was to ensure that release criteria levels for critical pathways could be measured with a high degree of statistical confidence. These three elements (pathways, instrumentation, and sampling) are used to predict dose from residual radioactivity at a facility to be released. This predicted dose is then compared with dose and concentration guidelines to determine the necessity for additional cleanup of the facility. Results of this study indicated that, if the predicted effective dose equivalent from a decommissioned site to an individual is greater than 100 mrem/yr, the site cannot be released for unrestricted use. Thus, if unrestricted release is the goal, additional cleanup will be required. (Auth)(SET) (DCM)

8

Gardner, D.L., and K.J. Eger, General Electric Company, Shippingport, PA

Sampling Plan for the Unconditional Release of Building Materials and Similar Large Components Encountered in Decommissioning

Transactions of the American Nuclear Society 54:48-50; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 48-50) (1987)

The most efficient sampling plan for the unconditional release of building materials and similar large components encountered in decommissioning can be developed without requiring 100% coverage by measurements on all surfaces. The sampling plan being implemented in the

decommissioning of the Shippingport Atomic Power Station is summarized as follows: (1) A set of initial radiation surveys was made available to the decommissioning operations contractor on turnover of the site. (2) The history of an area would be continuously updated during the decommissioning process. (3) Some "expected contaminated" items are consigned for removal as radioactive waste; other "expected contaminated" items are to be subject to further review to see if decontamination will be cost-effective. (4) A second comprehensive survey of the site buildings was accomplished in early 1985. (5) A third survey was made in the fuel handling building during asbestos removal work when scaffolding was erected to give further detail about the suspect elevated areas. (6) Following the third survey, a decontamination team will conduct a confirmatory survey room by room to verify that clean areas are clean or should be redefined as contaminated. A determination would be made in the contaminated areas on a case basis either to dispose of the items as radioactive material or to clean them. (7) Items that were still "expected clean" after this series of surveys and/or cleanup steps are to be surveyed again during disassembly. (8) The final survey of the candidate material still "expected clean" after these steps would be released. (Auth)(DCM)

9

Martin, W.P., Savannah River Laboratory, Aiken, SC

SEP Decontamination and Decommissioning Scoping Study

DPST-85-793; 68 pp. (1986, June)

Of the approximately 3000 site facilities, 496 were judged to be radioactively contaminated thereby requiring Decontamination and Decommissioning (D&D) after shutdown. To enable projection of D&D timing for each of the 496 facilities, a plant shutdown schedule was developed. A 5-year "cool-down" period was added to the highly contaminated facilities to allow radioactive decay resulting in a reduction of cost, waste volume, and radiation exposure. D&D of all facilities is projected to be completed in FY 2045. Since essentially all of the plant facilities are scheduled to operate past FY 2000, only seventy-four of the 496 facilities are projected to be decommissioned prior to FY 2000. These facilities include currently exposed facilities and those scheduled for shutdown in the near future - seepage basins, HWCTR, R-Reactor, high level waste tanks, etc. The

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

type of D&D chosen is the factor having the most significant effect on D&D costs and waste volumes. The two types of final D&D are Entombment and Dismantlement. Dismantlement can increase costs and waste volumes by a factor of 2 to 100 compared to entombment. This point should be kept in mind when reviewing this scoping study as approximately 75% of the projects are estimated based upon the less costly entombment option. The D&D estimates for the 496 facilities are summarized by plant area in Table 3 and by custodian group (Program/General Department) in Table 4. The total estimated D&D cost in constant FY 1986 dollars is approximately \$800,000,000, with total solid waste volumes of 5,000,000 and 170,000 cubic feet, for low level waste (LLW) and transuranic waste (TRU), respectively. A 6% annual escalation factor increases the total project costs of 800,000,000, FY 1986 dollars to 7 billion dollars.

10

McKernan, M.L., UNC Nuclear Industries, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project Technology Transfer Program Plan

SSDP-0015; 9 pp. (1986, October)

The Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program (Program) has been established to record and disseminate technical information compiled from the decommissioning of the Shippingport Atomic Power Station. Program documentation will be available to the nuclear industry for use in planning future decommissioning of nuclear reactors.

This program plan has been developed to identify the responsibilities, objectives and program tasks for the Program. The plan outlines the program for the technology transfer activities on the project with the intent to assure that: all project participants are fully cognizant of their responsibilities for technology transfer; the requirement for technology development and transfer by the U.S. Department of Energy (DOE) Surplus Facilities Management Program (SFMP) is met; and the SSDP serves as a demonstration project. (Auth)(SET)(DCM)

11

Wells, D.L., General Electric Company, Shippingport, PA

The SSDP Management Supported by an Effective Cost/Schedule Control System

Transactions of the American Nuclear Society 54:44-45; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 44-45) (1987)

This paper considers the support that a well-managed cost/schedule control system (C/SCS) can provide project management when management in turn supports the C/SCS program. The C/SCS initially implemented on the Shippingport Atomic Power Station (SAPS) was a validated General Electric Company system, which was developed for the Clinch River Project. Therefore, the major variable involved is the management process developed and the way that it supports use of the C/SCS. Selected aspects of this process are reviewed, the results achieved outlined, and some ideas presented for consideration. (Auth)

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

12

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

Weldon Spring Site Annual Site Environmental Monitoring Report, Weldon Spring, Missouri - Calendar Year 1985

DOE/OR/20722-101; 102 pp. (1986, September)

The environmental monitoring program was continued at the Weldon Spring Site (WSS) during 1985. The WSS comprises two separate areas: the 89.5-ha (221-acre) Weldon Spring Chemical Plant (WSCP) and Weldon Spring Raffinate Pits (WSRP) area, and the 3.6-ha (9-acre) Weldon Spring Quarry (WSQ). The WSRP and WSQ areas are presently used for the interim storage of low-level radioactively contaminated waste materials. The DOE Derived Concentration Guides (DCGs) -- representing the concentration of radionuclides in air or water -- was lowered from the previous 1984 rate of 500 mrem/yr to 100 mrem/yr in 1985. To determine whether the site is in compliance with DOE standards, environmental measurements are expressed as percentages of applicable DCGs. Monitoring at the WSS measures uranium, radium-226, and thorium-230 concentrations in surface water, groundwater, and sediment; radon gas concentrations in air; and external gamma radiation exposure rates. The WSS was formerly used for the processing of radioactive materials. Radioactivity above currently applicable limits exists at the site, and elevated levels of radiation will be present until remedial action is completed. Radon concentrations, external gamma dose rates, and radionuclide concentrations, in groundwater and surface water at the site were generally equivalent to the 1984 levels. (Auth)(SET)

13

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

Niagara Falls Storage Site Environmental Monitoring Report, Lewiston, New York - Calendar Year 1984

DOE/OR/20722-55; 48 pp. (1985, July)

During 1984, an environmental monitoring program was continued at the Niagara Falls Storage Site, a United States Department of Energy (DOE) surplus facility

located in Niagara County, New York, presently used for the storage of radioactive residues, contaminated soils and rubble. The monitoring program measured radon gas concentrations in air; uranium and radium concentrations in surface water, groundwater, and sediments; and external gamma exposure rates. Environmental samples collected were analyzed to determine compliance with applicable standards. Radiation doses to the public were also calculated. During 1984, annual average radon concentrations at the site boundary and exclusion area monitoring locations were below the DOE Concentration Guide (CG) for uncontrolled areas. Annual average uranium and radium-226 concentrations in groundwater and surface water were below the DOE CG for release to uncontrolled areas. Sediment samples generally showed average concentrations of uranium and radium-226 lower than those measured in past years. External gamma exposure rates were below the DOE Radiation Protection Standards. All radiation doses to the public were within DOE standards. (Auth)

14

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

Weldon Spring Site Environmental Monitoring Report, Weldon Spring, Missouri - Calendar Year 1984

DOE/OR/20722-58; 39 pp. (1985, July)

During 1984, the environmental monitoring program was continued at the U.S. Department of Energy (DOE) Weldon Spring Site (WSS), located in St. Charles County, Missouri. The WSS comprises two separate areas: a 52-acre Raffinate Pits (WSRP) area and a 9-acre Quarry (WSQ). The monitoring program measures the radon concentration in the air, the radium and uranium concentrations in the surface water and groundwater, and external gamma radiation levels at both sites. The nitrate and chloride content of surface water is also measured. All environmental samples collected are analyzed to determine compliance with applicable environmental quality standards. DOE Order 5480.1A, Chapter XI, provides applicable Concentration Guide (CG) limits for radionuclides in controlled and uncontrolled areas. Potential radiation doses to the public from the radioactive materials stored at the site are also calculated. During 1984, site boundary radon concentrations, including naturally occurring sources, were all below the DOE CG limit of 3 pCi/l. Total uranium and radium-226 con-

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

centrations in groundwater within the controlled Raffinate Pit site were below the DOE CG limits for uncontrolled areas. At two on-site and two off-site locations in the Quarry area, total uranium content in the groundwater exceeded the DOE CG limit for release to uncontrolled areas. Average external radiation exposure rates were not appreciably different from normal background for the area. All radiation doses to the public from the stored materials were within DOE standards. (Auth)

15

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

Report on the Performance Monitoring System for the Interim Waste Containment at the Niagara Falls Storage Site, Lewiston, New York

DOE/OR/20722-71; 52 pp. (1985, October)

The Niagara Falls Storage Site (NFSS) is an interim storage site for low-level radioactive waste, established by the U.S. Department of Energy (DOE) at Lewiston, New York. The waste containment structure for encapsulating low-level radioactive waste at the NFSS has been designed to minimize infiltration of rainfall, prevent pollution of groundwater, preclude formation of leachate, and prevent radon emanation. Accurately determining the performance of the main engineered elements of the containment structure will be important in establishing confidence in the ability of the structure to retain the wastes. For this purpose, a waste containment performance monitoring system has been developed to verify that these elements are functioning as intended. The key objective of the performance monitoring system is the early detection of trends that could be indicative of weaknesses developing in the containment structure so that corrective action can be taken before the integrity of the structure is compromised. Consequently, subsurface as well as surface monitoring techniques will be used. After evaluating several types of subsurface instrumentation, it was determined that vibrating wire pressure transducers, in combination with surface monitoring techniques, would satisfactorily monitor the parameters of concern, such as water accumulation inside the containment facility, waste settlement, and shrinkage of the clay cover. Surface monitoring will consist of topographic surveys based on predetermined gridlines, walkover surveys, and aerial photography to detect vegetative stress or other changes not evident at

ground level. This report details the objectives of the performance monitoring system, identifies the elements of the containment design whose performance will be monitored, describes the monitoring system recommended, and outlines the costs associated with the monitoring system. (SET)

16

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

Environmental Monitoring Plan for the Niagara Falls Storage Site and the Interim Waste Containment Facility

DOE/OR/20722-86; 38 pp. (1986, April)

As part of the U.S. Department of Energy's (DOE) Surplus Facility Management Program (SFMP), the Niagara Falls Storage Site (NFSS) is undergoing remedial action. Vicinity properties adjacent to and near the site are being cleaned up as part of DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). These programs are a DOE effort to clean up low-level radioactive waste resulting from the early days of the nation's atomic energy program. Radioactively contaminated waste from these remedial action activities are being stored at the NFSS in an interim waste containment facility (IWCF). When the remedial actions and IWCF are completed in 1986, activities at the site will be limited to waste management. The monitoring program was prepared in accordance with DOE Order 5484.1 and is designed to determine the contribution of radioactivity from the site to the environs and to demonstrate compliance with applicable criteria. Major elements of this program will also supplement other monitoring requirements including the performance monitoring system for the IWCF and the closure/post-closure plan. Emphasis will be directed toward the sampling and analysis of groundwater, surface water, air and sediment for parameters which are known to be present in the material stored at the site. The monitoring program will employ a phased approach whereby the first 5 years of data will be evaluated, and the program will be reviewed and modified as necessary.

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Bechtel National, Inc., Oak Ridge, TN

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

Niagara Falls Storage Site Annual Site Environmental Report, Lewiston, New York - Calendar Year 1986

DOE/OR/20722-150 (1987, June)

The environmental monitoring program was continued at the Niagara Falls Storage Site (NFSS) during 1986. The monitoring program at the NFSS measures radon gas concentrations in air; external gamma radiation levels; and uranium and radium concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with the Department of Energy (DOE) radiation protection standard and to assess its potential effect on public health, the radiation dose was calculated for the maximally exposed individual. Based on the conservative scenario described in the report, this individual would receive an annual external exposure approximately equivalent to 6 percent of the DOE radiation protection standard of 100 mrem/yr. By comparison, the incremental dose received from living in a brick house versus a wooden house is 10 mrem/yr above background. The cumulative dose to the population within an 80-km (50-mi) radius of the NFSS that would result from radioactive materials present at the site would be indistinguishable from the dose that the same population would receive from naturally occurring radioactive sources. Results of the 1986 monitoring show that the NFSS is in compliance with the DOE radiation protection standard. (Auth)(SET)

18

Francis, C.W., and R.G. Stansfield, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN

Characterization Plan for the Old Hydro- fracture Facility

ORNL/TM-9991; 87 pp. (1986, September)

This report summarizes the results of several studies at ORNL that have measured the concentration of radionuclides and, to some extent, concentrations of hazardous chemicals in the sediment of the impoundment, as well as the concentrations in soils and groundwater near the Old Hydrofracture Facility. The report addresses only the contamination of and the potential releases to the environment that might result from the facility per se and makes no attempt to address potential releases that

might result from permanent disposal of wastes during its operation. Outlined in the report are the additional actions needed to obtain the information required to confirm the extent of contamination within the facility. The major efforts include the measurement of radionuclides and potentially hazardous chemicals contained in the five underground waste storage tanks at the facility and determining of the lateral and vertical contamination due to seepage of waste from the impoundment. (Auth)(SET)

19

Geraghty and Miller, Inc., Oak Ridge, TN

Monitoring Plan for Characterization of the Building 3028 Leak Site

ORNL/Sub-85-97368/2; 44 pp. (1986, June)

The Oak Ridge National Laboratory (ORNL) has established a Remedial Action Program to characterize, manage, and restore areas where past use has resulted in residual contamination of facilities or the environment. In March of 1985, a leak was discovered in the low-level waste (LLW) line leading from Building 3028 during excavation for the construction of condensate traps in the line. Radiation readings as high as 200 R/hr were measured in the contaminated soil in contact with the pipeline. A dye test conducted on the suspect section of line indicated the presence of the leak underneath the southeast corner of the building. The line at that point serves both Building 3028 and Building 3047. A wide variety of radionuclides are processed or produced in the hot cells of Building 3047. All available published and unpublished background information on contaminant inventory, geology, hydrology, and ecology of the site is presented in this report. A monitoring plan is proposed to provide a preliminary assessment of the extent of contamination at the leak site and to provide additional geologic and hydrologic data for evaluating possible contaminant migration pathways.

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Greager, E.M., UNC Nuclear Industries, Inc., Richland, WA

UNC Environmental Surveillance Report for the 100 Areas, FY 1981

UNI-1849; 35 pp. (1981, October 29)

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

The UNC Environmental Surveillance Program for the 100 Areas provides monitoring to assist in evaluating the environmental impact of 100-N Reactor facilities, the shutdown reactor facilities, and burial grounds in the retired 100 Areas. The major objectives of the program are to monitor radionuclide concentrations in radiological release pathways, maintenance of a database for trend analyses, sampling and data for accidental release analyses, and demonstration of compliance with applicable regulations. The surveillance program consists of sampling and monitoring of several environmental parameters. At 100-N Area, samples of ambient air, groundwater, vegetation, soil, and sediment are collected and analyzed along with direct radiation measurements around the 1301-N Facility and along the river shoreline. At the retired 100 Areas, soil and vegetation samples are collected and analyzed. Special samples to monitor the potential biotransport of radionuclides may also be included in the surveillance program. Based on the sampling performed for the environmental surveillance program, 100 Area facilities are in compliance with applicable regulations and there is no significant adverse environment impact from past or present reactor operations.

21

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

Radionuclide Uptake by Trees at a Radwaste Pond in Washington State

Health Physics 50(6):769-774 (1986, June)

This paper presents work conducted in the summer of 1980 by Rockwell Hanford Operations, Hanford, WA, in support of a proposed effort to decommission and decontaminate a Hanford radwaste pond (216-U-10 Pond). The radionuclide values are below any levels of environmental concern and within state and federal guidelines. The U-Pond was constructed for the surface disposal of industrial waste waters from nuclear separation processes. Tree leaf/twig, root, core and soil samples were collected and analyzed for Cs-137, Sr-90, and Pu-239/Pu-240. Strontium-90 was more readily taken up by trees than Cs-137 or Pu-239/Pu-240. Soil concentration values for Cs-137 and Pu-239/Pu-240 were significantly greater than all tree component parts. Radionuclide concentration ratios were higher for Sr-90 than for Cs-137 and Pu-239/Pu-240 for all tree components examined. (Auth) (SET)

22

MK-Ferguson Company, St. Charles, MO; Jacobs Engineering Group, Inc., St. Charles, MO

Annual Environmental Monitoring Report, Weldon Spring, Missouri - Calendar Year 1986

Report; 94 pp. (1987, May)

This report represents a summary of the environmental monitoring activities conducted during 1986 in and around the Weldon Spring Site (WSS), a U.S. Department of Energy (DOE) surplus facility located in St. Charles County, Missouri. The WSS is part of the Surplus Facilities Management Program, a DOE program to plan and manage the final disposition of retired DOE-owned facilities. The WSS comprises two physically separate areas: the 89.5-hectare (221-acre) Weldon Spring Chemical Plant (WSCP) and Weldon Spring Raffinate Pits (WSRP) area, and the 3.6-hectare (9-acre) Weldon Spring Quarry (WSQ) area. The WSRP and WSQ areas are presently used for the interim storage of radioactively contaminated waste materials. The WSCP was transferred to the DOE from the Department of the Army on October 1, 1985. Records of routine environmental monitoring by the Army during previous years are unavailable. During 1986, additional groundwater monitoring wells were installed and surface water sampling locations added on and around the WSCP. Routine sampling of these wells did not begin until the first quarter of 1987. The WSS was formerly used for the processing of radioactive materials. Radioactivity, above current applicable limits for areas of unrestricted use, exists at the site, and elevated levels of radiation will be present until remedial action is completed. Detailed explanations regarding radiation levels measured in 1986 can be found in the summary in Section 2.0 and the related activities and special studies described in Section 3.0. The monitoring program at the WSS during 1986 measured uranium, radium-226, and thorium-230 concentrations in surface water, groundwater, and sediment; radon gas concentrations in air; and external gamma radiation exposure rates. Potential radiation doses to the public were also calculated, based on assumed exposure periods and the above measurements. Radon concentrations, external gamma exposure rates, and radionuclide concentrations in groundwater and surface water at the site were generally equivalent to previous years' levels. Other than radon gas monitoring, no airborne radioactivity measurements were made. The maximum calculated annual radiation dose to a hypothetically exposed indi-

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vidual at the WSRP and WSCP area was 3 mrem, or 3 percent of the DOE radiation protection standard. The calculated annual maximum radiation dose to a hypothetically exposed individual at the WSQ was 0.5 mrem, or less than 1 percent of the DOE radiation protection standard of 100 mrem. Therefore, based on the data and dose calculations, the site currently complies with DOE Offsite Dose Standards. (Auth)

23

Reyes, B.D., M.J. Case, and R.N. Wilhelmsen, Idaho National Engineering Laboratory, Idaho Falls, ID

Annual Report 1985 - Environmental Surveillance for the EG&G Idaho Radioactive Waste Management Areas at the Idaho National Engineering Laboratory

EGG-2451; 84 pp. (1986, August)

The 1985 environmental surveillance report for the EG&G Idaho, Inc., radioactive waste management areas at the Idaho National Engineering Laboratory describes the environmental monitoring activities at the Radioactive Waste Management Complex (RWMC), the Waste Experiment Reduction Facility (WERF), the Process Experimental Pilot Plant (PREPP), and two surplus facilities. The purpose of these monitoring activities is to provide for continuous evaluation and awareness of environmental conditions resulting from current operations, to detect significant trends, and to project possible future conditions. This report provides a public record comparing RWMC, WERF, PREPP, and surplus facility environmental data with past results and radiation protection standards or concentration guides established for operation of Department of Energy facilities. (Auth)

24

Rossin, A.D., U.S. Department of Energy, Office of the Assistant Secretary for Nuclear Energy, Washington, DC

Draft Environmental Impact Statement: Remedial Action at the Weldon Spring Site - Availability Announcement and Intent To Conduct Public Meetings and Hearing

Federal Register 52(45):7190-7192 (1987, March 9)

The Department of Energy has published a draft Environmental Impact Statement (DEIS) regarding remedial action at the Weldon Spring Site. The DEIS assesses the environmental impacts of several alternatives for long-term management of the wastes associated with remedial activities at the site, which is located about 30 miles west of St. Louis, Missouri. The alternatives considered are (1) long-term management in the existing raffinate pits with improved containment; (2) long-term management in the raffinate pits area in a new disposal cell (DOE's preferred alternative); (3) long-term management at another site; and (4) no action. Alternative 2 has two subalternatives: (a) the disposal cell is located partially above grade; and (b) the disposal cell is located completely above grade. Alternative 3 has three subalternatives: (a) disposal of wastes at Hanford; (b) disposal of wastes at "nearby site" within 100 miles of Weldon Spring; and (c) reprocessing of the raffinate and quarry sludge at an existing facility in the Four Corners area with disposal of the remaining wastes in the existing raffinate pits. The potential geological, hydrological, radiological, chemical, ecological, air quality, land-use, and socioeconomic impacts associated with each alternative are assessed. (Auth)(DCM)

25

Stansfield, R.G., and C.W. Francis, Oak Ridge National Laboratory, Oak Ridge, TN

Characterization Plan for the Waste Holding Basin (3513 Impoundment)

ORNL/TM-9969; 51 pp. (1986, September)

U.S. Department of Energy (DOE) facilities are required to comply fully with all federal and state regulations. In response to this requirement, the Oak Ridge National Laboratory (ORNL) has established the remedial action program, to provide comprehensive management of areas where past research, development, and waste management activities have been conducted and have resulted in residual contamination of facilities or the environment. One of the objectives of this program is to define the extent of contamination at these sites. The intent is to document the known environmental characteristics of the sites and identify the additional actions, such as sampling, analytical measurements, and modeling, necessary to confirm contamination and the possible migration of contaminants from the sites. One of these sites is the waste holding basin (3513 impoundment). The 3513 impoundment is an unlined waste settling basin con-

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

structed in 1944 for collection of ORNL wastewater before its discharge into White Oak Creek. Operation of the facility ceased in 1976 when a new process waste treatment plant came into operation. Considerable site-specific environmental information has been developed over the years relative to the type and quantities of radionuclides and hazardous substances contained in the pond water and sediment. The concentrations and patterns of distribution for many of the radionuclides in the aquatic biota as well as for the terrestrial plants growing on the berm of the impoundment have been determined by DOE ecological studies. Recently, some data were collected that evaluate the extent of contaminant movement to the groundwater. Results from these studies are summarized in this report. Also included in this report is an outline of additional tasks needed to obtain the necessary information to model the transport and dose pathways of hazardous substances from the site.

26

Stansfield, R.G., and C.W. Francis, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN

Characterization of the Old Hydrofracture Facility (OHF) Impoundment

ORNL/TM-9990; 133 pp. (1986, September)

This characterization study was conducted on a radioactive-waste impoundment known as the Old Hydrofracture Facility (OHF) Pond, at Oak Ridge National Laboratory, to provide information necessary for its proper disposition. The pond sediment was sampled and analyzed to determine whether it would classify as a hazardous waste under regulatory definitions promulgated in accordance with the Resource Conservation and Recovery Act (RCRA). Chemical analyses indicated that the sediment/waste does not contain hazardous

chemical constituents above levels permitted by RCRA regulations. The sediment was found to contain an estimated radioactivity inventory of approximately 9500 GBq (260 Ci), consisting primarily of Cesium-137, Strontium-90, Cobalt-60, and Uranium-238. (Auth)(SET)

27

U.S. Department of Energy, Office of Remedial Action and Waste Technology, Washington, DC

Remedial Action at the Weldon Spring Site - Draft Environmental Impact Statement

DOE/EIS-0117D (1987, February)

Several alternatives are considered for long-term management of wastes associated with remedial action activities at the Weldon Spring site, located about 48 km (30 mi) west of St. Louis, Missouri. The site is currently contaminated as the result of processing of uranium, thorium, and other materials previously carried out at the site. The Weldon Spring site consists of four areas: raffinate pits, quarry, chemical plant, and vicinity properties. The alternatives considered are (1) long-term management in the existing raffinate pits with improved containment, (2) long-term management in the raffinate pits area in a new disposal cell (DOE's preferred alternative), (3) long-term management at another site, and (4) no action. Several subalternatives are considered for Alternatives 2 and 3 to more fully explore potential environmental impacts. The potential geological, hydrological, radiological, chemical, ecological, air quality, land-use, and socioeconomic impacts associated with each alternative are assessed and compared for the remedial action period and for long-term management. These analyses indicate that all action alternatives (in particular Alternative 2 -- DOE's preferred alternative) can be implemented without significant environmental consequences provided that appropriate mitigative measures are taken. (Auth)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM HEALTH, SAFETY, AND BIOMEDICAL STUDIES

28

Meshkov, N., P. Benioff, J. Wang, and Y.C. Yuan,
Argonne National Laboratory, Argonne, IL

Weldon Spring Historical Dose Estimate

ANL/EES-TM-308; 157 pp. (1986, July)

This study was conducted to determine the estimated radiation doses that individuals in five nearby population groups and the general population in the surrounding area may have received as a consequence of activities at a uranium processing plant in Weldon Spring, Missouri. The study is retrospective and encompasses plant operations (1957-1966), cleanup (1967-1969), and maintenance (1969-1982). The dose estimates for members of the

nearby population groups are summarized. Of the three periods considered, the largest doses to the general population in the surrounding area would have occurred during the plant operations period (1957-1966). Dose estimates for the cleanup (1967-1969) and maintenance (1969-1982) periods are negligible in comparison. Based on the monitoring data, if there was a person residing continually in a dwelling 1.2 km (0.75 mi) north of the plant, this person is estimated to have received an average of about 96 mrem/yr (ranging from 50 to 160 mrem/yr) above background during plant operations, whereas the dose to a nearby resident during later years is estimated to have been about 0.4 mrem/yr during cleanup and about 0.2 mrem/yr during the maintenance period. These values may be compared with the background dose in Missouri of 120 mrem/yr.

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

29

Bauer, R.G.

Asbestos Insulation Removal at the Shippingport Station Decommissioning Project

SSDP-0011; CONF-860905; Spectrum '86, Low, Intermediate and High Level Waste Management - Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986; (10 pp.) (1986)

The purpose of this paper is to transfer technology developed during the asbestos removal at the Shippingport Station Decommissioning Project (SSDP). The information is provided to assist engineering personnel preparing for asbestos removal. A brief background of the project and its specific considerations are given. Engineering decisions, lessons-learned and recommendations are presented to assist in the avoidance of contracting, safety, and technical difficulties. (Auth.)

30

Crimi, F.P., General Electric Company, Shippingport, PA

Physical Decommissioning of the Shippingport Atomic Power Station

Transactions of the American Nuclear Society 54:42-44; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 42-44) (1987)

The Shippingport Atomic Power Station (SAPS) consists of the nuclear steam supply system and associated radioactive waste processing systems, which are owned by the U.S. Department of Energy (USDOE), and the turbine generator and balance of plant, which are owned by the Duquesne Light Company. The Shippingport Station Decommissioning Project (SSDP) is being managed by the General Electric Company and its integrated subcontractor, Morrison-Knudsen-Ferguson Company, for the USDOE. The objectives of the SSDP are to: (1) demonstrate the safe and cost-effective dismantlement of a large scale nuclear plant; (2) provide useful data for future decommissioning projects; and (3) maintain the SAPS in a radiologically safe condition. This paper pres-

ents the current status of the physical decommissioning work, which started September 1985. The controlling path and parallel work activities are described along with the project's cost and schedule status through December 31, 1986. (Auth)(DCM)

31

Elder, J.C., E.J. Cox, D.P. Hohner, and A.M. Valentine, Los Alamos National Laboratory, Los Alamos, NM

Radioactive Liquid Wastes Lines Removal Project at Los Alamos (1981-1986)

LA-10821-MS; 120 pp. (1986, September)

This report describes the abandoned liquid waste lines removal operations conducted at Los Alamos in the period 1981 to 1986. Particular emphasis has been placed on as-left conditions, that is, on the location of sections of waste lines or contaminated soil which were left in place on the basis of ALARA decisions. Contaminated items were left when interfering utilities, roads, structures, or great depth made complete removal not cost effective or not safe. Left items were either not highly contaminated or they were not near the surface. Total cost of the project was \$4.2 million. Approximately 5800 mT of contaminated waste was placed in the Solid Waste Management Site at TA-54 Area G. The project accomplished the removal of approximately 34,500 ft (6.5 miles) of abandoned waste lines under carefully controlled conditions. Procedures for excavation, waste disposal, personnel protection, and radiation monitoring are described. Environmental monitoring criteria and methods for determining acceptable levels of contamination in soils and on surfaces are discussed.

32

Elder, J.C., and C.L. Knoell, Los Alamos National Laboratory, Los Alamos, NM

TA-2 Water Boiler Reactor Decommissioning (Phase 1)

LA-10890-MS; 49 pp. (1986, December)

Removal of external structures and underground piping associated with the gaseous effluent (stack) line from the TA-2 Water Boiler Reactor was performed as Phase 1 of

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reactor decommissioning. Six concrete structures were dismantled and 435 ft of contaminated underground piping was removed. Extensive soil contamination by TxCs was encountered around structure TA-2-48 and in a suspected leach field near the stream flowing through Los Alamos Canyon. Efforts to remove all contaminated soil were hampered by infiltrating groundwater and heavy rains. Methods, cleanup guidelines, and ALARA decisions used to successfully restore the area are described. The cost of the project was approximately \$320K, and 970 mT of low-level solid radioactive waste resulted from the cleanup operations.

33

General Electric Company, Nuclear Energy Operations, San Jose, CA

Launching Large-Scale Decommissioning

Nuclear Power Newsletter (1984, Fall):6-7 (1984, Fall)

The Shippingport decommissioning project will be the first such project involving a large-scale, commercial nuclear power plant. The Department of Energy selected General Electric as the contractor to implement their decommissioning plan for the site. The reactor operated from 1957 until October 1982. The Shippingport project involves the dismantling of reactor equipment from the plant and disassembly of its buildings, as well as removal, transport and disposal of radioactive materials. The project objectives are: to place Shippingport in a radiologically safe condition; to demonstrate safe, cost-effective dismantlement of a large-scale nuclear power plant; and to provide useful data for future decommissioning projects. The total estimated cost of the Shippingport decommissioning project, in 1986 dollars, is \$79.7 million. (SET)

34

Horton, H.L., Savannah River Plant, Health Protection Department, Aiken, SC

Decommissioning and Dismantling of 305-M Test Pile at the Savannah River Plant

Health Physics 49(1):192-193 (1985, July)

The 305-M Test Pile was started up at the Savannah River Plant in 1952 and placed on "standby" status in 1981. This test pile was used to measure the uranium content of reactor fuel. In 1984 work began to decommission and dismantle the test pile. Extensive procedures were utilized which included a detailed description of the radiological controls and safety measures. These controls allowed the job to be completed with radiation doses as low as reasonably achievable. (Auth)

35

Mullee, G.R., and J.M. Usher

Shippingport Station Decommissioning Project (SSDP) - A Progress Report

SSDP-0012; CONF-860905; Spectrum '86, Low, Intermediate and High Level Waste Management - Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986; (7 pp.) (1986)

The Shippingport Atomic Power Station was shutdown in October 1982 by the Plant Operator, Duquesne Light Company, for decommissioning by the U.S. Department of Energy. The planning for decommissioning was completed in September 1983. In September 1984 operational responsibility for the station was transferred to the DOE's Decommissioning Operations Contractor, the General Electric Company (assisted by an integrated subcontractor, MK Ferguson Company). Significant accomplishments to date include the completion of all prerequisites for decommissioning, the removal of asbestos from plant systems, loading of irradiated reactor components into the reactor vessel for shipment, the commencement of electrical deactivation and the commencement of piping/component removal. Decontamination and waste processing are progressing in support of the project schedule. The reactor vessel will be shipped as one piece on a barge for burial at Hanford, Washington. The final release of the site is scheduled for April, 1990. A technology transfer program is being utilized to disseminate information about the project. (Auth)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM SITE STABILIZATION AND RECLAMATION

36

McDaniel, E.W., T.M. Gilliam, L.R. Dole, and G.A. West, Oak Ridge National Laboratory, Oak Ridge, TN

Weldon Spring, Missouri, Raffinate Pits 1, 2, 3, and 4: Preliminary Grout Development Screening Studies for In Situ Waste Immobilization

ORNL/TM-9264; 30 pp. (1987, April)

Results of Oak Ridge National Laboratory's initial support program to develop a preliminary grout formula to solidify in situ the Weldon Spring waste are presented. The Screening study developed preliminary formulas based on a simulated composite waste and then tested the formulas on actual waste samples. Future data needs are also discussed. (Auth)

37

Voigt, W.R., U.S. Department of Energy, Washington, DC

Floodplain Involvement Notification for Proposed Remedial Action at the Monticello Uranium Mill Tailings Site, Monticello, UT

Federal Register 51(85):16371 (1986, May 2)

The Department of Energy proposes to conduct remedial action at the former Atomic Energy Commission uranium millsite in Monticello, Utah. The millsite will be cleaned up in accordance with the Environmental Protection Agency standards for Remedial Action at Inactive Uranium Processing Sites. The currently proposed remedial action alternative entails removing all contaminated material from within the floodplain and stabilizing approximately 2.4 million tons of tailings contaminated material at the site. DOE will also prepare a floodplain assessment to be included in the Environmental Assessment being prepared for the proposed remedial action. This article includes an address to which one can write for further information. Public comments or suggestions regarding the proposed activities in the floodplain area are invited. (Auth)(CAC)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

38

Mullee, G.R., and A.R. Schulmeister, General Electric Company, Shippingport, PA

Waste Management for Shippingport Station Decommissioning Project

SSDP-0014; CONF-870306; Waste Management '87, Proceedings of a Conference, Tucson, AZ, March 1-5, 1987; (4 pp.) (1987)

The waste management plan at the Shippingport Station Decommissioning Project assures that hazardous wastes from the site will be disposed of in accordance with the Environmental Protection Agency requirements, and that the handling, packaging, and transportation of hazardous and radioactive materials will comply with all Federal, State, and local regulations. Radioactive waste will be transported by truck or barge to the Hanford, Washington burial ground for burial. At the time of this report, initial inventory of liquid radioactive waste is nearly complete. The non-fuel bearing irradiated core components, which were left in the fuel storage canal, have been either loaded in the reactor vessel or transported by truck to the burial ground. The components which have been loaded in the vessel are being sealed in place with concrete as part of the integral one-piece reactor pressure vessel (RPV) shipment. Five hundred cubic yards (in-place volume) of asbestos has been removed from the piping systems and buried. The reactor pressure vessel, pressurizer, steam generators and other radioactive materials have not yet been moved by ocean barge to Hanford, Washington. The entire decommissioning operation is scheduled to be completed by January, 1990. (Auth)(SET)(DCM)

39

Rossin, A.D., U.S. Department of Energy, Washington, DC

Record of Decision for Remedial Actions at the Niagara Falls Storage Site, Lewiston, NY

Federal Register 51(172):31795-31797 (1986, September 5)

The DOE has selected long-term in place management for the radioactive wastes and residues at the Niagara Falls Storage Site (NFSS) in Lewiston, New York. This

shall be accomplished by a multilayered engineered cap which will be constructed over the interim waste containment area. It will be 302 meters long, 137 meters wide and 8.9 meters high, with a side slope of 1 vertical to 5 horizontal. Other remedial action alternatives considered included: no action; decontamination of the NFSS, transport, and long-term management of the radioactive wastes and residues at the DOE site in Hanford, Washington or at a DOE site in Oak Ridge, Tennessee; removal, transport, and long-term management of the radioactive residues at either Hanford, Washington, or at Oak Ridge, Tennessee, and long-term management of the radioactive wastes at NFSS; removal, transport, and long-term management of the radioactive residues at either Hanford, Washington, or at Oak Ridge, Tennessee, and removal and ocean disposal of the radioactive wastes. Long-term management in place has less environmental impacts for the action alternatives for (1) transportation and occupational injuries and deaths, and (2) additional imputed radiological health effects during the action period to the general public and workers. Long-term in place management at NFSS is far less costly than the other alternatives. Subject to the requirements of the option selected for management of residues and wastes at the NFSS, the following representative measures will be employed to avoid or minimize impacts during the remedial action: dampening contaminated materials with water and/or dust suppressants; stopping contaminated material-handling operations during adverse weather conditions; using equipment designed and/or selected to minimize particle releases; cleaning and washing trucks and other vehicles before they leave the site; restricting access to the site; monitoring equipment and workers; training workers; and installing dikes to prevent release of contaminants through water pathways. This long-term management project is expected to be implemented in the next 5-10 years. (SET)(DCM)

40

Skavdahl, R.E., General Electric Company, San Jose, CA

Innovations in GE Waste Management

Nuclear Europe 5(7-8):30 (1986, July)

The advanced volume reduction and solidification rad-waste system (Aztech) developed by General Electric is described. Decommissioning of the Shippingport reactor and at-reactor storage are discussed.

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

41

Yannitell, D.M., General Electric Company, Shippingport, PA

Barge Transportation of Reactor Pressure Vessel and Other Low Specific Activity Waste

Transactions of the American Nuclear Society 54:46-48; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 46-48) (1987)

The Shippingport Station Decommissioning Project is a U.S. Department of Energy sponsored project to dismantle the Shippingport Atomic Power Station and return the government-leased property in a radiologically safe condition to its owner, the Duquesne Light Company. All radioactive material removed from the station will be transported to and buried at the government-owned

Hanford Reservation in Richland, Washington. Based on economic and safety considerations, the majority of the radioactive material, including the one-piece reactor pressure vessel/neutron shield tank (RPV/NST) package, will be shipped by barge. This material can be divided into three categories: (1) The RPV/NST package - the RPV, its non-fuel bearing internals, and the integral NST will be prepared as a monolithic metal/concrete package for shipment; (2) Components used as their own container - several large, internally contaminated plant components will be decontaminated to meet low specific activity (LSA) requirements and sealed to serve as their own strong-tight containers; and (3) The LSA containers - over three-hundred 87-cubic foot strong-tight boxes will be packed with LSA material from the dismantled plant systems. These boxes will be packed, eight at a time, into 4- X 4- X 20-ft International Organization for Standardization containers for weather protection and for ease in handling and tie-down to the barge. (Auth) (DCM)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

42

Campbell, L.F., and G.D. Coxon, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN

The Niagara Falls Storage Site Remedial Action Project: Status Update and Summary of Special Features

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 419-424) (1986)

The U.S. Department of Energy (DOE) and its Project Management Contractor, Bechtel National, Inc., are conducting remedial action at the Niagara Falls Storage Site (NFSS) near Lewiston, New York to stabilize low-level radioactive wastes stored at the site and to decontaminate over two dozen contaminated vicinity properties. Over the past 4 years a 10-acre interim waste containment facility has been developed at the site to hold the approximately 250,000 cubic yards of contaminated soil and rubble from the cleanup operations. Several existing buildings were demolished or modified for burial inside the containment area. In addition, residues inside a 165-ft-high concrete tower were transferred to one of the buildings inside the containment area using hydraulic mining techniques. The residues were dewatered and covered with clay to minimize radon emanation; the tower was demolished and the rubble disposed of in the containment area. Environmental monitoring will continue throughout the interim storage period. In addition, the surface and subsurface condition of the containment structure will be monitored to ensure that undesirable trends are detected in time for corrective action to be taken. The DOE Record of Decision on the long-term disposition of the NFSS is expected to be made by the end of April, 1986.

43

Frazier, R.J., D.J. Harrison, R.D. Meyer, F.C. Schrag, and R.C. Wilson, Rockwell International, Rocketdyne Division, Canoga Park, CA

Nuclear Materials Development Facility Decommissioning - Final Report

AI-DOE-13559 (1987, March 31)

The Nuclear Materials Development Facility (NMDF), Building 055, was for research, development, and production work on radiotoxic nuclear fuels, primarily Pu-239. The decision was made in FY 1982 to decommission the facility as part of the Department of Energy's (DOE's) Surplus Facilities Management Program. The intent was to decontaminate and decommission (D&D) the NMDF to the extent it would be suitable for unrestricted use. A project plan was prepared to describe the scope of the work, the techniques used, and the equipment needed for D&D. Activity requirements and detailed work procedures were prepared to define the work required on each major segment of the decommissioning. A facility description, history, and the special techniques used during D&D activities, which include glovebox decontamination, support area contamination, and HVAC decontamination, are summarized in this document. The NMDF was decontaminated to levels that were as low as reasonably achievable (ALARA), but in all cases to levels below the limits prescribed for unrestricted use. The disposal of potentially contaminated NaK, contained in 10 bubblers that were used to purify the inert atmosphere of the gloveboxes, also is discussed. The decommissioning of Rockwell's NMDF began in October 1982 and was completed in October 1986. Final surveys, waste shipments, and the final report were completed by March 1987. (Auth)

44

Jones, E.D., West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination and Decommissioning of Extraction Cell 3 at the West Valley Demonstration Project

DOE/NE-44139-3; 59 pp. (1985, December)

This report describes the decontamination and decommissioning (D&D) of Extraction Cell 3 (XC-3) at the West Valley Demonstration Project. XC-3 is one of several cells in the former reprocessing plant required for use in support of the solidification of high-level waste. It became radioactively contaminated during nuclear fuel reprocessing from 1966 to 1972. XC-3 contained systems used in the final uranium extraction cycle. Several pump niche and sample box drains were routed into the cell. The report describes the work performed to accomplish the D&D objectives of removing existing piping and equipment from XC-3 and of reducing the radiation and contamination levels, to allow installation of equipment

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

for the Liquid Waste Treatment System. Contaminated debris and equipment inside the cell were removed, packaged and stored for future disposition. Interior surfaces (walls, floor, and ceiling) of the cell were then decontaminated to a radiation level that allowed entry without the use of protective clothing or respiratory protection. (SET)(DCM)

45

Kline, W.H., G.F. Fassnacht, and H.J. Moe, Argonne National Laboratory, Plant Facilities and Services Division, Argonne, IL; Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Decontamination and Decommissioning of the Argonne National Laboratory East Area Radioactively Contaminated Surplus Facilities - Final Report

ANL-87-18 (1987, July)

Argonne National Laboratory (ANL) has decontaminated and decommissioned (D&D) seven radiologically contaminated surplus facilities at its Illinois site so that they could be released for conventional demolition and the land returned to unrestricted use. The D&D work involved dismantling of all process equipment and associated plumbing, ductwork, drain lines, etc., so that contaminated components could be separated from those which were not. After appropriate radiation surveys were performed, floor and wall coverings, suspended ceilings, room partitions, pipe, conduit and electrical gear were taken down as necessary in each facility in order that both exposed and concealed surfaces of all walls, ceilings, and floors were accessible for radiological monitoring and decontamination. In addition, underground sewers were excavated so that they, and the surrounding soil, could be checked for contamination. The grounds around each facility were also thoroughly surveyed. Contaminated

materials and soil were packaged and shipped to a Department of Energy low-level waste burial site, while nonactive debris was buried in the ANL landfill. Clean, reusable items were saved, and metal scrap which was free of radioactivity was sold for salvage. After completion of the decommissioning work, each building was torn down and the site relandscaped. The project was completed in 1985, nine months ahead of schedule, required 33 months and 15 man-years to accomplish, produced just under 19,000 cubic feet of radioactive waste, and cost 1.88 million dollars, which was 700 thousand dollars under the original estimate. (Auth)(DCM)

46

Mullee, G.R., General Electric Company, Shippingport, PA

Operational Lessons Learned During Decommissioning

Transactions of the American Nuclear Society 54:45-46; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 45-46) (1987)

The General Electric Company, decommissioning operations contractor (DOC) for the Shippingport Atomic Power Station, has instituted a system for evaluating abnormal events and reporting the lessons learned. In addition to the reporting of unusual occurrences (events with programmatic significance) required by U.S. Department of Energy (DOE) orders, the Shippingport Station Decommissioning Project (SSDP) abnormal event evaluation system also includes less serious events and near-misses. The system has the objectives of contributing toward the maintenance of a safe work environment and providing information for future projects through the technology transfer program. This paper describes the abnormal event evaluation system, reports the lessons learned, and concludes that the attention directed to evaluation/correction of near-misses has been effective--there have been no serious events. (Auth) (DCM)

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

47

DeLaney, E.G., U.S. Department of Energy, Division of Facility and Site Decommissioning, Washington, DC

Decommissioning of United States Department of Energy Nuclear Facilities

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (13 pp.)

The background leading to the current decommissioning program being conducted by the U.S. Department of Energy is reviewed, and examples of past decommissioning experience are presented. The objectives of the program and the manner in which these objectives are being achieved are described. The plans for future decommissioning projects in this program are presented. Two major projects that are underway and one project that is to start in two years are described. The experience from this program is expected to be of use in the eventual decommissioning of commercial nuclear facilities in the United States and in other countries. (A111)(CAC)

48

DeLaney, E.G., U.S. Department of Energy, Division of Facility and Site Decommissioning, Washington, DC

U.S. DOE Decommissioning Activities

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (14 pp.) (1985)

This paper contains copies of visual aids on the decommissioning activities of the U.S. Department of Energy (DOE) which were presented during the JPDR Decommissioning Workshop. The visuals outline the program management, technical approach, and major projects of the Surplus Facilities Management Program, including overviews of the Mound Laboratory, Advanced Nuclear Systems and Projects Division's (ANSPP's) Project and the Weldon Spring Site Remedial Action Project (WSS-RAP). (CAC)(DCM)

49

Harris, R.A., U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN

Historical Nuclear Materials Balance Report for the Former AEC-Owned Weldon Spring Chemical Plant, Weldon Spring, Missouri

DOE/OR-872; 36 pp. (1986, July)

From June 1957 through December 1966, four types of nuclear materials were processed in the AEC-owned Weldon Spring Chemical Plant. These materials were: (1) natural uranium; (2) depleted uranium; (3) slightly enriched uranium; and (4) natural thorium. Material balances for each of these materials are summarized. In processing the materials, contaminant discharges occurred to (a) the atmosphere through stacks, (b) area waterways through sewers, and (c) to raffinate pits still in existence at the site. These discharges are summarized. Natural uranium processing accounted for more than 97% of the nuclear materials throughput. Total material balance closures for natural uranium, depleted uranium, slightly enriched uranium, and natural thorium were 99.94%, 100%, 99.27%, and 98.52%, respectively. Of the contaminant discharges, approximately 75% went to and remain in the existing raffinate pits. Discharges to stacks and sewers account for the remaining 25%. As far as can be determined, it appears that all plant processes operated efficiently and all materials were well accounted for with only minimal variances.

50

Myrick, T.E., Oak Ridge National Laboratory, Oak Ridge, TN

The ORNL Remedial Action Program

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S10 (1987)

The ORNL Remedial Action Program (RAP) was established in 1985 to provide comprehensive management of all inactive contaminated sites under ORNL control. Over 160 sites are now included in the program, ranging in complexity from inactive burial grounds and experimental reactors to individual waste storage tanks or

CHAPTER 1. SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

process ponds. The sites are being collectively managed to ensure adequate consideration of site interactions and long-term decommissioning/closure alternatives. Program implementation is being focused in six principal areas: (1) preliminary assessment/site investigation of all RAP sites; (2) maintenance, surveillance, and corrective actions for sites requiring routine controls; (3) remedial investigation/feasibility studies (RI/FS) for specific site assessment; (4) technology demonstrations for potential remedial action techniques; (5) program strategy development, with primary emphasis on closure criteria; and (6) final site decommissioning/closure. Major activities conducted in FY 1986 include initiation of a comprehensive groundwater well installation program; implementation of characterization efforts at Solid Waste Storage Area 6, White Oak Creek/Lake, and the hydrofracture facilities; and demonstration on in situ grouting and vitrification techniques for corrective applications. An overview of the current RAP efforts, as well as a look at the future of the program and the critical issues for program success, will be presented. (Auth)

51

Voorhees, L.D., R.M. Cushman, M.A. Faulkner, and B.M. Horwedel, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN

Data Base Management for the Remedial Action Program at Oak Ridge National Laboratory

ORNL/TM-9997; 50 pp. (1986, August)

The Oak Ridge National Laboratory's (ORNL's) Remedial Action Program was established to provide appropriate corrective measures at over 140 sites that were contaminated with radioactive and/or hazardous chemical wastes. To achieve this goal, numerous and varied studies are being conducted which will result in the collection of an unprecedented amount of data for the ORNL site. To manage such data effectively and efficiently, a computerized data base is being developed. The data base provides a unified repository for all data generated within the Remedial Action Program, to allow for necessary storage, manipulation, analyses, assessment, display, and report generation. Data base management for the Remedial Action Program is documented in this report by: defining the organization of the data management staff and the services provided; describing the design of the data base, including its management system, organization, and applications; providing examples of the current and anticipated tasks; and discussing quality assurance measures implemented to control the accuracy of the data entries and the security of the data. (Auth)

Chapter 2

NUCLEAR FACILITIES DECOMMISSIONING

- **Design, Planning, and Regulations**
- **Environmental Studies and Site Surveys**
- **Health, Safety, and Biomedical Studies**
- **Decontamination Studies**
- **Dismantlement and Demolition**
- **Waste Disposal**
- **Remedial Action Experience**
- **General Studies**

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

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Gentilly-1 Nuclear Power Station Decommissioning

This overview document defines "End State," the condition to which the Gentilly-1 nuclear power station will be decommissioned. The decommissioning effort was scheduled to begin in April 1984 and end March 31, 1986. The "End State" is a variant of a Stage 2 decommissioning program in which certain parts of the plant are completely dismantled and the existing structures are modified for other uses. The remaining portions of the plant (reactor containment building and turbine building) will be isolated. Certain active wastes generated during the operating life of the station and the decommissioning effort will be stored in these buildings. This document therefore defines the decommissioning effort and serves as a licensing document for the storage of active wastes under surveillance on the site. At the completion of decommissioning operations, the Gentilly-1 nuclear power station will be termed the "Gentilly-1 Waste Storage Facility," or G-1 WSF. Included on the G-1 WSF site will be a dry irradiated fuel storage facility, in which all the fuel irradiated during the operating life of the station will be stored. (Auth)(CAC)(DCM)

53

Report of Nuclear Subcommittee of the Advisory Committee for Energy: Standards for Nuclear Power Plants Decommissioning

Genshiryoku Iinkai Geppo 30(7):10-17 (1986, February)

Nuclear power generation by Japan's 30 plants reached 22.531 million kW(e). Accompanying the steady development of nuclear power generation is the realization that standard procedures will have to be established for decommissioning commercial nuclear power plants at the end of their service lifetime. Since March, 1984, the Subcommittee on Nuclear Reactor Decommissioning has held discussions about a rational approach to decommissioning of nuclear facilities that will conform to the actual situation in Japan. Topics discussed included costs, disposal of wastes, and technical developments. The Subcommittee finished the meetings concerning development of procedures for decommissioning nuclear

facilities on July 2, 1985, and it was decided to present a report to the Atomic Energy Committee meeting, which was to be held on July 15. The fundamental concept of the decommissioning measures is to dismantle and remove the nuclear power generation facilities which have reached their end of life operation. A case study on typical nuclear power generation facilities will be performed, and, based on the study results, standard procedures will be decided. Definitive studies of the cost of decommissioning must be made. Low level and extremely low level radioactive wastes will be placed under the required control.

54

Report of Atomic Energy Subcommittee, Advisory Committee for Energy: The Way That the Measures of Decommissioning Commercial Nuclear Power Generation Facilities Should Be

Genshiryoku Shiryo 176:1-15 (1985, September)

Accompanying the steady development of nuclear power generation in Japan, social interest is growing concerning the decommissioning of nuclear power generating facilities after they have reached the end of their useful operational life. Techniques exist today, and improved techniques are being developed for decommissioning these facilities. However, when the measures of decommissioning are taken, the consideration given to ensure the safety is important. Besides, since enormous expense is required for a short period, it is important to examine the concrete countermeasures from now so as to carry out the decommissioning smoothly. For this purpose, the Reactor Decommissioning Countermeasures Subcommittee was organized, and since March, 1984, examination has been carried out on the decommissioning measures from the finish of operation through disassembling and removal to the disposal of wastes of commercial nuclear power generation facilities, and also on the rational processes, expense countermeasures and technical development. This report discusses the results of the Subcommittee's examination.

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Decommissioning License for Gundremingen A

Nuclear News 30(1):65 (1987, January)

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

A license has been issued to begin decommissioning work on the 250-MW(e) boiling water reactor at Gundremmingen A in Germany. This is the second major decommissioning project in Germany. The first project, involving the Niederaichbach gas-cooled heavy-water reactor at Karlsruhe, received a license earlier in 1986, although that license is now being contested by nuclear opponents because they fear the site might be reused for a new nuclear plant. The Gundremmingen A unit was operated successfully from 1966 to 1977. However, after a long shutdown following an incident in which cooling water leaked into the containment, the decision was made in 1980 to decommission the plant. This decision was made because the cost of upgrading the unit to meet tighter German licensing requirements was judged to be excessive. One of the first operations in the decommissioning program will be the removal of the mixed-oxide fuel that is still in the reactor. It will be stored at the site in containment/transport casks of the type used for interim spent-fuel storage in Germany. (Auth)(CAC) (DCM)

56

UC-Berkeley Unit To Be Shut Down

Nuclear News 30(3):118 (1987, March)

On January 15, the Board of Regents of the University of California approved funding for the decommissioning of the 1-MW(t) TRIGA reactor in Etcheverry Hall at the school's Berkeley campus. The decision was reached despite protests from the Nuclear Engineering faculty, who asserted that the reactor is in better condition now than when it was first built, and suggested that political pressure influenced the decision. (Auth)

57

Proceedings of the American Association of Cost Engineers 29th Annual Meeting

Proceedings of the American Association of Cost Engineers 29th Annual Meeting, Denver, CO, June 30-July 3, 1985 (1985)

The papers were given at a conference on cost estimation. They focus mainly on the cost of decommissioning nuclear power plants, and costs of electric power generation. Topics such as outage management, sizing of power plants and prudency audits are discussed. One paper deals with the economics of converting a gas furnace to a coal fired one to preheat steel slabs.

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Decommissioning Nuclear Power Plants

State of the World 1986, L.R. Brown (ed.) W.W. Norton, for Worldwatch Institute; (pp. 119-138) (1986)

The article suggests that from 2000 to 2010, nuclear decommissioning could be the largest expense facing the utility industry. Implications of decontamination and dismantlement, waste disposal, and cost estimation are reviewed.

59

Adams, A.L., United Kingdom Atomic Energy Authority, Windscale Nuclear Power Development Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

The Decommissioning of the Windscale Advanced Gas-Cooled Reactor

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (17 pp.) (1985)

The United Kingdom Atomic Energy Authority has developed a plan and procedure to decommission its Advanced Gas-cooled Reactor to Stage 3 (green field site). Implementation of that plan commenced in 1982, and the project is planned for completion in late 1995. The task is a pioneering venture of a development nature. Its successful execution will provide information and establish methods that may be applicable to similar tasks elsewhere as they become desirable or necessary in the twenty-first century. (Auth)

60

Alexander, R.E., U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

Residual Radioactive Contamination Limits for Decommissioning

Federal Register 51(207):39266 (1986, October 27)

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

The proposed rule would establish residual radioactive contamination limits (including induced and other volumetric radioactivity as well as removable and fixed surface contamination) which must be met before structures and lands can be released on an unrestricted, unregulated basis. Structures and lands with residual radioactive contamination below these limits would be eligible for unrestricted release without regulatory restrictions from a radioactivity standpoint. The proposed amendments are necessary to provide licensees with quantitative criteria to use during decommissioning relative to cleanup of structures and lands intended to ensure that structures and lands used in NRC licensed facilities and activities will be decontaminated in a manner that adequately protects public health before being released on an unrestricted, unregulated basis. This proposed rule is a reissue of a withdrawn rule. An abstract of the withdrawn rule was printed in the Federal Register 51(76):14910-14911, April 21, 1986. (Auth)(SET)

61

Allen, J.K.

Inconsistencies in Regulatory Doctrines Governing Mixed Wastes

Transactions of the American Nuclear Society 50:70; CONF-851115; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 10-14, 1985; (p. 70) (1985)

A scenario is outlined that illustrates the types of situations that have arisen recently at nuclear facilities, created by the rapid changes occurring in nuclear and environmental regulations. The presentation argues that hazards from the chemical nature of substances far outweighs that of radioactivity. Current costs of decommissioning a typical BWR type reactor are discussed. Potential environmental considerations are presented to illustrate the complexity of the decision-making that must take place in order to evaluate all factors.

62

Auclair, K.D., and G.L. Palau, Bechtel Eastern Power Corporation, Middletown, PA

The Use of CADD/CAE for Remote Vehicle System Mission Planning

Transactions of the American Nuclear Society 53:495-496; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 495-496) (1986)

Many factors contribute to the successful completion of a remotely operated vehicle mission. Among the most important is mission planning which includes a comprehensive evaluation of the objectives of the mission, the equipment and operator capabilities, and the physical constraints within the environment into which the equipment will be deployed. Experience gained during the recovery of Three Mile Island Unit 2 (TMI-2) indicates that computerized design and drafting systems (CADD) can be used as an effective aid in mission planning which can improve the efficiency, quality, and execution of tasks using remote vehicle systems. CADD systems can be utilized for pretask identification of alternative vehicle transit routes, interferences and obstructions to remote equipment movement, identification of landmarks from which the equipment operators can navigate, and operator familiarization with the physical layout and work area constraints. All of this can result in a reduction in the time and cost required to perform a job, and in a nuclear environment can also result in a significant reduction in personnel radiation exposure.

63

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

Putting Decommissioning Plans into Practice

Nuclear Engineering International 30(376):25-26 (1985, November)

Some topics which were brought up at the International Nuclear Reactor Decommissioning Planning Conference held in 1985 near Washington are discussed. Engineering was emphasized, as well as the management of waste, and the estimating of decontamination and decommissioning costs. A program for investigating the decontamination and re-use of decommissioned materials was described at the conference. (SET)(DCM)

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Cantor, R., Oak Ridge National Laboratory, Energy and Economic Analysis Section, Oak Ridge, TN

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

Nuclear Reactor Decommissioning: An Analysis of the Regulatory Environments

ORNL/TM-9638; 153 pp. (1986, August)

In the next several decades, the electric utility industry will be faced with the retirement of 50,000 megawatts (MW) of nuclear capacity. The responsibility for the financial and technical burdens this activity entails has been delegated to the utilities operating the reactors. The decommissioning will be dictated by federal, state, and local regulations. The purpose of this study was to highlight some of the current and likely trends in regulations and regulatory practices that will significantly affect the costs, technical alternatives and financing schemes encountered by the electric utilities and their customers. To identify significant trends and practices among regulatory bodies and utilities, a review of these factors was undertaken at various levels in the regulatory hierarchy. The technical policies were examined in reference to their treatment of allowed technical modes, restoration of the plant site including any specific recognition of the residual radioactivity levels, and planning requirements. The financial policies were examined for specification of acceptable financing arrangements, mechanisms which adjust for changes in the important parameters used to establish the fund, tax and rate-base treatments of the payments to and earnings on the fund, and whether or not escalation and/or discounting were considered in the estimates of decommissioning costs. The attitudes of regulators toward financial risk, the tax treatment of the decommissioning fund, and the time distribution of the technical mode were found to have the greatest effect on the discounted revenue requirements. (Auth)(SET)

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Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, Gloucester, United Kingdom

Proposals for Decommissioning of Magnox Nuclear Power Stations: Book 1 - Parts 0-2

Book 1, Parts 0-2; 360 pp. (1983, February)

In February 1979 the Conference of Directors-General considered a Preliminary Report on Decommissioning of Nuclear Power Stations (CDG 409). This was prepared by the CEGB Interdepartmental Working Group on Decommissioning and reached the general conclusion

that by using the present technology and regulatory criteria complete clearance of a magnox, steel-vesselled power station could be achieved. The costs were very uncertain and it would be necessary to consider each station individually to verify this general conclusion, to identify special features and to establish probable costs. In consequence the Directors-General approved a three year detailed study concentrated on a selected steel-vesselled magnox station that would lead to a comprehensive report comprising a logical engineering plan supported by a safety statement and cost estimates. The selected station was Dungeness 'A', mainly because it was typical in terms of design, output and physical size of stations commissioned in 1965-1966, and was coastal sited. The other stations commissioned during 1965-1966 were Hinkley Point 'A', Trawsfynydd, and Sizewell 'A'. Since decommissioning represents a major undertaking which, if taken to completion, could demand substantial resources, it was recognized that it should be managed centrally. Also, it would be necessary to involve Regions, Divisions, and Headquarters from the outset, but at the same time to avoid unnecessary overlaps. The study was, therefore, divided broadly into major areas of responsibility close to those likely to obtain when the actual need to undertake decommissioning commences. Thus, Regions concentrated on matters specific to post-operation and sites while GDCD devoted its efforts to the generic and technical aspects as well as taking an overall lead role. These proposals, which fulfill the requirements of the Directors-General, represent a collective view of those within CEGB concerned with decommissioning of nuclear power stations. This is the first of four manuals about Proposals for Decommissioning of Magnox Nuclear Power Stations produced with the approval of the Conference of Directors General. South Eastern, South Western, and North Western Regions combined to prepare Parts 1 and 2 which cover the decommissioning Stages 1 and 2. Part 0 is an introduction to decommissioning operations, costs, and planning. Part 1 includes decommissioning stage 1, shutdown, depressurization, removal of fuel, plant safety, and surveillance. Part 2 includes decommissioning stage 2, removal of plant and buildings external to the biological shield, and surveillance. (Auth)(JMR)(DCM)

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Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, Gloucester, United Kingdom

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

Proposals for Decommissioning of Magnox Nuclear Power Stations: Book 2 - Part 3, Chapters 1-6

Book 2, Part 3, Chapters 1-6; 229 pp. (1983, February)

In February 1979 the Conference of Directors-General considered a Preliminary Report on Decommissioning of Nuclear Power Stations (CDG 409). This was prepared by the CEGB Interdepartmental Working Group on Decommissioning and reached the general conclusion that by using the present technology and regulatory criteria complete clearance of a magnox, steel-vessel power station could be achieved. To verify this conclusion, the Directors-General approved a three year detailed study of a selected steel-vessel magnox station that would lead to a comprehensive report comprising a logical engineering plan supported by a safety statement and cost estimates. The selected station was Dungeness 'A' because it was typical in terms of design, output and physical size of stations commissioned in 1965-1966, and was coastal sited. The study was divided broadly into major areas of responsibility close to those likely to be present when the actual need to undertake decommissioning commences. Therefore, Regions concentrated on matters specific to post-operation and sites while GDCD devoted its efforts to the generic and technical aspects as well as taking an overall lead role. These proposals, which fulfill the requirements of the Directors-General, represent a collective view of those within CEGB concerned with decommissioning of nuclear power stations. This is the second of four manuals about Proposals for Decommissioning of Magnox Nuclear Power Stations produced with the approval of the Conference of Directors General. This manual discusses decommissioning stage 3, which deals with the dismantlement of the reactor itself, comprising the graphite core, internal structure, pressure vessel and biological shield; the removal of the residual plant and buildings; and the release of the site for further use. (Auth)(JMR)(DCM)

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Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, Gloucester, United Kingdom

Proposals for Decommissioning of Magnox Nuclear Power Stations: Book 3 - Part 3, Chapters 7-13

Book 3, Part 3, Chapters 7-13 (1983, February)

In February 1979 the Conference of Directors-General considered a Preliminary Report on Decommissioning of Nuclear Power Stations (CDG 409). This was prepared by the CEGB Interdepartmental Working Group on Decommissioning and reached the general conclusion that by using the present technology and regulatory criteria complete clearance of a magnox, steel-vessel power station could be achieved. To verify this conclusion, the Directors-General approved a three year detailed study of a selected steel-vessel magnox station that would lead to a comprehensive report comprising a logical engineering plan supported by a safety statement and cost estimates. The selected station was Dungeness 'A' because it was typical in terms of design, output and physical size of stations commissioned in 1965-1966, and was coastal sited. The study was divided broadly into major areas of responsibility close to those likely to be present when the actual need to undertake decommissioning commences. Therefore, Regions concentrated on matters specific to post-operation and sites while GDCD devoted its efforts to the generic and technical aspects as well as taking an overall lead role. These proposals, which fulfill the requirements of the Directors-General, represent a collective view of those within CEGB concerned with decommissioning of nuclear power stations. This is the third of four manuals about Proposals for Decommissioning of Magnox Nuclear Power Stations produced with the approval of the Conference of Directors General. This manual is a continuation of the discussion of decommissioning stage 3, which deals with the dismantlement of the reactor itself, comprising the graphite core, internal structure, pressure vessel and biological shield; the removal of the residual plant and buildings; and the release of the site for further use. Chapters in this manual cover solid waste management, ventilation, machinery and controls, cutting methods, alternative schemes, final site landscaping and security, and aspects of deferred stage 3 decommissioning. (Auth)(JMR)(DCM)

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Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, Gloucester, United Kingdom

Proposals for Decommissioning of Magnox Nuclear Power Stations: Book 4 - Part 4

Book 4, Part 4; 162 pp. (1983, February)

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

In February 1979 the Conference of Directors-General considered a Preliminary Report on Decommissioning of Nuclear Power Stations (CDG 409). This was prepared by the CEEB Interdepartmental Working Group on Decommissioning and reached the general conclusion that by using the present technology and regulatory criteria complete clearance of a magnox, steel-vesselled power station could be achieved. To verify this conclusion, the Directors-General approved a three year detailed study of a selected steel-vesselled magnox station that would lead to a comprehensive report comprising a logical engineering plan supported by a safety statement and cost estimates. The selected station was Dungeness 'A' because it was typical in terms of design, output and physical size of stations commissioned in 1965-1966, and was coastal sited. The study was divided broadly into major areas of responsibility close to those likely to be present when the actual need to undertake decommissioning commences. Therefore, Regions concentrated on matters specific to post-operation and sites while GDCD devoted its efforts to the generic and technical aspects as well as taking an overall lead role. These proposals, which fulfill the requirements of the Directors-General, represent a collective view of those within CEEB concerned with decommissioning of nuclear power stations. This is the fourth of four manuals about Proposals for Decommissioning of Magnox Nuclear Power Stations produced with the approval of the Conference of Directors General. This manual contains an initial assessment of the decommissioning of the Sizewell 'A' nuclear power station. Included in the assessment are overall decommissioning operations of stages 1, 2, and 3; decommissioning costs; planning and consents; defueling; management of operational waste; delagging; site organization and external resources; and safety. (Auth)(JMR)(DCM)

69

Commander, J.C., H.J. Welland, and E.A. Moshey,
EG&G Idaho, Inc., Idaho Falls, ID

Tokamak Fusion Test Reactor Preliminary Decontamination and Decommissioning Plan

CONF-851102; Proceedings of the 11th Symposium on Engineering Problems in Fusion Research, Austin, TX, November 18, 1985; (pp. 214-217) (1986)

This paper describes the issues involved in developing the Tokamak Fusion Test Reactor (TFTR) preliminary Decontamination and Decommissioning (D&D) Plan. The TFTR machine is radiation-activated at a low level (greater than 1 rem) or at a high level (1 to 100 rem) depending upon the TFTR program scenario. Consequences of high level activation would be use of remote D&D operation, at a significant cost. The D&D plan was produced in conjunction with preconceptual design studies for a compact ignition machine to be sited at the Princeton Plasma Physics Laboratory. Among several options under consideration was the option to install the machine in the TFTR test cell after completion of TFTR operations, which would necessitate the immediate D&D of the TFTR Tokamak and in-cell auxiliary systems. Therefore, the primary purpose of the preliminary D&D plan was to provide a framework for estimating the cost and schedule for TFTR D&D or inclusion in the evaluation of the TFTR test cell siting option. A secondary purpose was to provide a starting point for the final TFTR D&D plan which would require review and approval prior to any TFTR D&D activities.

70

Conti, M., Comitato Nazionale per l'Energia Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA), Rome, Italy

Decommissioning of Nuclear Installations in Italy: A Short Outline of the Activities

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (6 pp.) (1985)

Nuclear energy originated in Italy between the late 50's and early 60's. During this time, many types of research facilities (reactors, hot cells, laboratories, etc.) were set up and activities were started to support the construction of the first nuclear power plants. Three power plants were built and went into operation in a short time. Now, 20-25 years later, many of these facilities and power plants will be decommissioned. The Italian National Electricity Board (ENEL) plans to complete decommissioning stage 1 (hardened safe storage) on the Garigliano power plant (a dual cycle 160 MW(e) BWR) in August 1978, following the decontamination of the turbine building. The shut down of two other old power plants--Latina

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

GCR 160 MW(e) and Trino Vercellese PWR 270 MW(e) - is planned in the next few years. In this framework, the National Committee on Nuclear Energy and Alternative Energies (ENEA), owner of the research facilities, will start decommissioning activities with the following aims: (1) dismantlement of the oldest out-of-service facilities to gain operating experience; (2) development of appropriate technologies for this application; and (3) contribution to set-up regulations, not yet officially available. These activities will be carried out in cooperation with national technology industries, ENEL, and competent authorities on general policy, and authorized by Italian licensing agencies (ENEA-DISP, Nuclear Safety, and Radiological Protection Directorate). (CAC)

71

Derche, B., Commissariat à l'Energie Atomique, Paris, France

Licensing and Decommissioning of Nuclear Installations in France

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 89-101) (1986)

Nuclear licensing procedure in France is characterized by a great number of different kinds of licensing procedures with the possibility of mutual control and intervention. The effectiveness is achieved through centralization of the licensing decisions. Only the decree of December 11, 1963 contains a regulation for decommissioning, still there exist practical experiences with decommissioning.

72

Dittmar, L.A.

Can Nuclear Power Survive Rate-of-Return Regulation?

Transactions of the American Nuclear Society 53:367-368; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 367-368) (1986)

Most commercial nuclear plants in the U.S., both under construction and in operation, are subject to rate-of-return regulation. Utilities that own nuclear plants cannot reasonably expect to recover all of the costs, including a fair return on investment, of constructing, operating, maintaining, and decommissioning their plants - at least not under regulation as it currently exists. The future of nuclear power in this country will in large part be determined by the financial and organizational restructuring of the electric utility industry that is certain to occur. This inevitable restructuring is likely to be accompanied by modifications to and realignment of the financial regulation of the electric utility industry. But such changes will not bode well for energy options that cannot meet the ultimate market test.

73

Driscoll, J.A., HM Nuclear Installations Inspectorate, Bootle-Merseyside, United Kingdom

Decommissioning of Nuclear Installations in the United Kingdom

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 209-221) (1986)

The author gives a review of the basis for, and the historical development of, the law applying to nuclear installations in the United Kingdom. Decommissioning is seen as one of many operations which are subject to legally enforceable requirements placed on the operators of such nuclear installations. The procedures developed from the experience in decommissioning of nuclear power stations are presented and the appropriate regulatory control is being defined.

74

Fricke, W., AEG-Telefunken, Federal Republic of Germany

The Kernkraftwerk Lingen (KWL) Fuel

Nuclear Engineering International 13(150):934-935 (1968)

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The Lingen fuel elements were supplied by the joint AEG-GE company Kernreaktorteile GmbH and based on the design used for Gundremmingen. These fuel elements were delivered on schedule and a BWR fuel manufacturing capability was established in Germany. This article discusses the design, fabrication, testing, and performance of the fuel. (Auth)(CAC)

75

Gee, J.H., Department of Environmental Studies and Assessments, Toronto, Ontario, Canada

Environmental and Safety Assessment of the Canadian Nuclear Fuel Waste Management Concept (Pre-Closure Phase)

Proceedings of the Canadian Nuclear Fuel Waste Management Program 20th Information Meeting (1985 General Meeting) (TR-375), Winnipeg, Manitoba, Canada, October 1-2, 1985, Vol. 2; (pp. 418-420) (1986, January)

The objective of the Pre-Closure Environmental and Safety Assessment is to assess the environmental and socio-economic impacts due to construction, nuclear fuel waste transportation, operation and decommissioning of a nuclear fuel waste disposal facility located somewhere in the shield region of Ontario, covering the period up to the time of releasing the site for some alternative use. The author presents a summary overview of the objectives and scope of the Pre-Closure Environmental and Safety Assessment and of the scope of the ongoing interim assessment studies.

76

Gentile, G., and F. Nocera, Ente Nazionale per l'Energia Elettrica, Rome, Italy

Licensing and Decommissioning in Italy

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 102-108) (1986)

In Italy the licensing procedure starts when the National Electricity Board officially plans the erection of a nuclear facility in a certain region and this plan is approved by the Committee of Ministers for Economic Planning. Direct participation of the local population is to a certain extent permitted during the licensing procedure. In the field of decommissioning there does not exist a unitary legal regime so far.

77

George, A.F., Nuclear Installations Inspectorate, London, United Kingdom; Valtion Teknillinen Tutkimuskeskus, Espoo, Finland

Licensing of Spent Fuel Storage Facilities in the United Kingdom

VTT-SYMP-63; CONF-850992; Proceedings of an IAEA Technical Committee Meeting on Methods Used in the Design of Wet and Dry Spent Fuel Storage Facilities, E. Vitikainen and P. Silfverberg (eds.), Espoo, Finland, September 30, 1985; (pp. 195-211) (1985)

The legal framework for the licensing of spent fuel storage facilities in the United Kingdom is explained and the requirements necessary to obtain a license are stated. The application of license conditions once a license is issued is discussed together with the safety report submitted by licensees. Those spent fuel storage facilities currently proposed, operational, under construction or being decommissioned on license sites in the United Kingdom are summarized and possible future projects examined.

78

Glaize, G., Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Fontenay-aux-Roses, France

General Comparison of the Licensing and Decommissioning Procedures for Nuclear Installations

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh

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International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 237-257) (1986)

The licensing procedure in all legal systems assessed has the purpose to guarantee public safety. The procedures and conditions of application, however, are different in each country. The author examines especially details of the French and the American licensing procedures.

79

Hagen, E.W., General Electric Company, Shippingport, PA

Human Factors Planning for Nuclear Plant Decommissioning

CONF-8506100; Proceedings of the IEEE Third Conference on Human Factors and Power Plants, Monterey, CA, June 23-27, 1985, 382 pp.; (pp. 257-262) (1985)

A new opportunity is arising for the application of human factors principles in the nuclear industry to plant decommissioning. A description is given of the application of human factors in the planning for the Shippingport Station Decommissioning Project (SSDP). As a systematic basis to assure proper preparation for the SSDP, the Management Oversight and Risk Tree (MORT) techniques were utilized to form the basis for a readiness model. The core ingredients of readiness, i.e., property, people, and procedures, were utilized to develop a readiness tree. Other applications of human factors techniques on the SSDP have included a task analysis to establish the training program for operations personnel, a procedure validation program, and a computer-based configuration control system.

80

Harbecke, W., Kernkraftwerk Lingen GmbH, Darmer/Lingen, Federal Republic of Germany

Decommissioning of the Kernkraftwerk Lingen (KWL) Nuclear Power Station

Report (1985)

KWL nuclear power station is situated in lower Saxony at the River Ems, nearly 5 km south of Lingen. It was

designed as a boiling water reactor with a thermal output of 520 MW. The primary steam heats up two steam converters that produce secondary, non-contaminated steam. This secondary steam is lead to the turbine via a fossil fired superheater at a temperature of 530 degrees C. This report discusses the decommissioning of KWL and includes sections on the reactor's history, decommissioning preparation and schedule, and several illustrations. (Auth)(CAC)

81

Harmon, D.F., U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

Residual Radioactive Contamination Limits for Decommissioning

Federal Register 51(76):14910-14911 (1986, April 21)

This unpublished rule is being withdrawn pending initiation of a new proposed rulemaking to establish residual radioactive contamination limits for structures and lands. The proposed rule would have established residual radioactive contamination limits that must be met before buildings, structures, equipment, materials, and lands may be released for use on an unrestricted basis. This rule has been reissued as a proposed rule. An abstract of the rule was printed in the Federal Register 51(207):39266, October 27, 1986. (Auth)(SET)

82

Hibbs, M.

Decommissioning of All German Reactors Underway by 1997, SPD Says

Nucleonics Week 27(33):8-9 (1986, August 14)

The German Social Democratic Party (SPD) announced that it would abandon nuclear power if it succeeded in toppling the conservative coalition government of Chancellor Helmut Kohl. Decommissioning of German commercial reactors will begin in 1987 or 1988. The loss of power from nuclear plants, now supplying 36% of Germany's electric supply, would increase short-term consumption of coal, gas, and imported nuclear power from France. In the long-term, loss of nuclear power

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would be compensated through solar power and more intensive conservation measures. The five German reactors presently under construction (Muelheim-Kaerlich, Brokdorf, Emaland, Isar-2, and Neckarwestheim) would not be finished or turned over to their commercial operators under the SPD plan. The cost of abandoning nuclear energy in Germany will be about DM 10 (U.S. \$0.45) per household per month, and DM 20 for households heating with electricity. Further details of the plan will be forthcoming at the SPD national party congress to be held in Nuremberg during the last week of September 1986. (SET)

83

Hollmann, H., Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

License for Decommissioning - Requirements and Regulations

Energiewirtschaftliche Tagesfragen 36(7):589-593 (1986, July)

Due to the fact that an increasing number of reactors of older design are approaching the end of their serviceable life and have to be decommissioned, the post-operational phase with the special technical and legal aspects involved is to be given more attention. Reconciling the licensing requirements with the technical ones is a difficult task in this phase, as the standards developed meanwhile for the construction and operational phase cannot be applied. The author outlines some solutions of the problems emanating from the different needs of operating or decommissioning licenses, and tries to define requirements for an appropriate, legal definition of the state of a nuclear installation subsequent to final shut-down.

84

Hubert, E.H., C. Andersson, J. Deprimoz, J.C. Mayoux, and M. Richard, International Nuclear Law Association, Brussels, Belgium

Decommissioning of Nuclear Installations - Regulations - Financing - Responsibility - Insurance

INIS-mf-9563; CONF-8309278; Nuclear International Jura '83, Proceedings of the International

Conference on Nuclear Laws, San Francisco, CA, September 11-15, 1983; (50 pp.) (1983)

This paper highlights three aspects of decommissioning of nuclear installations which relate, more or less directly, to legal options already applied or advocated. It reviews the regulatory conditions for decommissioning a nuclear installation and indicates legal provisions for financing decommissioning expenditures. It also describes the legal provisions to determine liabilities in case of nuclear damage and the assistance which insurers may provide to cover the consequences of such liabilities. (Auth)

85

Hudson, C.R., Oak Ridge National Laboratory, Engineering Technology Division, Oak Ridge, TN

Cost Estimate Guidelines for Advanced Nuclear Power Technologies

ORNL/TM-10071; 101 pp. (1986, July)

To make comparative assessments of competing technologies, consistent ground rules must be applied when developing cost estimates. This document provides a uniform set of assumptions, ground rules, and requirements that can be used in developing cost estimates for advanced nuclear power technologies.

86

International Atomic Energy Agency, Vienna, Austria

Methodology and Technology of Decommissioning Nuclear Facilities: Report of a Technical Committee

CONF-8504299; Methodology and Technology of Decommissioning Nuclear Facilities, Report of a Technical Committee Meeting, Vienna, Austria, April 22-26, 1985. International Atomic Energy Agency, Vienna, Austria, 107 pp.; IAEA Technical Report Series No. 267; 107 pp. (1986)

The decommissioning and decontamination of nuclear facilities is a topic of great interest to many Member States of the International Atomic Energy Agency

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(IAEA) because of the large number of older nuclear facilities which are or soon will be retired from service. In response to increased international interest in decommissioning and to the needs of Member States, the IAEA's activities in this area have increased during the past few years and will be enhanced considerably in the future. A long range program using an integrated systems approach covering all the technical, regulatory and safety steps associated with the decommissioning of nuclear facilities is being developed. The database resulting from this work is required so that Member States can decommission their nuclear facilities in a safe, timely, and cost effective manner and the IAEA can effectively respond to requests for assistance. The report is a review of the current state of the art of the methodology and technology of decommissioning nuclear facilities, including remote systems technology. This is the first report in the IAEA's expanded program and was of benefit in outlining future activities. Certain aspects of the work reviewed in this report, such as the recycling of radioactive materials from decommissioning, will be examined in depth in future reports. The information presented should be useful to those responsible for, or interested in, planning or implementing the decommissioning of nuclear facilities.

87

International Atomic Energy Agency, Vienna, Austria

Ordinance of 5 December 1983 Concerning Funds for the Decommissioning of Nuclear Installations

INIS-nf-9664; 6 pp. (1983, December)

This Ordinance (RS 732.013) which entered into force on 1 January 1984 establishes a fund for the financing of decommissioning activities which was provided for by the Federal Order of 1978 concerning the Atomic Energy Act. This fund is destined to finance these operations. Nuclear operators are obliged to make annual contributions which are calculated to cover the costs which each one of them expects to encounter at the time of decommissioning. (Auth)

88

Iwamoto, K., Agency of Natural Resources and Energy, Tokyo, Japan

Law Regulations on Decommissioning of Reactors

Denki Kyokai Zasshi 740:28-33 (1985, June)

Concerning the decommissioning of reactors, the major provisions are discussed in the Electricity Enterprises Act and The Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors. Tokai Unit 1 in Tokai Power Station, Japan's first nuclear power plant, will be subject to the Law regulations on reactor decommissioning about ten years hence. JPDR (Japan Power Demonstration Reactor) is being dismantled in the near future. According to the Act the electricity enterprise must obtain the permission thereon from the Ministry for International Trade and Industry. According to the Law, the reactor owner must report thereon in advance to the competent Minister and the competent Minister may give orders concerning the necessary measures etc.

89

Keene, W., Catholic University, Washington, DC

Decommissioning an AGN-201

Nuclear News 29(14):26 (1986, November)

Catholic University is in the process of decommissioning its AGN-201 research and test reactor. It bears Serial No. 101, and the University believes that it was the first of its kind to be built. Before arriving at the University, it was on a world tour as part of President Eisenhower's Atoms for Peace Program. The reactor has now come to the end of its useful life, and the University has a small stockpile of vacuum tubes for the reactor's control system. Some of these vacuum tubes have become difficult to find, and the University is willing to respond to requests for a specific tube. Call Warren Keene, Reactor Administrator, Catholic University, Washington, DC, Phone: 20/635-5206. There seems to be a delay in the decommissioning of this and other AGN-201 reactors located at other universities. The delay is caused by the U.S. Department of Energy's slow response in providing shipping containers for returning the reactor fuel. (CAC)(DCM)

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Kerever, A.

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Control of the Legality of the Construction of Nuclear Installations in France

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 20, 1985, 645 pp.; (pp. 222-236) (1986)

Rules and regulations for the construction and decommissioning of nuclear installations are assessed in the light of decisions of the 'Conseil d'Etat'. Of special interest are the questions of procedure and of substantive law. The author criticizes the great extent of regulatory power, especially after the decree of December 11, 1963.

91

Kernkraftwerk Lingen GmbH, Darmer/Lingen, Federal Republic of Germany

Lingen Nuclear Power Station - Technical Report for Period July-December 1985

INIS-mf-10217; 15 pp. (1986)

The competent authority in the Federal Republic of Germany issued a license for decommissioning the KWL on November 23, 1985. This license was publicly announced on December 19, 1985 and was made available for public inspection for a period of two weeks beginning on December 20, 1985, in the Ministry of Federal Affairs in Hanover, and in the Lingen building surveyor's office. Upon termination of the period of public inspection, the license is considered to have been delivered to third parties, and at this date a one-month period for filing protest begins and ends on February 3, 1986. The license permits the decommissioning of the nuclear power plant, activities for preparing and maintaining the confinement of the plant, modified utilization of individual components, and dismantling of individual components. Further, instructions are given concerning stack release of radioactivity and the discharge of waste from the controlled area.

92

Kovach, W.D., Houston Lighting and Power Company, Houston, TX

Utility Perspectives on Decommissioning - The Accounting Involvement

Transactions of the American Nuclear Society 53:74; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (p. 74) (1986)

The purpose of this paper is to discuss the approach taken by Houston Lighting and Power Company in determining a decommissioning plan and its continuing efforts toward funding of this plan for the South Texas Project. This approach is broadened to an overall utility viewpoint.

93

LaGuardia, T.S., TLG Engineering, Inc., Brookfield, CT

Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates

CONF-860422; Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986; (pp. 964-967) (1986, April)

The guidelines are not intended to be a "cookbook" or a "standard." Their purpose is to ensure all decommissioning cost elements are properly included and to provide guidance on the detail required. Other methodologies may be used if they accomplish this objective.

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LaGuardia, T.S., TLG Engineering, Inc., Brookfield, CT

Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates

Transactions of the American Nuclear Society 52:31-32; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 31-32) (1986)

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Decommissioning cost estimates have been made for specific commercial nuclear power plants and for reference plants, utilities, the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Energy, consultants, and others. The different technical, site-specific, and economic assumptions used have made it difficult to interpret these cost estimates during the process of developing rates and rate structures for the recovery of decommissioning expenses. The estimates made to date have not anticipated the problems in identifying the plant-specific differences that form the bases for the variations in cost estimates.

95

Lange, K.

Legal Aspects of a 'Backing-Out of Nuclear Energy'

Neue Juristische Wochenschrift 39(40):2459-2465 (1986, October 1)

The author investigates the question, whether a backing out of nuclear energy, i.e. the prevention of the erection and commissioning of new nuclear power plants as well as the decommissioning of operating atomic power plants, is legally feasible. This depends on special provisions of the Atomic Energy Act (sec. 7 para. II, sec. 17 para. III) which have precedence over more general provisions.

96

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

Decommissioning Windscale Advanced Gas-Cooled Reactor

Proceedings of the Institution of Mechanical Engineers 199(A2):129-134 (1985)

This paper describes the UKAEA project to decommission the Windscale advanced gas-cooled reactor. The plan is to take down the reactor itself, the heat exchangers and the sphere in which they are all contained. A special remote-handling machine is being developed which will cut up the radioactive items, and a facility is being built to package the waste for storage and disposal. (Auth)

97

Lazo, R.M.

Pacific Gas and Electric Company, Humboldt Bay Power Plant, Unit No. 3 - Prehearing Conference

Federal Register 51(170):31384; DOCKET 50-133-OLA; ASLBP No. 86-536-07 LA (Decommissioning) (1986, September 3)

The Pacific Gas and Electric Company holds a license to possess but not to operate the Humboldt Bay Power Plant, Unit No. 3, a 65-MW(e) boiling water reactor located in Eureka, California. The U.S. Nuclear Regulatory Commission (NRC) has published in the Federal Register a notice of consideration of the issuance of an amendment to the facility license and an offer for hearing on the amendment. The amendment is related to decommissioning the facility and specifically would: (1) delete license conditions related to seismic investigation, analysis and modification; (2) approve the Licensee's decommissioning plan for 30 years of onsite storage of residual radioactivity (SAFSTOR); (3) revise the technical specifications to reflect the permanent shutdown and 'possess-but-not-operate' status of the facility and to reflect the SAFSTOR status; and (4) extend Licensee's license for an additional 15 years from November 9, 2000 to November 9, 2015 to be consistent with the 30 years safe storage plan. Pursuant to the NRC notice, interested parties filed a joint request for hearing and petition for leave to intervene. This article announced the special prehearing conference that would discuss the amendment and proceeding. (DCM)

98

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

Decommissioning Regulations

Transactions of the American Nuclear Society 52:31; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (p. 31) (1986)

Nuclear facilities fall under the regulatory authority of the U.S. Nuclear Regulatory Commission (NRC) or the U.S. Department of Energy (DOE) depending on whether or not the facility is licensed by the NRC or

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owned by DOE and not licensed by the NRC. Examples of the former include all commercial power reactors, commercial low-level radioactive waste burial grounds, high-level waste repositories (none yet in existence), and monitored retrievable storage facilities (also none yet in existence). Examples of the latter include the Shippingport Atomic Power Station and all unlicensed DOE facilities such as reactors, separations plants, and low-level waste burial grounds. The owners of both kinds of facilities must meet the applicable standards of the U.S. Environmental Protection Agency (EPA). Decommissioning of NRC-licensed facilities will be administered by the NRC under proposed regulations published in the February 11, 1985, issue of the Federal Register (50FR5600). Decommissioning of DOE-owned facilities that are not licensed by NRC is administered by DOE under DOE orders. NRC decommissioning regulations will require the facility owner to demonstrate at the time the facility is licensed that the owner will have the necessary funds to decommission the facility, either at the end of its useful lifetime or at any earlier time.

99

Nocera, F., and C. Sartorelli, International Nuclear Law Association, Brussels, Belgium

Nuclear Operator's Liability During and Following Decommissioning of Nuclear Facilities

INIS-mf-9564; CONF-8306278; Nuclear International Jura '83, Proceedings of the International Conference on Nuclear Laws, San Francisco, CA, September 11-15, 1983; (9 pp.) (1983)

This paper examines the main problems connected with the decommissioning of nuclear installations and, in particular, the related liabilities incurred by the operators. It is essentially based on the case of the decommissioning of the Italian nuclear power plant at Garigliano, but also considers the regulatory aspects of more general interest to many countries. (Auth)

100

Organization for Economic Cooperation and Development, Nuclear Energy Agency, Paris, France

Decommissioning of Nuclear Facilities: Feasibility, Needs and Costs - Report by an Expert Group

Report; 84 pp. (1986)

This study focuses on the technical feasibility, needs, and costs of decommissioning the larger commercial nuclear facilities in the Organization for Economic Cooperation and Development (OECD) member countries that are coming into service up to the year 2000. It is intended to inform the public and to assist in planning for the decommissioning of these facilities. In this report, reactor decommissioning activities generally are considered to begin after operations have ceased and the fuel has been removed from the reactor, although in some countries the activities may be started while the fuel is still at the reactor site. Defueling of gas-cooled reactors is a particularly lengthy process and may be done in parallel with initial decommissioning operations. However, the management of the spent fuel discharged at the end of operations is no different from the management of fuel discharged during the reactor operating lifetime, and its costs are a part of the total spent fuel management costs of that reactor. Therefore, this report does not deal with spent fuel management or its costs. The three principal alternatives for decommissioning are described in Section 2. The factors to be considered in selecting the decommissioning strategy are reviewed in Section 3. Section 4 contains a discussion of the feasibility of decommissioning techniques available for use on the larger reactors and fuel cycle facilities. The numbers and types of facilities to be decommissioned and the projections of resultant waste volumes generated for disposal are given in Section 5. Finally, the costs of decommissioning these facilities, the effect of these costs on electricity generating costs, and alternative methods of financing decommissioning are discussed in Section 6. (Auth)(DCM)

101

Osteen, D.E.

Special Rules Relating to Nuclear Decommissioning Costs - Public Hearing on Proposed Regulations (26 CFR Parts 1 and 602)

Federal Register 51(180):32929; LR-18-85 (1986, September 17)

This document provided notice of a public hearing on proposed regulations with respect to special rules relating to nuclear decommissioning costs. The subject of the public hearing was proposed regulations under sections

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88 and 468A of the Internal Revenue Code of 1954. Instructions for submitting requests to speak and outlines of oral comments were included in the article. (Auth)(DCM)

102

Pelzer, N.

Licensing and Decommissioning of Nuclear Installations: Report of Working Group 1

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 49-76) (1986)

Working Group 1 (Licensing and Decommissioning of Nuclear Installations) investigated the question, "Should it be recommended to work out international principles and rules on the licensing and decommissioning of nuclear installations and to make them subject to international instruments?" It was found that the legal systems in the countries examined are still too disparate to allow for a recommendation aiming at harmonizing the provisions for licensing. With respect to decommissioning, the WG considers the IAEA three-stage-plan to be a valuable first step towards standardization.

103

Plotkin, S., Federation of Scientists, Los Angeles, CA

Decommissioning Nuclear Power Plants

Bulletin of the Atomic Scientists 41(10):56-57 (1985, November)

This article centers on two errors found in David Rose's article, "Nuclear Power" ("Bulletin", August 1985). The first error concerns the cost of decontaminating plants contaminated with Nickel-59 and Niobium-94. Plotkin, author of this article, states that the cost of decommissioning and dispersal of the low-level waste from the plant is likely to cost between 100 and 130 percent of the original capital investment. Rose responded to Plotkin's

charge by stating that the most reliable present estimate of cost of decommissioning is 10-15 percent of the construction cost. The second error deals with the disposal of high-level waste. Plotkin feels that a method of disposal should be tested for one prototype life cycle to ascertain that no serious design errors exist. With the half-life of some elements lasting thousands of years, testing of disposal methods is not feasible. Rose feels that modern serious studies of the disposal problem indicates that satisfactory isolation is technologically feasible. (SET)

104

Plumb, K.F., Federal Energy Regulatory Commission, Washington, DC

Pennsylvania Power & Light Company et al. - Electric Rate and Corporate Regulation Filings: (2) Boston Edison Company

Federal Register 51(170):31361-31362; DOCKET EL86-51-000 (1986, September 3)

A complaint was filed by Boston Edison Company with the Federal Energy Regulatory Commission on August 14, 1986. The complaint alleged that certain purchasers of power from Boston Edison's Pilgrim Unit No. 1 had violated their contracts and their filed rates by refusing to make decommissioning payments to the company. Boston Edison asked the Commission to order the customers to pay their accrued decommissioning liability since June 15, 1983 and thereafter to make decommissioning payments to the Company on a monthly basis. (Auth)(CAC)(DCM)

105

Restrick, J.K.

U.S. Decommissioning Requirements and Recommendations on International Principles and Rules on Decommissioning

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 132-137) (1986)

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

U.S. requirements for decommissioning nuclear power plants have been under development for the past seven years. During the year 1985, policies and requirements for the following areas will be developed: methods of decommissioning, timing, planning, and financial security. Due to the common nature of the problems with decommissioning, international exchange of information is highly desirable.

106

Rowden, M.A., and S.E. Fowler, International Nuclear Law Association, Brussels, Belgium

Technical and Legal Aspects of the Decommissioning of Nuclear Installations

INIS-mf-9562; CONF-8309278; Nuclear International Jura '83, Proceedings of the International Conference on Nuclear Laws, San Francisco, CA, September 11-15, 1983; (32 pp.) (1983)

Many of the plants licensed at the start of nuclear power programs will require decommissioning in the 1990's and this issue should now be confronted by the nuclear industry, its regulators and governments. This paper deals with the United States program and experience in the decommissioning of nuclear installations and describes alternative decommissioning methods including safety and financial aspects. (Auth)

107

Schroeder, F.

University of California at Santa Barbara: The University of California at Santa Barbara L-77 Research Reactor - Order Authorizing Dismantling of Facility and Disposition of Component Parts

Federal Register 51(173):31991; DOCKET 50-433 (1986, September 8)

An application was submitted to the U.S. Nuclear Regulatory Commission (NRC) by the University of California at Santa Barbara, requesting authorization to dismantle the L-77 reactor, and to dispose of the component parts in accordance with the plan submitted as part of the application. The L-77 is a research reactor located

in Santa Barbara, Santa Barbara County, California. The NRC reviewed the application and found that the dismantling and disposal of component parts as described in the licensee's plan will be in accordance with regulations, and will not be inimical to the common defense and security or to the health and safety of the public. Based on an Environmental Assessment prepared by the NRC, the Commission has determined that the proposed action will not result in any significant environmental impact and that an Environmental Impact Statement need not be prepared. Accordingly, the licensee was authorized to dismantle the L-77 reactor facility and dispose of the component parts in accordance with its dismantling plan and the Commission's rules and regulations. After completion of the dismantling and disposal, and following an inspection by the NRC to verify compliance with the plan and NRC regulations, consideration will be given to issuance of a further order terminating the facility license. (DCM)

108

Shetler, A.P., and N. Jayawardene, Ontario Hydro, Toronto, Ontario, Canada

The Effect of Proposed Changes to the IAEA Transport Regulations on Decommissioning and Other Low Level Waste Transportation

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 341-348) (1986)

Ontario Hydro has studied the proposed changes to the IAEA Transport Regulations contained in the 1985 4th draft edition. The study shows that these proposed changes will have significant strategic and economic effects on the transportation of radioactive decommissioning and other low-level wastes. Under the 1985 4th draft edition, the definition of Low Specific Activity (LSA) material is revised and a new regulation is proposed which restricts the quantity of LSA material or Surface Contaminated Objects (SCO) in a single package to that which would have an unshielded dose rate of 10 mSv/h (1 rem/h) at 3 m. The objective of this paper is to highlight the implications of the proposed regulatory changes. An example of the impact of these changes is presented by considering the transportation of typical CANDU decommissioning wastes which arise through

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piece-by-piece removal of a reactor assembly. The potential effect of the changes is that less decommissioning waste can be shipped in a single low-level waste package. This results in the requirement for so many small, low-level waste packages that Type B shipments are strategically and economically more attractive. However, use of Type B shipments would also result in higher dose uptake and waste management costs than under the 1973 Regulations.

109

Shimoyama, S.

Licensing and Decommissioning of Nuclear Installations in Japan

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 138-174) (1986)

The present report discusses the current status of Japan's licensing system and legislation concerning reactor decommissioning operations. Besides Japan is working to promote worldwide nuclear safety research. However, developing nuclear safety regulations that are uniformly applicable is a difficult job due to big differences in geographical, political, economical, and technological conditions.

110

Stepanova, V.D., and Y.A. Egorov

Problem of Nuclear Power Plant Decommissioning and Radiation Safety

Radiation Safety and Shielding of NPP: Issue 9 - Collection of Articles. Energoatomizdat, Moscow, USSR; (pp. 38-44) (1985)

Problems dealing with nuclear power plant decommissioning are presented. A plan for procedures for NPP decommissioning, cost of the decommissioning, and radiation doses to the population during the disposal of liquid radioactive effluents into water cooling ponds are discussed.

111

Steyer, K.G., U.S. Nuclear Regulatory Commission, Washington, DC

NRC Standards Preparation and Research Related to Decommissioning

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (8 pp.) (1985)

In the United States, several small demonstration reactors and small power and test reactors in the range of 6 to 250 megawatts thermal have been decommissioned. The 60 thermal megawatt Elk River Reactor was dismantled and the rest are presently in various stages of safe storage or entombment. The 72 MW(e) Shippingport, 65 MW(e) Humboldt Bay, and 285 MW(e) Indian Point I reactors are being decommissioned and other reactors will be eventually. Specific requirements for decommissioning reactors up to this time have been determined on a case-by-case basis. This paper discusses the NRC standards preparation and research related to decommissioning activities. Included are sections describing the status and details of the proposed regulations, related regulatory guides, research used for the evaluation of licensee plans, ongoing NRC decommissioning research program, and future research. (Auth) (CAC)

112

Steyer, K.G., and C. Mattsen, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

General Requirements for Decommissioning Nuclear Facilities

Federal Register 51(207):39276 (1986, October 27)

The advance notice of proposed rulemaking sought comment on a proposal to develop a more explicit policy for decommissioning nuclear facilities. The proposal would provide more specific guidance on decommissioning nuclear facilities. The proposal would provide more specific guidance on decommissioning criteria for production and utilization facility licensees and byproduct, source, and special nuclear material licensees. This action is intended to protect public health and safety and

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to provide the applicant or licensees with appropriate regulatory guidance for implementing and accomplishing nuclear facility decommissioning. Although it is planned to provide additional guidance through regulatory guides, it is necessary to amend the regulations in order to achieve appropriate assurances that funds for decommissioning will be available. The major cost impact of the proposed rule would involve proper planning at all stages of nuclear facility operation. Proper planning includes providing for (1) financial assurance that funding will be available for decommissioning; (2) maintenance of records that could affect decommissioning; and (3) careful planning of procedures at the time of decommissioning. For nonreactor facilities affected by financial assurance requirements, it is estimated that the major impact will result in an aggregate expenditure of 21 staff-years (\$1.6 million) spread over 5 years (or \$320,000 per year). (Auth)

113

Steyer, K.G., and C. Mattsen, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

Decommissioning Criteria for Nuclear Facilities

Federal Register 51(76):14899-14900 (1986, April 21)

The advance notice of proposed rulemaking sought comment on a proposal to develop a more explicit policy for decommissioning nuclear facilities. The proposal would provide more specific guidance on decommissioning criteria for production and utilization facility licensees and byproduct, source, and special nuclear material licensees. This action is intended to protect public health and safety and to provide the applicant or licensees with appropriate regulatory guidance for implementing and accomplishing nuclear facility decommissioning. Although it is planned to provide additional guidance through regulatory guides, it is necessary to amend the regulations in order to achieve appropriate assurances that funds for decommissioning will be available. The major cost impact of the proposed rule would involve proper planning at all stages of nuclear facility operation. Proper planning includes providing for (1) financial assurance that funding will be available for decommissioning, (2) maintenance of records that could affect decommissioning, and (3) careful planning of procedures at the time of decommissioning. For nonreactor facilities

affected by financial assurance requirements, it is estimated that the major impact will result in an aggregate expenditure of 21 staff-years (\$1.6 million) spread over 5 years (or \$320,000 per year). (Auth)

114

Suetsuna, I.

Japan Decides How To Decommission Its Reactors

Nuclear Engineering International 31(378):22-23 (1986, January)

Dismantling after five to ten years of mothballing will be Japan's standard decommissioning procedure. This method was preferable to immediate dismantling or entombment because the mothballing period markedly reduces the dose level. The waste volume arising from decommissioning is large. After the mothballing period, a large percent of the decommissioning wastes, usually concrete, can be reused for aggregates or landfills. The point was also raised that technological development is urgently required to decrease dose rates during decommissioning, to conduct decommissioning work efficiently, and to reduce the volume of waste generated. (SET)

115

Surmeier, J., U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Financial Responsibility Standards for Long Term Care for Low Level Waste Disposal Sites

Federal Register 51(207):39280 (1986, October 27)

The proposed rule is designed to provide standards to ensure that each licensee responsible for the disposal of low-level radioactive waste possesses an adequate bond, surety, or other financial arrangement to insure completion of all requirements established by the Commission for decontamination, decommissioning, and site closure. Section 151 of the Nuclear Waste Policy Act authorizes the NRC to develop standards or financial arrangements for low-level radioactive waste site closure. Comments on the NPRM will define the nature and scope of the action. (Auth)

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116

Taisei Construction Company Limited, Tokyo, Japan

Method of Decommissioning Nuclear Reactors

Japanese Patent 61-10,800/A; Japanese Patent Application 59-130680; 4 pp. (1986, January 18)

A plan to decommission and isolate an entire nuclear reactor and its containment without dismantlement is presented. After isolating the reactor and its containment structure from other structures, shafts passing through the base of the facility and extending to the bedrock are constructed. Then, a tunnel is formed by excavating and removing soils from the circumferential edge and the inside below the base of the facility by utilizing the shafts, and blades larger than the outer contour of the base are protruded downwardly below the base of that portion. Thus, the whole area below the base is excavated allowing the facility to sink by its own weight. The space within the facility is used to dispose of wastes. Then, grouting materials such as concrete are used to fill the spaces outside and inside the facility so as to completely seal the nuclear reactor. The soils that were originally excavated from beneath the facility are then used to cover it.

117

Thexton, H.E., Organization for Economic Cooperation and Development, Nuclear Energy Agency, Nuclear Development Division, Paris, France

The Cost and Financing of the Decommissioning of Nuclear Power Plants

Scientific Afternoon, Proceedings of an International Atomic Energy Agency General Conference - Thirtieth Regular Session, Vienna, Austria, September 1986, Preprint; (11 pp.) (1986, September)

Although no large power reactor has yet been fully decommissioned, costs can be estimated on the basis of extensive relevant experience. Independent estimates made by several OECD countries are shown to be reasonably uniform, giving confidence that they are accurate enough for current financial planning purposes. A surcharge on nuclear electricity generating costs of about 2 percent or less, collected during a 25-year reactor operating lifetime, will generally be sufficient to pay for reactor decommissioning. (Auth)

118

Traube, K., and S. Kornbichler, AEG-Telefunken, Federal Republic of Germany

Design Features of Kernkraftwerk Lingen (KWL)

Nuclear Engineering International 13(150):930-933 (1968)

The experience gained from the design of the Kahl and Gundremmingen nuclear power stations provided a basis for the design of the Lingen BWR. This article reports on this experience and discusses a number of new developments by AEG-Telefunken used for the first time in this reactor. Details of how the design performed during start-up are also described. (Auth)(CAC)

119

U.S. Atomic Energy Commission, Directorate of Regulatory Standards, Washington, DC

Termination of Operating Licenses for Nuclear Reactors

U.S. Atomic Energy Commission Regulatory Guide 1.86 (1974, June)

This guide describes methods and procedures, considered acceptable by the U.S. Department of Energy's Regulatory staff, for the termination of operating licenses for nuclear reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position. Section 50.51, "Duration of license, renewal," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that each license to operate a nuclear production and utilization facility be issued for a specified duration. Upon expiration of the specified period, the license may be either renewed or terminated by the Commission. Section 50.82, "Applications for termination of licenses," specifies the requirements that must be satisfied to terminate an operating license, including the requirement that the dismantlement of the facility and disposal of the component parts not be inimical to the common defense and security or to the health and safety of the public. When a licensee decides to terminate his nuclear reactor operating license, he may request that his operating license be amended to restrict him to possess but not operate the facility. A possession-only license permits

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various options and procedures for decommissioning, such as mothballing, entombment, or dismantling. The requirements imposed depend on the option selected. (CAC)(DCM)

120

von Busekist, O., European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium

Competences and Activities of International Organizations

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 192-208) (1986)

The International Atomic Energy Agency, the Organization for Economic Cooperation and Development, Nuclear Energy Agency, and Euratom have initiated a considerable degree of technological and scientific harmonization. However, they have so far not used their broad statutory power to develop international legal instruments for the licensing and decommissioning of nuclear installations. The experience of the international organizations shows that careful preparation will be necessary to achieve a reasonable level of uniformity in these matters.

121

Wagner, H., and W. Boucsein, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Shut-down of Nuclear Facilities: International Comparison of Legislation

Energiewirtschaftliche Tagesfragen 36(4):342-347 (1986, April)

The number of nuclear facilities (especially nuclear reactors) to be shut down is expected to grow considerably in the foreseeable future. This draws the attention to the issue of legislation concerning shut-down and dismantling measures.

In the Federal Republic, the Atomic Energy Law prescribes a governmental approval for the shut-down of a nuclear facility as coming under similar conditions as those for licensing the construction and operation of such a facility. A comparison of the legal provisions on an international scale and those of major Western industrialized countries reveals the current state of international discussion and the practicability of the German provisions.

122

Wijlhuizen, H., Keuring van Electrotechnische Materialen, N.V., Arnhem, Netherlands

Quality-Assured Nuclear Power Stations

Elektrotechniek (Meppel, Netherlands) 64(3):207-210 (1986, March)

The Dutch electricity supply is characterized by a high degree of safety and reliability. To maintain or even improve the standards during design, construction, operation and decommissioning of new nuclear power plants specific measures must be taken. The concepts of these requirements are presented.

123

Wood, R.S., U.S. Nuclear Regulatory Commission, Office of State Programs, Washington, DC

Mandatory Property Insurance for Decommissionation of Nuclear Facilities

Federal Register 51(207):39277-39278 (1986, October 24)

The proposed rule would require nuclear power plant licensees to obtain an increased amount of onsite property damage insurance from the current minimum of \$585 million to \$1.02 billion. The NRC believes that such insurance should be required so that the financing and pacing of cleanup following an accident does not become a public health and safety problem. Recent studies indicate that as much as \$1.06 billion may be required to cover onsite cleanup of the worst reactor accidents if inflation and other factors are included. Other issues addressed in the proposed rule are (1) whether the Federal government can preempt State law that prohibits certain public utilities from buying insurance offered by

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either mutual companies or by insurance companies that require payment of a retrospective premium and (2) whether a priority of payment of insurance proceeds for decontamination and cleanup can be imposed. Action in these areas is required for the same reason as imposition of general insurance requirements, i.e., to remove the financial aspects of recovery after an accident from having an adverse impact on public health and safety. Alternatives that were considered included (1) requiring a lower dollar amount and (2) not explicitly requiring insurance above the currently required but rather allowing the necessity for additional insurance to be determined at the State level. The impact of the proposed rule on licensees would probably not be large. Most licensees currently purchase insurance in excess of \$1.02 billion. Approximately 10 licensees would be required to carry more insurance than they otherwise would for an annual incremental premium cost of roughly \$1 million per year. Thus the total impact of the rule would be approximately \$10 million per year. The impact on the public would generally be positive in that public health and safety would be better protected. The impact on the NRC would be minimal with respect to increasing the amount of insurance. A decontamination priority, if it were invoked, could require additional hearings with attendant costs. One-half of a staff-year is required by OSP to continue the rulemaking, with minimal impact on other offices expected. (Auth)

124

Yaziz Yunus, Unit Tenaga Nuklear, Bangi, Malaysia

Nuclear Power Plant Decommissioning - The Nature of Problems

Warta Nuklear Malaysia 2(1):14-15 (1986, April)

A number of issues have to be taken into account before the introduction of any nuclear power plant in any country. These issues include reactor safety (site and

operational), waste disposal and, lastly, the decommissioning of the reactor itself. Because of the radioactive nature of the components, nuclear power plants require a different approach to decommissioning compared to other plants. Until recently, issues on reactor safety and waste disposal were the main topics discussed. As for reactor decommissioning, the debates have been academic until now. Although reactors have operated for 25 years, decommissioning of retired reactors has simply not been fully planned. The Shippingport Atomic Power Plant in Pennsylvania, the first large-scale power reactor to be retired, is now being decommissioned, and the work has rekindled the debate. Outside the United States, decommissioning is also being confronted on a new plane.

125

Ziegler, E., Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Decommissioning and Disposal of Nuclear Facilities in the Federal Republic of Germany: Licensing Procedure and Proposals on the Harmonization of Rules and Regula- tions

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 175-181) (1986)

No special experience exists in the FRG in decommissioning nuclear power plants. The author proposes to consider a decommissioned facility no longer as a nuclear facility as defined in sec. 7 of the Atomic Energy Act, but as an area to be assessed only under aspects of radiation protection law.

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126

Berkow, H.N., U.S. Nuclear Regulatory Commission, Washington, DC

Pacific Gas and Electric Company: Draft Environmental Statement for Decommissioning of Humboldt Bay Power Plant Unit No. 3 - Extension of Comment Period

Federal Register 51(113):21427-21428; DOCKET 50-133 (1986, June 12)

On April 28, 1986, the NRC published a notice entitled "The Availability of the Draft Environmental Statement for Decommissioning of Humboldt Bay Power Plant, Unit No. 3." The comment period for this Draft Environmental Statement was to expire on June 16, 1986. Due to the need for a thorough review by the public and the importance of the decommissioning issue, the comment period has been extended for sixty (60) days. (Auth) (CAC)

127

Berkow, H.N., U.S. Nuclear Regulatory Commission, Washington, DC

Finding of No Significant Environmental Impact Regarding Proposed Order Authorizing Dismantling of the Reactor and Disposition of Component Parts: The University of California at Los Angeles

Federal Register 51(140):26319; DOCKET 50-142 (1986, July 22)

The Nuclear Regulatory Commission is considering issuance of an order authorizing the University of California at Los Angeles to dismantle the UCLA Argonaut Reactor Facility on its campus in Los Angeles, California and to dispose of the reactor components in accordance with the application dated October 19, 1985, as supplemented. The Order would authorize Phase I of the disposal of the components in accordance with the application for decontamination and dismantling, dated October 29, 1985. Opportunity for hearing was afforded by the Proposed Issuance of Orders Authorizing Disposition of Component Parts and Termination of Facility License published in the Federal Register on September 24, 1984. This article discusses and summarizes the finding of no environmental impacts associated with this particular dismantling and decontamination operation. (Auth) (CAC)

128

Berkow, H.N., U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, DC

Finding of No Significant Environmental Impact Regarding Proposed Order Authorizing Dismantling of the Reactor and Disposition of Component Parts: Virginia Polytechnic Institute and State University

Federal Register 51(213):40098; DOCKET 50-124 (1986, November 4)

The Nuclear Regulatory Commission (NRC) is considering issuance of an order authorizing the Virginia Polytechnic Institute and State University (VPI) to dismantle the Argonaut reactor facility in Blacksburg, Virginia and to dispose of the reactor components in accordance with VPI's application dated July 17, 1986. The order would authorize the dismantling of the facility and disposal of the components in accordance with the application for decontamination and dismantling. NRC has prepared an Environmental Assessment (EA) of this action, dated October 29, 1986. As a result of the findings of the assessment, the NRC has determined not to prepare an Environmental Impact Statement for the proposed action. The dismantling and decommissioning operations are calculated to result in a total radiation exposure of less than 2 person-rem to facility staff and the public. The EA concluded that the operation will not result in any significant environmental impacts on air, water, land or biota in the area. (Auth)(CAC)(DCM)

129

Fowler, T.W., S.T. Windham, R.S. Callis, and C.R. Phillips, U.S. Environmental Protection Agency, Eastern Environmental Radiation Laboratory, Montgomery, AL

Radiological Survey of Ingalls Shipbuilding Division, Pascagoula, Mississippi, and Environs

EPA-520/5-83-022; PB-84-149-384; 78 pp. (1983, September)

This report presents results of the survey conducted by the Environmental Protection Agency's Eastern Envi-

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ronmental Radiation Facility personnel to assess environmental radioactivity remaining from operations of nuclear-powered vessels at Ingalls Shipyard, Pascagoula, Mississippi. Since Ingalls Shipyard will no longer build or service nuclear powered ships and has completed the decommissioning of the nuclear support facilities, an additional purpose of the survey was to determine if there is any remaining radioactivity from previous operations which could contribute to significant population exposure.

130

Goodwin, B.W., and E.L.J. Rosinger, Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, Canada

Environmental and Safety Assessment

Proceedings of the Canadian Nuclear Fuel Waste Management Program 20th Information Meeting (1985 General Meeting) (TR-375), Winnipeg, Manitoba, Canada, October 1-2, 1985, Vol. 1; (pp. 21-29) (1986, January)

A major objective of the Nuclear Fuel Waste Management Program (NFWMP) is the preparation of an environmental and safety assessment of the Canadian concept for nuclear fuel waste disposal. The Assessment is to evaluate the potential environmental, social, and economic impacts on people and the environment of the transportation, storage, immobilization and disposal of nuclear fuel wastes. The assessment must cover two distinct phases: The pre-closure and post-closure phases. The pre-closure assessment deals with the period up to and including vault backfilling, sealing, and closure. The post-closure assessment deals with the period after the vault has been sealed, the surface facilities decommissioned and the surface environment restored. Since the overall NFWMP is in a generic research phase, the assessments of the disposal concept are also of a generic nature.

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Kreider, K.A., and J.J. McGarry, Bechtel Eastern Power Corporation, Middletown, PA

Operational Experiences with a Remote Core-Boring Device

Transactions of the American Nuclear Society 53:505-507; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 505-507) (1986)

The use of a teleoperator to obtain core-bore samples from the walls of the TMI-2 reactor building's 282-ft, 6-in. elevation is described. The teleoperator extracted core bores from a hostile environment with general area radiation levels of approximately 66 R/h, hot spots of 1130 R/h, and high levels of surface contamination. The remote core drilling device, developed by Carnegie-Mellon University under contract to GPU Nuclear Corporation, consisted initially of four core drills mounted on a vertical column that in turn was mounted on the remote reconnaissance vehicle (RRV). The RRV is an 1100-lb six-wheeled vehicle built mostly from commercially available components by Carnegie-Mellon. It is powered and controlled through a 20-ft ribbon tether and is highly maneuverable. A two-man crew operates the vehicle from a remote console, one drives and maneuvers and one manages the on-vehicle tether reel.

132

Lindeken, C.L., J.A. Loftis, and R.C. Ragaini, Lawrence Livermore National Laboratory, Livermore, CA

U.S. Department of Energy Comprehensive Environmental Response Compensation and Liability Act Program, DOE Order 5480.14: Lawrence Livermore National Laboratory Phase 1, Installation Assessment: Phase 1, Site 300

UCID-20720 (Pt. 1); 79 pp. (1986, October)

The purpose of this assessment is to document the identification and location of those inactive disposal sites at Lawrence Livermore National Laboratory's (LLNL) Site 300 that may pose an undue risk to health, safety, and the environment as a result of migration of hazardous substances from the disposal sites. The scope of this report is limited to the Phase I Assessment of five locations at LLNL's Site 300 in accordance with DOE Order 5480.14. This report includes the results of the investigation conducted through March 1986.

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Ministry of Industry, Stockholm, Sweden

After Chernobyl: Consequences for Energy Policy, Nuclear Safety, Radiation Protection and Environment Protection

After Chernobyl: Consequences for Energy Policy, Nuclear Safety, Radiation Protection and Environment Protection. Liber, Stockholm, Sweden; 850 pp. (1986)

Basic problems of the safety of nuclear power have been elucidated, and the cause of the Chernobyl accident and its effects are discussed. The impact of this accident on the evaluation of Swedish nuclear safety is dealt with, and recommendations concerning increased safety when nuclear power accidents take place in other countries are presented. The environmental and economic consequences of early decommissioning of the Barsebaeck power plant are discussed as well as the general aspects of nuclear power phaseout in Sweden.

134

Vocke, R.W., Los Alamos National Laboratory, Los Alamos, NM

Case Histories of Environmental Assessment Documents for Nuclear Waste

CONF-850314; Waste Management '85: Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Waste Policies and Programs, General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 24-28, 1985, 573 pp.; (pp. 39-44) (1985)

Nuclear power programs and policies in the United States have been subject to environmental assessment under the Nation Environmental Policy Act (NEPA) since 1971. NEPA documentation prepared for programmatic policy decision-making within the nuclear fuel cycle and concurrent federal policy are examined as they relate to radioactive waste management in this paper. Key programmatic environmental impact statements that address radioactive waste management include: the Atomic Energy Commission document on management of commercial high level and transuranium-

contaminated radioactive waste, which focused on development of engineered retrievable surface storage facilities (RSSF); the Nuclear Regulatory Commission (NRC) document on use of recycled plutonium in mixed oxide fuel in light water cooled reactors, which focused on plutonium recycle and RSSF; the NRC statement on handling of spent light water power reactor fuel, which focused on spent fuel storage; the NRC statements on uranium milling and decommissioning of nuclear facilities; the Environmental Protection Agency (EPA) statements on remedial action standards for inactive uranium processing sites and radiation protection requirements for normal operations of activities in the uranium fuel cycle; and the Department of Energy (DOE) statement on management of commercially generated radioactive wastes, which focused on development of deep geologic repositories. DOE is currently pursuing the deep geologic repository option, with monitored retrievable storage as a secondary option. (Auth)(DCM)

135

Washburn and Gillis Associates Limited, Fredericton, New Brunswick, Canada; SENES Consultants Limited, Willowdale, Ontario, Canada; DPA Consulting Limited, Toronto, Ontario, Canada; Maritime Nuclear Limited, Fredericton, New Brunswick, Canada

Lepreau 2 Environmental Impact Statement

INIS-mf-10489; 461 pp. (1984, May)

Maritime Nuclear, a joint undertaking of Atomic Energy of Canada Limited and the New Brunswick Electric Power Commission, proposes to construct a second CANDU 600 MW nuclear-powered generating unit at the site of the existing Point Lepreau Generating Station, in New Brunswick. A feasibility study is now underway and guidelines issued by the Lepreau 2 Environmental Assessment Panel identified six priority issues and concerns. These are: impacts on the biological environment, impacts of radiation on humans, impacts on the socioeconomic environment, monitoring, emergency planning, and decommissioning. These factors as well as a description of the proposed facility are described in this report.

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Washburn and Gillis Associates Limited, Frederic-

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

ton, New Brunswick, Canada; SENES Consultants Limited, Willowdale, Ontario, Canada; DPA Consulting Limited, Toronto, Ontario, Canada; Maritime Nuclear Limited, Fredericton, New Brunswick, Canada

Lepreau 2 Environmental Impact Statement: Summary

INIS-mf-10491; 30 pp. (1984, May)

Maritime Nuclear, a joint undertaking of Atomic Energy of Canada Limited and the New Brunswick Electric Power Commission, proposes to construct a second CANDU 600 MW nuclear-powered generating unit at the site of the existing Point Lepreau Generating Station, in New Brunswick. A feasibility study is now underway and guidelines issued by the Lepreau 2 Environmental Assessment Panel identified six priority issues and concerns. These are: impacts on the biological environment, impacts of radiation on humans, impacts on the socio-economic environment, monitoring, emergency planning, and decommissioning. These factors as well as a description of the proposed facility are described in this report.

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West, L., and M.A. Talebizadeh, University of Arkansas, Fayetteville, AR

Gamma Analysis of Soil at SEFOR, a Decommissioned Reactor

Transactions of the American Nuclear Society 53:165-166; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 165-166) (1986)

This is a work-in-progress report of a project to assay the soil for possible fission product contamination at the SEFOR site. SEFOR, the former Southwest Experimental Fast Oxide Reactor, was a cooperative program among a consortium of utilities, General Electric, the U.S. Atomic Energy Commission, and others. The 20-MV(th) sodium-cooled test reactor operated between 1969 and 1972. After cessation of the experimental program, the facility was decommissioned into a mothball status. This work is a result of an effort to examine the site for possible contamination which might have

resulted from either operating or decommissioning activities, such as flushing sodium barrels. Soil has been collected in over 25 locations in and around the SEFOR site. Although samples from the entire site have not been analyzed, the investigated areas are free of contamination.

138

Yalcintas, M.G., Oak Ridge National Laboratory, Oak Ridge, TN

Shielding Calculations at Dismantled Synchrocyclotron

CONF-870405; Proceedings of a Radiation Protection and Shielding Conference, Knoxville, TN, April 22-24, 1987; (3 pp.) (1987)

The Space Radiation Effects Laboratory (SREL) located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration (NASA). A synchrocyclotron was formerly in operation in this building and a primary beam of 600 MeV protons and secondary beams of 400 MeV pions and muons were produced for the purpose of studying the effects of radiation on materials, components, and systems planned for use in space. The synchrocyclotron and its accessory equipment were removed in 1980. At several locations, the scattered synchrocyclotron beam caused an induced radioactivity within the walls of the cyclotron room. The concrete shields surrounding the synchrocyclotron have been removed from the building and stored adjacent to the radiochemistry laboratory. The facility is no longer operational, and it has been decided to decommission the synchrocyclotron. In 1985, the Oak Ridge National Laboratory Radiological Survey Activities (ORNL/RASA) group was invited to perform a radiological survey to determine the amount of residual radioactivity on the walls and the floor, calculate the dose to potential occupants working in the building, and make recommendations to minimize exposures from the residual radioactivity on the walls and the floor of the cyclotron room. In this paper, accelerator decommissioning is reviewed, and criteria for decommissioning of accelerators is discussed. The survey method is described, and the findings at the SREL are presented.

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING ENVIRONMENTAL STUDIES AND SITE SURVEYS

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**Yalcintas, M.G., Oak Ridge National Laboratory,
Health and Safety Research Division, Oak Ridge,
TN**

Results of the Radiological Survey at the Space Radiation Effects Laboratory, New- port News, Virginia

ORNL/TM-10064; 35 pp. (1986, August)

**The Space Radiation Effects Laboratory located in New-
port News, Virginia, was operated by the College of
William and Mary for the National Aeronautics and
Space Administration (NASA). A synchrocyclotron was**

**formerly in operation in this laboratory and a primary
beam of 600 MeV protons and secondary beams of 400
MeV pions and muons were produced for the purpose of
studying the effects of radiation on materials planned for
use in space. The synchrocyclotron was removed in 1980.
At several locations, the scattered radiation caused an
induced radioactivity within the walls of the cyclotron
room. A radiological survey has been performed to deter-
mine the amount of residual radioactivity on the walls.
Calculations were performed to determine the thickness
of the concrete walls and floors for shielding the residual
radiation in the cyclotron room. Recommendations were
made to minimize exposure to a potential occupant work-
ing in the building from the residual radioactivity on the
walls and floor of the cyclotron room. (SET)**

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING HEALTH, SAFETY, AND BIOMEDICAL STUDIES

140

Alejnikov, V.E., International Atomic Energy Agency, Vienna, Austria

The IAEA Review of Methods of Reducing Occupational Exposures During the Decommissioning of Nuclear Facilities

Kernenergie 29(9):325-330; Radiation Protection Physics, Proceedings of the 18th International Symposium, Bad Schandau, Democratic Republic of Germany, February 4-7, 1986 (1986, September)

International interest in decommissioning has increased rapidly in the last few years because of the large number of older facilities which are, or soon will be, retired from service and because of the many hundreds of new facilities which have been built or planned and will eventually require decommissioning. A state-of-the-art review of methods of reducing occupational exposures during decommissioning of nuclear facilities has been prepared recently for the International Atomic Energy Agency. The report concludes that decommissioning can be carried out without unacceptable impact on man or his environment. However, additional development is required to reduce occupational exposures during decommissioning.

141

Cuddihy, R.G.

Evaluating Health Risks to Workers in Nuclear Industries

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

This article discusses the management of worker injury claims in new industries related to decommissioning old nuclear industry facilities and points to the difficulty of this. Here, in addition to radiation, workers will be exposed to a wide variety of toxic agents for which little exposure information can be obtained. These include potentially harmful chemicals, asbestos, and other fibrous insulating materials in addition to the risks from mechanical injuries and self-imposed exposures such as smoking and dietary factors. The available epidemiologic

information is not sufficient to resolve the risks from such complex exposures to the many agents that will be encountered in dismantling old nuclear facilities. A good example of the difficulties that may be faced by industries involved in future nuclear facility decommissioning can be seen in the current asbestos industry litigations. (Auth)(CAC)

142

Gouvras, G.

Radiological Protection Criteria for the Recycling of Materials from the Dismantling of Nuclear Installations

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

The Working Party was convened in 1984 by the Group of Experts under the terms of Article 31 of the EURATOM Treaty to develop radiological protection criteria for the recycling of materials that result from reactor decommissioning. Two approaches in establishing these criteria were explored: one defined acceptable individual and collective dose levels and the other defined "clearance" levels for activity concentrations of recycled materials. Because stipulating dose limits would pose problems for both regulators and operators, the Party formulated the criteria based on activity concentration levels. This report outlines and discusses these criteria. (CAC)

143

Grant, T.J., Ebasco Services, Inc., New York, NY

Decommissioning Dose Estimates Compared to Recent Industry Experience

Transactions of the American Nuclear Society 52:32-33; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 32-33) (1986)

Several studies commissioned by the U.S. Nuclear Regulatory Commission have presented an overview of the

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technology, radiation exposure, and costs of decommissioning a large commercial nuclear power plant. These studies have become key reference documents for a variety of regulatory, research, and financial planning groups. Recent industry experience, however, has called into question the occupational dose estimates in these reports.

144

Ikezawa, Y., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Health Physics, Tokai, Ibaraki, Japan

JPDR Decommissioning Program: Workers Exposure and Environmental Impact

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (17 pp.) (1985)

The same radiation control methods used during reactor operation can be used during reactor dismantlement. However, further effort is necessary to reduce exposure to the dismantling workers and to increase the efficiency of dismantling operations, based on the principle of ALARA. This paper discusses radiation monitoring and radiation measurement techniques used during the dismantlement of the Japan Power Demonstration Reactor (JPDR). The development of monitoring instruments and an estimation of exposure doses to workers and the public are also discussed. (CAC)(DCM)

145

International Atomic Energy Agency, Vienna, Austria

Quality Assurance During Commissioning and Operation of Nuclear Power Plants - A Safety Guide

IAEA Safety Series, No. 50-SG-QA5 (Rev. 1); 44 pp. (1986)

This Safety Guide provides requirements and recommendations for the establishment and implementation of a quality assurance program for activities important to safety during the commissioning, operation and decom-

missioning phases of a nuclear power plant. It applies to activities such as the commissioning, inspecting, testing, operating, refueling, maintaining, repairing, modifying and eventually shutting down and decommissioning of nuclear power plants. It also applies to associated activities related to safety, such as radiation protection, environmental monitoring, handling of radioactive wastes, responses to emergencies and physical security.

146

Mies, H.P., W. Stang, G.V.P. Watzel, D. Rittscher, and W. Schacky

The Decommissioning of the Nuclear Power Station Gundremmingen Block

VGB Convention, Strassburg, Federal Republic of Germany, September 2-5, 1986, Preprint (1986)

The nuclear power station Gundremmingen unit A (KRB A) was built from 1962 to 1966. During its operation from 1966 to 1977, the two-cycle boiling water reactor generated approximately 15,000 GWh and attained an average capacity factor of approximately 75%. Decommissioning of the facility began in 1983 in which an alternative method was tested that largely eliminates the decontamination step. The disassembled metal parts are melted down, the melt tested to make sure that the radioactivity is uniformly dispersed throughout, and the molten metal cast into casks which will have radiation levels at or below the level approved for controlled reuse. By the end of 1987, approximately 1000 Mg of low-level contaminated steel will be converted into cast iron casks, which will be used in nuclear power stations as waste containers for radioactive materials. This report contains a general section on the decommissioning of nuclear power plants in Germany and follows with sections on the experiences in the decommissioning of KRB A, the re-utilization of dismantled steel parts, the status of KRB A decommissioning, and future decommissioning plans. Several illustrations and a chart listing the radiation limits allowed for re-utilization of metal scrap are included. (CAC)(DCM)

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

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Problem Areas and Research Needs on Radiation Protection in Nuclear Power Plants

CONF-7811132; Radiation Protection in Nuclear Power Plants and the Fuel Cycle, Proceedings of a Conference. Bristol, United Kingdom, November 27-December 1, 1978, Vol. 1; (pp. 51-57) (1978)

The Advisory Committee on Reactor Safeguards has been assigned by Congress the responsibility to prepare an annual review of the Reactor Safety Research Program of the U.S. Nuclear Regulatory Commission. The first committee report on this subject was published in December, 1977. Among the many topics considered were the evaluation and control of occupational radiation exposures at commercial nuclear power plants. Areas relative to exposure evaluation that have been identified as needing attention at the present time include improved techniques for monitoring occupational neutron exposures, better data collection and analysis with respect to internally deposited radionuclides, and an up-grading in quality control procedures in the manufacture of radiation monitoring instruments. Areas relative to exposure control that have been identified as needing attention include the development of additional design and manufacturing approaches for preventing the production and buildup of key radionuclides within reactor cooling systems; the development and testing of the techniques for removing those radionuclides which do accumulate in the system; the maintenance, repair, modification, replacement, and disposal of major nuclear power plant components, such as steam generators; and the development of design features that would facilitate decommissioning of nuclear power plants. Also in need of further development are procedures for conducting cost/benefit assessments of the value of increased inplant inspections and further recycling and reuse of waste effluents.

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

Administrative and Research Needs Associated with the Control of Occupational Exposures in Commercial Nuclear Power Plants

IAEA-SM-242/33; CONF-790654; Occupational Radiation Exposure in Nuclear Fuel Cycle Facilities, Proceedings of an International Atomic Energy Agency/Organization for Economic Cooperation and Development, Nuclear Energy Agency International Symposium, Los Angeles, CA, June 18-22, 1979; (pp. 379-394) (1980)

This review of occupational exposures in commercial nuclear power plants in the United States of America has revealed that, although many problem areas are being adequately addressed, there is a need for additional work. Areas relative to exposure evaluation that need attention include better data collection and analysis as to when and where exposures occur, improved information on exposures from internally deposited radionuclides, improved techniques for monitoring occupational neutron exposures, and an upgrading in quality control procedures in the manufacture, calibration, use and maintenance of monitoring instruments. Areas relative to exposure control that need attention include the development of additional design and manufacturing approaches for preventing the production and build-up of key radionuclides within reactor cooling systems. The development and testing of techniques for removing those radionuclides that do accumulate in such systems, the application of risk/benefit assessments to procedures for the maintenance, repair, modification, replacement and disposal of major nuclear power plant components, such as steam generators, and the development of design features to facilitate the decommissioning of nuclear power plants. Professional radiation workers also have to be aware of the impact that the proposed major reductions in occupational dose limits would have on their operations. This impact is compounded by the fact that the number of people receiving graduate education in radiation protection in the United States is decreasing.

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Rhyne, W.R., and A.A. El-Bassioni, H&R Technical Associates, Inc., Oak Ridge, TN; U.S. Nuclear Regulatory Commission, Washington, DC

Methodology for Comparing the Health Effects of Electricity Generation from Uranium and Coal Fuels

CONF-811236; Assessing Health Impacts of Energy Technologies at the Regional or National Levels, Proceedings of a Workshop, Upton, NY, December 7-8, 1981; (27 pp.) (1981, December)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING HEALTH, SAFETY, AND BIOMEDICAL STUDIES

A methodology was developed for comparing the health risks of electricity generation from uranium and coal fuels. The health effects attributable to the construction, operation, and decommissioning of each facility in the two fuel cycles were considered. The methodology is based on defining (1) requirement variables for the materials, energy, etc.; (2) effluent variables associated with the requirement variables as well as with the fuel cycle facility operation; and (3) health impact variables for effluents and accidents. The materials, energy, etc., required for construction, operation, and decommissioning of each fuel cycle facility are defined as primary variables. The materials, energy, etc., needed to produce the primary variable are defined as secondary requirement variables. Each requirement variable (primary, secondary, etc.) has associated effluent variables and health impact variables. A diverging chain or tree is formed for each primary variable. Fortunately, most elements reoccur frequently to reduce the level of analysis complexity. (Auth)

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Siempelkamp Giesserei GmbH and Company, Krefeld, Federal Republic of Germany

Plant for Recovery of Metal Components from Nuclear Power Stations

German Patent DE 3,331,383/A; 17 pp. (1985, March 14)

The plant consists of a container for accommodating the material reduced in size, an electric furnace with top loading, a device made as a horizontal extrusion plant with drawing device for treatment of the material until it solidifies, and a separating machine for dividing the extrusion into sections, which can be transported.

151

Stephenson, D.E., C.M. King, B.B. Looney, W.G. Holmes, and D.E. Gordon, Savannah River Laboratory, Aiken, SC; Anderson Hospital and Tumor Institute, Houston, TX

Factors for Assessment of Human Health Risk Associated with Remedial Action at Hazardous Waste Sites

DP-MS-85-129; CONF-851235; Proceedings of an American Geophysical Union Fall Meeting, San Francisco, CA, December 9, 1985; (17 pp.) (1985)

A risk assessment strategy that is cost effective and minimized human health risks was developed for closure of hazardous waste sites at the Savannah River Plant. The strategy consists of (1) site characterization, (2) contaminant transport modeling, and (3) determination of relative merits of alternative remedial actions according to the degree of health protection they provide.

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Allen, J.C., West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination of the Warm Aisles at the West Valley Demonstration Project - Final Topical Report for the Period January 1985-February 1986

DOE/NE-44139-11; 51 pp. (1986, June)

The West Valley Demonstration Project is a DOE project to solidify in a glass form the 2,120 cubic meters (560,000 gallons) of liquid high-level waste stored in two underground steel tanks at the site of the world's first commercial nuclear fuel reprocessing plant, West Valley, New York. One project objective is to utilize as much of the existing plant areas as practical for the installation of solidification support systems. Previously, Extraction Cell Three (XC3) and the Product Purification Cell (PPC) had been chosen as the location of the Liquid Waste Treatment System (LWTS). Subsequently, it was decided that areas of the Upper Warm Aisle (UWA) and the Lower Warm Aisle (LWA) which are located adjacent to the south wall of XC3 and PPC would also be needed for the installation of LWTS equipment. Shielded concrete niches which contained pumps and valve manifolds are located in the warm aisles. One pump niche and one valve manifold niche in the UWA and one pump niche in the LWA were identified as needed for the LWTS. Also, it was necessary to remove some equipment which was located outside of the niches. Subsequently, decontamination plans were made and carried out to prepare these areas for modification and installation activities. Predecontamination survey activities began in January 1986 and decontamination operations were completed in February 1986. Decontamination efforts, results, and lessons learned are reported. (Auth)

153

Allen, J.C., West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination of the Extraction Sample Aisle at the West Valley Demonstration Project

DOE/NE-44139-28; 23 pp. (1986, September)

This report describes the decontamination and decommissioning (D&D) of the Extraction Sample Aisle (XSA)

at the West Valley Demonstration Project. The XSA is one of several areas in the former reprocessing plant required for use in support of the solidification of high-level waste. The XSA contained three glove boxes which housed sample stations. It became radioactively contaminated during fuel reprocessing from 1966 to 1972. This report describes the work performed to accomplish the D&D objectives of removing existing piping and equipment and of reducing radiation and contamination levels, to As-Low-As-Reasonably-Achievable (ALARA) levels for the installation of new equipment. Also reported are pre- and post-radiological conditions, personnel exposure, radioactive waste volume collected, cost and schedule data, and lessons learned. (Auth)

154

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

Electropolishing Applications in the Nuclear Industry

PNL-SA-13708; CONF-861146; Proceedings of the AIChE Winter Annual Meeting, Miami, FL, November 2-7, 1986; (18 pp.) (1986, July)

Commercial electropolishing technology has been developed into a rapid, effective decontamination method that is used worldwide to decontaminate a variety of metallic components and structures. The pre-polishing of surfaces to minimize contamination pickup and facilitate subsequent decontamination is a rapidly emerging technology that can be applied to large components using in situ techniques.

155

Bauer, K.G., Siempelkamp Gießerei GmbH and Company, Krefeld, Federal Republic of Germany

Melting Radioactive Metallic Components from Nuclear Engineering Equipment

CONF-850557; Jahrestagung Kerntechnik '85 (Nuclear Technology '85), Proceedings of a German Nuclear Society Annual Meeting, Munich, Federal Republic of Germany, May 21-23, 1985, 869 pp. Deutsches Atomforum eV, Bonn, Federal Republic of Germany; (pp. 687-690) (1985)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

The results are summarized of a study of practical safety measures in the melting of scrap metal, such as that resulting from the decommissioning of a 1300 MW reference nuclear power station.

156

Bengel, P.R., D.L. Giefer, and R.G. Levesque, GPU Nuclear Corporation, Middletown, PA

Robotics Development at TMI-2

Transactions of the American Nuclear Society 53:504-505; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 504-505) (1986)

A remote reconnaissance vehicle (RRV) was initially developed to visually and radiologically survey the Three Mile Island Unit 2 (TMI-2) reactor building basement, which is not accessible to workers because radiation levels are extremely high (i.e. 10 to 1000 R/h). By mid-1985, the RRV had completed surveillance and sludge sampling missions that demonstrated its utility and suggested that the RRV could be modified to perform more aggressive sampling and decontamination work. The authors discuss the design criteria and operational experiences that GPU Nuclear Corporation has had with expanding the use of the RRV to take concrete core bores, perform gross flushes, and remove sediment from the reactor building basement. The six-wheeled vehicle weighs approximately 224 kg (600 lb) and is powered by two one-half-hp motors. Its power, control signals, and video transmissions pass through a thin-layered cable that winds around a reel located on the RRV.

157

Bergman, C., C. Airola, and G. Vikstroem, National Institute of Radiation Protection, Sweden; Studsvik Energiteknik AB, Nykoeping, Sweden; Swedish State Power Board, Ringhals Nuclear Power Plant, Varberg, Sweden

Recycling of Contaminated Scrap Material in Sweden

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of

Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

This paper discusses the recycling of contaminated scrap material in Sweden, beginning with a general introduction on existing reactors and decommissioning experience. This is followed by sections on the legal aspects of recycling, decommissioning of the R1 research reactor, operational waste experience, and future work in Sweden. (CAC)

158

Bernhardt, D.E., S.V. Prewett, and J. Pittman, Rogers & Associates Engineering Corporation, Salt Lake City, UT; Aerojet Ordnance Tennessee, Inc., Jonesboro, TN

Decommissioning/Standards for Depleted Uranium Manufacturing Facility

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S12 (1987)

Aerojet Heavy Metals Company (AHMC) is decommissioning its 6000-square meter California depleted uranium (DU) manufacturing facility. AHMC has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Source Materials License. Since the facility will be released for uncontrolled use it will be decontaminated to levels as low as reasonably achievable (ALARA). Equipment removal and decontamination tasks include removal of several pits, waste water tanks, and subgrade pipes and sewers. The specifications require a thorough cleaning and decontamination of the facility, not just sufficient cleaning to meet the numeric radiation cleanup criteria. The proposed clean-up criteria are based on State of California, U.S. Environmental Protection Agency (EPA), and U.S. Nuclear Regulatory Commission (NRC) guides and standards. The criteria for decontamination of the facility including limits for surface contamination and dispersed activity, limit external radiation exposure to less than 10 mrem per year, above natural background. The criteria for surface contamination are oriented to NRC Regulatory Guide 1.86. The value for removable contamination is 170 Bq/100 square

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cm (1000 dpm). The criteria for average fixed contamination, based on an area of 1 square meter is 830 Bq/100 square cm. The average concentration of DU in soil will be reduced to about 1.1 Bq/g (30 pCi/g) of U-238. Monitoring procedures and calibration parameters, and the experience from implementing the criteria will be given. Furthermore, the dosimetric relationship of the surface and dispersed contamination criteria and the annual dose criterion will be presented. (Auth)(DCM)

159

Birkhold, U., and W. Suess, Noell (G.G.) GmbH, Wuerzburg, Federal Republic of Germany

Investigations into the Melting Down of Radioactive Metals Under Control Area Conditions

Report (1986)

The smelting plant EIRAM is set up as part of the project for the demolition and decommissioning of the Niederaichbach nuclear power plant and forms a considerable part of the plan for the disposal of the radioactive waste which occurs. Approximately 1,700 tons of material from the control area will be melted down, and, when possible, reused as harmless material according to Section 9a of the Atomic Energy Law. This report discusses the advantages of this waste treatment process and specifications of the smelting plant and ventilation system. Following sections describe the operation and objectives of the smelting process, melt-down materials, measuring process, status of the EIRAM project, and future plans. (Auth)(CAC)

160

Burke, D.F., West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination of the Product Purification Cell at the West Valley Demonstration Project - Final Topical Report for the Period March 1984-January 1986

DOE/NE-44139-10; 54 pp. (1986, July)

This report describes the decontamination of the Product Purification Cell (PPC) at the West Valley Demonstration Project. The PPC is one of several cells

in the former reprocessing plant required for use in support of the solidification of high-level waste. It became radioactively contaminated during nuclear fuel reprocessing from 1966 to 1972. The PPC contained systems designed to purify and store concentrated plutonium and uranium solutions. This report describes the work performed to accomplish the objectives of removing existing piping and equipment from the larger north segment of the cell and of reducing radiation and contamination levels to allow installation of equipment for the Liquid Waste Treatment System (LWTS). Contaminated debris, piping, structure and twenty-four vessels inside the cell were removed, packaged and stored for future disposition. Twenty-eight vessels, with associated piping and structure were sealed behind a shield wall in the south side PPC since this space was not required for the LWTS. A mechanical arm was installed and tested to facilitate pipe cutting operations. After all piping, vessels and structure were removed, interior surfaces (walls, floor, and ceiling) of the cell were decontaminated to radiation and contamination levels that allowed entry without the use of protective clothing or respiratory protection. Debris sampling activities were initiated in March 1984 and the decontamination operations were completed in January 1986. (Auth)

161

Burton, H.M., and R.L. Freemerman, EG&G Idaho, Inc., Technical Information and Examination Program, Middletown, PA

Reactor Disassembly Activities at Three Mile Island Unit Two

Progress in Nuclear Energy 17(2):141-174 (1986)

Since the March 1979 accident at Three Mile Island Unit Two, much research and development work has been conducted to characterize and evaluate the damaged nuclear reactor core and its systems. The following 5 years have seen a combination of existing and new technologies brought to bear towards the ultimate goals of decontamination and defueling.

162

Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de la Vallee du Rhone, Institut de Protection et de Surete Nucleaire/Unite Centrale de Declassement des Installations Nucleaires, Marcoule, France

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Decontamination Tests on the Piping System of G2 Reactor

IPSN/UDIN-85/1384 (1985, December)

This report discusses the decontamination tests conducted on the piping system of the G2 reactor at Marcoule. Built in the late fifties, this reactor started operation in July 1958, reached full power (260 MW(t) and 40 MW(e) in July 1959, and was shut down in February 1980 after 150,000 hours of operation and 5 millions of MW(e) produced. This report describes the G2 facility and the steps and processes of the decontamination tests. Several diagrams and the projected work schedule for the G2 decommissioning program are also included. (Auth) (CAC)

163

Daugherty, H.F., and R. Keel, West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination and Decommissioning of the West Valley Reprocessing Plant

DOE/NE-44139-30; 53 pp. (1986, November)

The decontamination and decommissioning (D&D) activities at the West Valley Nuclear Fuel Reprocessing Plant through September 1, 1986 are described. The topics addressed are: D&D of areas for reuse by the Liquid Waste Treatment System; D&D of areas for reuse as High Level Waste canister storage; and technologies developed in D&D work. (Auth)(DCM)

164

Daugherty, H.F., and R. Keel, West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination and Decommissioning of the West Valley Reprocessing Plant

Transactions of the American Nuclear Society 52:34-35; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 34-35) (1986)

This paper addresses the methods being used to decontaminate and decommission the various cells and

operating spaces of the former West Valley Fuel Reprocessing Facility, located in West Valley, New York. Topics addressed include the application of innovative techniques to permit decontamination and decommissioning (D&D) of processing cells with initial radiological conditions including radiation levels greater than 100 k/h and extremely high levels of both alpha and beta/gamma airborne concentrations exceeding 10000 times the maximum permissible concentration.

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Delegard, C.H., R.L. Weiss, R.T. Kimura, A.G. Law, and R.C. Routson, Rockwell Hanford Operations, Richland, WA

Characterization and Anion Exchange Removal of Uranium from Hanford Groundwater

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 545-550) (1986)

In February 1985, uranium concentrations increased abruptly to 0.1 kg U per cubic meter in groundwaters underlying a retired liquid waste disposal facility in the United States Department of Energy-Richland Operations Hanford Site. Characterization tests showed the uranium was present as an anionic carbonate complex not sorbable by Hanford sediments. The uranium was mobilized by flow from a perched zone of water caused by recent nearby cooling water disposal above an impermeable sediment layer. In a unique demonstration of the concept of "as low as reasonably achievable," efforts were immediately undertaken to minimize the spread of the plume and to reduce the amount of uranium in the groundwater. An anion exchange-based uranium removal process flowsheet was rapidly developed and implemented. Operational for six months, the process has treated over 30,000 cubic meters of groundwater and collected 94% of the uranium while producing a treated effluent that meets criteria for discharge to the soil column.

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Distenfeld, C.H., B.H. Brosey, and P.J. Babel, Bechtel National, Inc., Middletown, PA; GPU Nuclear Corporation, Middletown, PA

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

A Collimated Surface Monitor for Estimating Activity Absorbed in Concrete Walls

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S22 (1987)

Removal of radioactivity from concrete surfaces is a necessary step in reducing the exposure rates in the Three Mile Island Unit 2 reactor building basement. Decontamination efforts in this area are underway, and methods for monitoring their success are being developed. While standard thermoluminescent dosimeters and other detector systems are sufficient to determine decontamination factors for some areas, the data can be very difficult to interpret where complex background sources are present. A surface monitor capable of excluding selected background sources in high radiation fields has been developed. The detector system can operate under water and is capable of measuring exposure rates up to approximately 100 R/hr. Replacement of the GM detector with a higher range unit will allow operation well beyond 100 R/hr. A special $\pi/2$ collimator is used in the design. The detector system is fabricated around the HP220A directional detector and employs additional shielding to reduce the background radiation to approximately 1/400th of the primary field of interest for Cs-137. The additional shielding extends to the front of the detector and reduces the field of view to $\pi/2$ steradians. A direct estimate of the surface activity in the concrete is available, since depth of penetration and isotopic inventory is understood. This instrument can be used in estimating activities in other structural materials if the above parameters are known. (Auth)

167

Feraday, M.A., International Atomic Energy Agency, Division of Nuclear Fuel Cycle, Vienna, Austria

The Characterization and Decontamination of Large Contaminated Areas

Scientific Afternoon, Proceedings of an International Atomic Energy Agency General Conference - Thirtieth Regular Session, Vienna, Austria, September 1986, Preprint; (15 pp.) (1986, October)

Information relevant to the decontamination of very large areas of contaminated land is reviewed. The topics

include the means of characterizing the area and the radioactive contamination; the methods of decontaminating various land forms, pavement, buildings, and forested areas; and the transport and disposal of the large volumes of waste. In addition, the emergency planning measures required to assist in such a cleanup are briefly discussed. (Auth)(CAC)

168

Gardner, F.W., Chem-Nuclear Systems, Inc., Columbia, SC

Northrop TRIGA Facility Decommissioning Plan Versus Actual Results

Transactions of the American Nuclear Society 52:36; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (p. 36) (1986)

This paper compares the TRIGA facility decontamination and decommissioning (D&D) plan to the actual results and discusses key areas where operational activities were impacted by the final U.S. Nuclear Regulatory Commission (NRC)-approved D&D plan. A discussion of fuel transport, release criteria, and release survey plans is included.

169

Gauchon, J.P., P. Mordenti, C. Bezia, P. Fuentes, Y. Kervegant, C. Munoz, and C. Pierlas, Commission of the European Communities, Luxembourg, Luxembourg

Decontamination by Water Jet, Chemical and Electrochemical Methods

EUR-10043; 87 pp. (1986)

The decontamination tests have been carried out on samples coming from representative specimens from primary circuit of the PWR and on samples coming from the emergency feed water piping of the German BWR (Isar). The oxide found in PWR primary loops can only be removed by a two-step process. The initial embrittling step is particularly effective in hot alkaline permanganate medium. Oxidation by ozone treatment is less effective. The second step involves chemical erosion of

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

the metal in nitrofluoric acid in conjunction with ultrasonic agitation. Among the reagents used, only oxalic acid is suitable for electrolytic decontamination. Among the reagents possible for decontamination of the laser specimens (ferritic steel lined with hematite) halogenous acid in mixture without or with oxygenated water, sulfuric acid, the formic acid/formaldehyde mixture are chosen. Metal erosion with high pressure jet as well as the decontamination efficiency on parts lined with hematite have made possible to determine the best conditions.

170

Gelfort, E., Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen mbH, Hannover, Federal Republic of Germany

Process for Contamination of Radioactively Decontaminated Iron and/or Steel Scrap

German Patent DE 3,318,377/C/; 3 pp. (1986, May 15)

The invention concerns a decontamination process by melting the scrap in the presence of a means of slagging the iron/steel melt. In order to reduce the residual radioactivity further, additional inactive isotopes of the radioactive elements present in the melt are added and are also melted. This ensures that the radioactive isotopes of the elements are displaced from the melt according to their specific solubilities and pass into the slag, which is separated from the melt. In this way, one obtains an iron or steel melt with such small residual radioactivity that the iron or steel can be re-used.

171

Hempelmann, W., Kernforschungszentrum Karlsruhe GmbH, Hauptabteilung Dekontaminationsbetriebe, Karlsruhe, Federal Republic of Germany

Methods of Treating Contaminated Metal Wastes at KfK

Report (1986)

The types and origins of the metal wastes treated at KfK are described. A classification is made by types and

shapes of materials and by levels and sources of contamination. The methods used to condition the metallic solids, mainly compaction, melting, and decontamination, are presented. The criteria of selection for treatment as applied to the metal wastes are outlined. The experience at KfK in treating metal wastes is reported. Special reference is made to the performance of the compaction plant and of decontamination for the purpose of safe reuse. Finally, the costs of the methods are compared, thus indicating the criteria of selection applied at KfK in the treatment of metal wastes. The main items of the report are condensed in six diagrams. (Auth)

172

Hermetz, R.E.

Tools for Decontamination and Decommissioning of Nuclear Facilities

CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (3 pp.) (1986)

The Decontamination and Decommissioning (D&D) of nuclear facilities requires many different tools. These can vary from small hand tools to the heavy equipment used to remove concrete and soil. Tools for D&D should be reliable, versatile, economical, and easily disposed of in case they become contaminated. In our search to find tools to do the work proficiently, many tools were considered. The ongoing effort to improve old procedures and develop new ones, as new and unusual equipment was needed, allowed us to get the job done in a timely and cost-effective manner.

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Hinds, S.S., M.D. Pavelek, and K.R. Hoyt, Bechtel National, Inc., Middletown, PA

TMI-2 Post-Accident Dose Reduction Through Coating Removal

CONF-860203; Health Physics Considerations in Decontamination and Decommissioning, Proceedings of the Health Physics Society 19th Midyear Topical Symposium, Knoxville, TN, February 2-6, 1986, 594 pp.; (pp. 229-233) (1986, February)

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This paper describes the approaches used to define sources and to achieve both effective decontamination and dose reduction through coating removal from surfaces in the TMI-2 auxiliary and fuel handling building and reactor building. The testing, production rates, and lessons learned during surface removal operations from 30,000 square feet of epoxy coated concrete floors are discussed. Finally, the resulting post-decontamination exposure levels and recommendations for future work are presented.

174

Kobayashi, T., K. Wada, and T. Sasaki, Shinko-Pfaunder Company Limited, Kobe, Japan

Method of Eliminating Radioactive Materials in Electrolytes During Electropolishing

Japanese Patent 59-116,595/A/; Japanese Patent Application 57-231901; 4 pp. (1984, July 5)

A method is proposed for recovering acids and metal ions from electrolytes that have been used for decontaminating metal surfaces. Metal surfaces of equipment and/or components contaminated with radioactive materials are decontaminated by electropolishing. The metal oxides thus stripped from the metal surfaces are then subjected to solid-liquid separation from the electrolytes by using filters. The acids are recovered from the filtrate containing the dissolved metals and the electrolytes by using diffusion dialysis membranes. After suitable pH adjustment of the remaining liquid wastes to prevent precipitation of metal hydroxides, the liquid wastes are transferred to a recovery vessel. Most of the metals in the liquid wastes are then deposited on cathodes by electro-deposition. The remaining metal ions are removed from the liquid wastes with ion exchange resins. (Auth)(DCM)

175

Koerting, K.

Karlsruhe Begins New Facility to Melt Down Reactor Scrap

Nuclear Europe 6(7-8):43 (1986, July)

An induction melting furnace is being erected in the building of the decommissioned FR2 reactor at Karlsruhe. It will serve to melt scrap from the Niedersachbach nuclear power plant. Depending on the activity of the resulting castings these will be reused or stored in an end repository.

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Lacroix, J.P., and M. Tailliez, Commissariat a l'Energie Atomique, Societe de Travaux en Milieu Ionisant, Gif-sur-Yvette, France

STMI's Industrial Experience in Low Activity Steel Waste Processing by Melting

CONF-860317; Waste Management '86, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986; (pp. 547-552) (1986)

The Societe de Travaux en Milieu Ionisant (STMI) of the Commissariat a l'Energie Atomique, has been requested by EDF to produce a pilot cast, made from contaminated carbon steel. The contaminated metal came from heat exchangers from Chinon A2. The purpose of the cast was to find the behavior and final distribution of the contamination radionuclides after melting. It also was aimed to evaluate the potential contamination of the surrounding environment due to the melting and casting processes. The pilot cast was produced in April 1984 in an existing industrial facility using full scale industrial facilities and methods. A melting arc furnace of four ton capacity was loaded with 3.6 tons of cut iron pieces (such as pipes and vessels) showing a 20 mCi/ton total activity. Atmospheric contamination monitoring was conducted during all steps of the operation: furnace feeding, melting, oxidation, reduction, and casting. Monitoring results were summarized and reported to the SCPRI (Central Agency for the Protection from Ionizing Radiation of the French Public Health Ministry). The operation included a gas and smoke filtration step. In general, all produced wastes were recovered and analyzed: filtration dust, furnace fire-clay, slag, and sand from the mold and casting ladle. The distribution of radionuclides was determined experimentally both in the cast and in the waste materials.

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Landolt, D., Swiss Federal Institute of Technology, Lausanne, Switzerland

Fundamental Aspects of Electropolishing

Electrochimica Acta 32(1):1-11 (1987, January)

The literature on the mechanism of electropolishing is reviewed. A brief history of electropolishing is given, and

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the two processes, anodic leveling (macrosmoothing) and anodic brightening (microsmoothing) are described and compared. Macrosmoothing results from differences of the gradient of electrical potential and/or concentration on a rough surface. Its rate can be quantitatively predicted in many cases. Microsmoothing results from the suppression of crystallographic factors on the dissolution process. Optimum conditions are achieved when dissolution is under mass transport control. The role of anodic films and of pitting is discussed. (Auth)(DCM)

178

Lester, R.K., and D.J. Rose, Rockefeller Foundation, New York, NY; Massachusetts Institute of Technology, Boston, MA

The Nuclear Wastes at West Valley, New York

Technology Review 79(6):20-29 (1977, May)

The West Valley plant was the first private nuclear fuel reprocessing plant in the U.S. It was closed in 1972 for modifications and enlargement. Its principal function was to recover uranium and plutonium in pure form from fuel irradiated in commercial power reactors. Over 600 metric tons of fuel was reprocessed at West Valley from 1966 to 1971, producing 600,000 gallons of liquid high-level radioactive waste. Most of the waste came from uranium fuel reprocessing and is in the approximately 30,000 gallons of sludge at the bottom of a carbon steel tank. This sludge will have to be removed from the tank because the tank will eventually corrode. Mechanical or hydraulic removal of the sludge presents a problem because of the construction of the tank. Acidifying and re-dissolving the sludge with nitric acid cannot be done because the tank would dissolve also. What to do about this particular problem and who will pay for the solution of the problem has become the topic of lively debate. A related problem is the future of the rest of the site. It seems unlikely that reprocessing will be revived there. A license for the decontamination and decommissioning of the reprocessing plant and waste handling facilities (including those for non-high-level wastes) will ultimately be issued by NRC. The extent to which the future use of the site is constrained by the presence of these decommissioned facilities should presumably influence the policy for high-level waste disposal and vice versa. It is not clear to what extent, if any, the problem of decommissioning those facilities other than the high-level waste tanks has been considered. The lease held by NFS on the

portion of the Western New York Nuclear Service Center in which these facilities are located is not scheduled to expire until the end of 1980. NRC officials state that the decommissioning question will be broached at that time. Such a delay, in which the technological goals for the high-level waste would apparently be settled before the decommissioning of the remainder of the site is even considered, would preclude an optimal assessment or resolution, unless it turns out that the constraint on the future use of West Valley site imposed by the least restrictive of high-level waste management alternatives exceeds those imposed by the other decommissioned facilities. Such an outcome cannot be assured in advance, and there are no valid reasons for delay in considering the general decommissioning problem as part of a holistic assessment. (Auth)(SET)(DCM)

179

Lini, D.C., F.D. Fisher, and F.F. Walters, Rockwell Hanford Operations, Richland, WA

New Approaches to Glovebox Design at Hanford

Transactions of the American Nuclear Society 52:365-366; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 365-366) (1986)

Discusses required upgrades and changes that are being incorporated into glove boxes being installed at Rockwell Hanford and other DOE installations or are being evaluated for future upgrades. The factors influencing these design changes include: (1) changing process/operating environment; (2) increasing costs for disposal of transuranic (TRU) waste; (3) reduction in allowable personnel exposure; (4) enhanced safeguards and accountability requirements; (5) increased awareness of human factors; (6) decontamination and decommissioning (D&D) considerations; and (7) increased costs of operations.

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Matsumoto, H., A. Kakimoto, I. Nakatani, and Y. Inagaki, Mitsubishi Heavy Industries Limited, Tokyo, Japan

Method of Processing Electrolytic Decontamination Liquids

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Japanese Patent 60-214,300/A; Japanese Patent Application 59-72184; 4 pp. (1985, October 26)

A method is proposed to improve the separating performance and cost-performance of diffusion dialysis in an electrolytic-decontamination process for radioactive metal wastes. When metal wastes are charged and electrolyzed in an electrolytic decontamination vessel, they are polished and decontaminated. When the metal concentration in the decontaminating liquids reaches a certain level, a pump is actuated to deliver the decontaminating liquid to a reduction vessel. In the reduction vessel, a predetermined reducing agent (phosphorous acid) is supplied and reduction is carried out under circulation and stirring by the pump. After the completion of the reduction, the liquid is sent to the regeneration system, that is, the diffusion dialysis vessel. Then, the acid component is regenerated by the diffusion dialysis and ion exchange and then recovered for reuse in an acid recovery vessel. Phosphorous acid is oxidized into phosphoric acid as a result of reducing the hexavalent chromium. This phosphorous acid-reduction can prevent the degradation in the diffusion dialysis membranes and the ion exchange resins to enable long time use, whereby the chromium separation efficiency can be improved and the amount of the secondary wastes generated can be decreased.

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McGoff, D.J., U.S. Department of Energy, Office of Light Water Reactor Safety and Technology, Washington, DC

The Recovery of a Nuclear Power Plant from an Unplanned Event: The Three Mile Island Experience

Scientific Afternoon, Proceedings of an International Atomic Energy Agency General Conference - Thirtieth Regular Session, Vienna, Austria, September 1986, Preprint; (10 pp.) (1986, September)

On March 28, 1978, a severe accident occurred at Unit 2 of the Three Mile Island (TMI) nuclear power station. After initial successful efforts to terminate the accident, there followed a lengthy, technically demanding, and unprecedented cleanup program. Phases of the program included plant stabilization, disassembly and defueling of the damaged reactor, and preparation for interim monitored storage. The objective of the cleanup program

is to bring the plant to a condition where decisions can be made about its ultimate disposition. The cleanup program required the mobilization of technical personnel from outside the power station operating staff and development of a new means to handle the waste materials and to disassemble and defuel the damaged reactor. Means to enable the safe deployment of cleanup personnel inside contaminated areas for extended periods of time were developed and successfully applied. The program is being safely implemented and is scheduled for completion in 1988. (Auth)

182

Murray, A.P., Westinghouse Research and Development Center, Chemical and Process Engineering Department, Pittsburgh, PA

A Chemical Decontamination Process for Decontaminating and Decommissioning Nuclear Reactors

Nuclear Technology 74(3):324-332 (1986, September)

Five chemical decontamination processes have been developed for nuclear reactor applications. One of these processes is the cerium decontamination process (CDP). This method uses a cerium acid reagent to rapidly decontaminate surfaces, obtaining decontamination factors in excess of 300 in 6 hr on pressurized water reactor specimens. Sound volume reduction and waste management techniques have been demonstrated, and solidified waste volume fractions as low as 9% experimentally obtained. The CDP method represents the hybrid decontamination technique often sought for component replacement and decommissioning operations: high effectiveness, rapid kinetics, simple waste treatment, and a low solidified waste volume.

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Neeb, K.H., Kraftwerk Union AG, Erlangen, Federal Republic of Germany

Decontamination in Light-Water Reactors, Techniques and Experiences

Atomkernenergie/Kerntechnik 48(3):181-184 (1986, August-September)

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The chemical and electrochemical processes currently available for decontamination in light-water cooled nuclear power plants are reviewed, and examples for application are given. The author points out that the process chosen will depend upon the special problems presented by each decontamination task and that there is no process for general use. Quality assurance of the process is of paramount importance, especially concerning decontamination effectiveness and absence of possible harm to the integrity of the materials present.

184

Odajima, M., Toshiba Corporation, Kawasaki, Kanagawa, Japan

Liquid Waste Processing Device

Japanese Patent 60-211,395/A; Japanese Patent Application 59-68162; 5 pp. (1985, October 23)

A volume-reduction procedure for application to liquid wastes from electrolytic decontamination and electropolishing operations in nuclear power plants is described. Aqueous sulfuric acid solutions resulting from electropolishing operations are concentrated by heating in an electrolytic liquid waste processing vessel. The concentrated acid is then decomposed by reacting it with copper. The dissolved copper is recovered electrolytically, and the resulting electrolytic liquid wastes are reduced in volume. Similarly, electrolytic solutions that have lost their decontaminating power and have accumulated much radioactivity over long periods of usage can be reduced in volume. The sulfuric acid is decomposed with the liberation of SO₂ gas by the reaction with copper. In this way, contaminated electrolytic liquid wastes can be reduced in volume, thereby decreasing the amount of secondary wastes generated as compared with a conventional neutralizing method requiring the addition of aqueous alkali solutions. (Auth)(DCM)

185

Phillips, E.C., West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination of the Product Handling Area at the West Valley Demonstration Project - Final Topical Report for the Period July 1985-February 1986

DOE/NE-44139-9; 36 pp. (1986, June)

The purpose of this report is to describe the decontamination and decommissioning (D&D) preparations of the Product Handling Area (PHA) at the West Valley Demonstration Project (WVDP). These preparations are in conjunction with the Liquid Waste Treatment System (LWTS) and the Cement Solidification System (CSS). Two interconnected facilities, the Uranium Product Cell (UPC) and the Uranium Loadout Area (ULO), form the PHA. Both of these facilities contain large tanks. Both of the tanks in the UPC are suitable for use as components of the LWTS. In addition, the UPC is the only existing means of access to the bottom of the Product Purification Cell (PPC) in which some of the equipment for the LWTS will be installed. Consequently, this report describes the decontamination of the PHA from a radioactively contaminated environment to one which may be entered in street clothes. Of the two facilities of the PHA, the UPC was more highly contaminated prior to decontamination. Decontamination of the UPA has been completed leaving most of the surfaces in the facility smearably clean. Decontamination of the UPC consisted of washing all surfaces, draining the floor sump, removing unneeded piping, installing a back flow filter system, painting all surfaces, installing rubber matting on the floor, and placing new stainless steel covering on the UPC ledge. Decontamination operations in the ULO have been completed and were similar to those in the UPC consisting of decontaminating by hand wipedown, removing contamination fixed in paint, and applying new paint. In addition, two pumps and a concrete pump niche were removed. Prior to decontamination, surface contamination was present in the ULO. After decontamination, most of the surfaces in the ULO were clean of smearable contamination. D&D Operations were initiated in the PHA in July 1985 and completed in February 1986. (Auth)(CAC)

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Phillips, E.C., and M.P. Golden, West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination and Renovation of the Master/Slave Manipulator Repair Shop and the Chemical Crane Room at the West Valley Demonstration Project - Final Topical Report for the Period June 1982-June 1983

DOE/NE-44139-4; 39 pp. (1986, January)

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This report describes the decontamination and renovation of the Master/Slave Manipulator Repair Shop (MSMRS) and the Chemical Crane Room (CCR) at the WVDP from radioactively contaminated conditions to essentially shirt sleeve environments. The MSMRS, has been decontaminated and renovated as follows: all tools, equipment and furnishings were removed, the walls were stripped and repainted, and the contaminated concrete floor was removed and disposed of as low-level waste. A new concrete floor was poured and a stainless steel liner covering the entire floor and extending 45.7 cm up the walls was added to provide the WVDP with a shop facility, that can be easily decontaminated. Decontamination of the MSMRS has been completed, and the facility is available for service. The CCR is for the storage and servicing of two bridge cranes used in the Chemical Process Cell (CPC). Decontamination and exposure reduction in the CCR has been completed using vacuum cleaning, damp wipe down, and surface grinding followed by shielding and painting. (Auth)(SET)

187

Sappok, M., Siempelkamp Giesserei GmbH and Company, Krefeld, Federal Republic of Germany

Reprocessing and Recycling of Low Level Contaminated Scrap Coming from Decommissioning and Back Fitting

Nuclear Materials Management 15:276-278; CONF-860654; Proceedings of the Institute of Nuclear Materials Management 27th Annual Meeting, New Orleans, LA, June 22-25, 1986; (pp. 276-278) (1986)

At Siempelkamp foundry, Federal Republic of Germany, a process was developed for recycling of low level contaminated metallic scrap from nuclear plants. The melting process was developed in cooperation with the German authorities. After several tests a license was given for melting under surveillance conditions. The maximum allowed activity to be handled is 74 Bq/g. A short description of the facility being used to carry out the experiments is given.

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Schartz, H.J., and M. Suchowitz, Kraftanlagen AG, Heidelberg, Federal Republic of Germany

Contamination Prevention and Decontamination

Nuclear Europe 6(12):23-27 (1986, December)

Development, deposition and prevention of contamination are discussed. Decontamination during normal plant operation, shutdowns and during and prior to decommissioning is outlined and considered as a part of overall waste disposal.

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Schenker, E., W M. Francioni, and G. Ulrich, Swiss Federal Institute for Reactor Research, Wuerenlingen, Switzerland

Laboratory Scale Melting of Contaminated Metallic Scrap

Melting and Recycling of Radioactive Metals from Decommissioning of Nuclear Installations, Proceedings of a Workshop, Leopoldshafen, Federal Republic of Germany, May 27-28, 1986; (13 pp.) (1986)

Laboratory-scale investigations were conducted to determine the effects produced by melting radioactively contaminated metallic scrap. Types of scrap tested in these investigations included: stainless steel tubes from a heavy water cooled research reactor in order to measure the tritium (H-3) content; carbon steels from various reactors to show the effects of different surfaces (rusted, painted, galvanized) and different atmospheres on the behavior of the contaminants during melting; and brass tubes from condensers. These experiments indicated that melting radioactively contaminated metal scrap may have potential for decreasing radiation levels in the metal and thus provide a method for recycling valuable metals. The method also can be used for volume reduction of waste. (Auth)(SET)(DCM)

190

Schenker, G.U., U. Pfeuti, and J.P. Wenger, Swiss Federal Institute for Reactor Research, Wuerenlingen, Switzerland; Simtec AG, Rumisberg, Switzerland; NOK Bznau Nuclear Power Plant, Doettingen, Switzerland

Decontamination by High Pressure Water

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CONF-860603; ENC-86, Proceedings of the Fourth European Nuclear Conference and the Ninth FORATOM Congress and International Nuclear Trade Fair, Geneva, Switzerland, June 1-6, 1986; (6 pp.) (1986)

The results of testing high pressure and ultrahigh pressure water jets for decontaminating metal surfaces showed good decontamination factors. The surfaces tested were from a proton accelerator loop having parts with complicated shapes, two refuelling water storage tanks made of mild steel, and Inconel 600 metal from steam generators. The accelerator loop parts, contaminated with depleted uranium, were cleaned in a glove-box by a high pressure water jet (600 bar, 0.6 l/s). A decontamination factor of more than 1000 was obtained. High pressure (700 bar) water jet cleaning was sufficient to decontaminate one of the water storage tanks; however, it took ultrahigh pressure (2400 bar) water to decontaminate the other tank. The reason for this could have been the difference in the types of paints covering the tank surfaces. For Inconel 600, it was found that ultrahigh pressure (greater than 2000 bar) water was effective in cleaning the surfaces. High pressure water was only a moderately effective surface cleaner. Preliminary experiments using a chemical pretreatment followed by a high pressure water cleaning resulted in decontamination factors of greater than 100. (DCM)

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Severa, J., and J. Bar, Ceskoslovenska Komise pro Atomovou Energii, Prague, Czechoslovakia

Contamination with Radioactive Materials and Decontamination

INIS-mf-10587; 204 pp. (1985)

The content of the monograph mainly designed for personnel in nuclear power plants, radiochemical laboratories and laboratories of nuclear medicine departments is basically divided into two parts. In the general part, the contamination of persons and objects with radioactive substances is discussed and the physico-chemical principles of decontamination are presented. The main part of the publication is devoted to concrete practical decontamination procedures. Special attention is given to the decontamination of components of nuclear power plants with WWER reactors and to the decontamination of the equipment of radiochemical and

radiological laboratories (in-service, after accidents and during decommissioning). Also described is the decontamination of garments, underwear, protective aids, rooms, buildings, terrain and water. One chapter is devoted to the disposal of radioactive wastes generated during decontamination.

192

Shtanko, V.M., P.P. Karyazin, V.G. Mosolova, and S.N. Sirotkin

Influence of Anodic Oxidation of Surfactants on Electrochemical Polishing of Metals

Journal of Applied Chemistry of the USSR 48(5):1829-1832 (1975)

Electrolytes with added surfactants are being used in industry for electrochemical polishing of various metallic components. Addition of surfactants considerably improves the technological properties of electrolytes and the quality of the polished surface. Because of the specific character of the anodic process with evolution of oxygen, oxidation of the surfactants is possible. As a result, the surfactant undergoes compositional and structural changes, with consequent changes in the properties of the electrolyte. This gives special significance to the choice of the surfactant. This paper describes experimental work on surfactants which have low oxidation tendencies and on ways of preserving their effectiveness. (Auth)(CAC)

193

Stewart, J.A., Savannah River Laboratory, Aiken, SC

Demonstration of a Remotely Operated TRU Waste Size-Reduction and Material Handling Process

Transactions of the American Nuclear Society 53:498-499; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 498-499) (1986)

Noncombustible plutonium-238 and plutonium-239 waste is generated as a result of normal operation and

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decommissioning activity at the Savannah River Plant and is being retrievably stored at the Plant. As part of the long-term plan to process the wastes for permanent disposal, a remote size-reduction and material handling process is being cold-tested at Savannah River Laboratory to provide design support for the Plant TRU Waste Facility scheduled to be completed in 1992. Testing of the equipment in a complete cold demonstration, known as the Components Test Facility, is scheduled to begin in November 1986 and will run through 1987.

194

Stoll, F.E., EG&G Idaho, Inc., Idaho Falls, ID

Final Report of the Decontamination and Decommissioning of the Initial Engine Test Facility and the IET Two-Inch Hot-Waste Line

EGG-2468; 26 pp. (1987, April)

The Initial Engine Test Decommissioning Project is described in this report. The Initial Test facility was constructed and operated at the National Reactor Testing Station, now known as the Idaho National Engineering Laboratory, to support the Aircraft Nuclear Propulsion Program and the Systems for Nuclear Auxiliary Power Transient test program, circa 1950 through 1960s. Due to the severe nature of these nuclear test programs, a significant amount of radioactive contamination was deposited in various portions of the Initial Engine Test facility. Characterizations, decision analyses, and plans for decontamination and decommissioning were prepared from 1982 through 1985. Decontamination and decommissioning activities were performed in such a way that no radiological health or safety hazard to the public or to personnel at the Idaho National Engineering Laboratory remains. These decontamination and decommissioning activities began in 1985 and were completed in 1987. (Auth)

195

Suwa, T., N. Kurihayashi, and E. Tachikawa, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development of Chemical Decontamination Process with Sulfuric Acid-Cerium (IV) for Decommissioning

Journal of Nuclear Science and Technology 23(7):622-632 (1986, July)

The decontamination of radioactively contaminated metal specimens by dissolution of the Cr-rich oxides adhering to the metal surfaces was studied. The dissolution studies primarily utilized sulfuric acid-cerium(IV) solutions as the decontaminating agent. The results of the investigation have been compared with reported results obtained with typical decontamination reagents. The H_2SO_4 -Ce(IV) solutions can dissolve simultaneously not only Cr but also Fe and Ni in the Cr-rich oxides. In the Ce(IV) concentrations and temperatures studied, 0.0013-0.010 M and 40-90 degrees C, respectively, dissolution was concentration dependent. Dissolution was independent of sulfuric acid concentration in the concentration range of 0.2-0.5 M H_2SO_4 and 0.005 M Ce(IV). The decontamination factor was about 33 after contact with 0.25 M H_2SO_4 -0.005 M Ce(IV) at 90 degrees C for 24 hours. The dissolution of the oxide is primarily governed by a redox reaction in the H_2SO_4 -Ce(IV) system and is decreased as the Ce(IV) is reduced to Ce(III). By electrolytically regenerating the Ce from Ce(III) to Ce(IV), the Ce(IV) concentration can be maintained at a constant value. Thus, the initial amount of Ce(IV) required to dissolve the oxides is less than would be required without electrolytic regeneration. (DCM)

196

Tachikawa, E., and H. Yasunaka, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Chemistry, Tokai, Ibaraki, Japan; Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development: Decontamination

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (20 pp.) (1985)

During the operation of power reactors, the accumulation of radioactive corrosion products (CRUD) on pipe surfaces of the primary systems occurs, resulting in a gradual yearly increase of dose rate around the systems varying from reactor to reactor. To reduce radiation

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doses to workers during reactor decommissioning and dismantling, it is essential to eliminate CRUD from the surfaces of pipes and various equipment in the reactor system. Elimination of CRUD also simplifies the dismantling procedure. The decontamination work for dismantling reactors is divided into three categories: (1) pre-dismantling decontamination; (2) surface decontamination of concrete buildings; and (3) decontamination of post-disassembled components. (CAC)(DCM)

197

Tanaka, M., Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Present Status of Decommissioning Material Reuse in Japan

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

The JPDR dismantlement will generate 2,204 tons of metal wastes and 27,160 tons of concrete wastes. These materials are considered good for demonstration tests on decommissioning material reuse. The JAERI is developing a research plan to study the possible reuse of such materials using the JPDR wastes. Electropolishing and melting of the contaminated metal wastes are considered probable demonstration tests by the JAERI. (Auth)(CAC)

198

Thurston, C.

DOE To Test Metal Decontamination Option for Radwaste Cleanup

Nucleonics Week 27(41):13 (1986, October 9)

This article discusses the demonstration phase of a cleanup project that will eventually involve 80,000 tons of scrap metal from four U.S. Department of Energy (DOE) facilities. The project, sponsored by the DOE's Oak Ridge Operations Office, marks DOE's first effort to

utilize metal decontamination methods that will allow reuse of the scrap, rather than disposing of it as radioactive waste. Utilities have increasingly pursued this option during the last year as surcharges and allocation limits have made it economically attractive. Contracts were awarded for the demonstration phase, which will be for the onsite or offsite decontamination of between 25 and 75 tons of scrap from the Oak Ridge, Paducah, and Portsmouth gaseous diffusion plants and the Fernald feed materials plant. The results of the demonstration will be part of the criteria for the selection of a single contractor to process 80,000 tons of scrap metal from the four DOE facilities. The ferric and non-ferric scrap to be decontaminated was produced during upgrading of the facilities that took place over a 10-year period. (Auth)(CAC)(DCM)

199

Vance, R.F., West Valley Nuclear Services Company, Inc., West Valley, NY

Characterization of the Head End Cells at the West Valley Nuclear Fuel Reprocessing Plant

DOE/NE-44139-31; 48 pp. (1986, November)

The head-end cells at the West Valley Nuclear Fuel Reprocessing Plant are characterized in this report. These cells consist of the Process Mechanical Cell (PMC) where irradiated nuclear fuel was trimmed of excess hardware and sheared into short segments; and the General Purpose Cell (GPC) where the segments were collected and stored prior to dissolution, and leached hulls were packaged for disposal. Between 1966 and 1972, while Nuclear Fuels Services operated the plant, these cells became highly contaminated with radioactive materials. The purpose of this characterization work was to develop technical information as a basis for decontamination and decommissioning planning and engineering. It was accomplished by performing remote in-cell visual examinations, radiation surveys, and sampling. Supplementary information was obtained from available written records, out-of-cell inspections, and interviews with plant personnel. (Auth)

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Whittaker, W.L.

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Design Rationale for a Remote Work Vehicle

Transactions of the American Nuclear Society 53:503-504; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 503-504) (1986)

The remote work vehicle (RWV) is a mobile, teleoperated, electrohydraulic robot designed for aggressive, radiological decontamination work. The RWV performs tasks such as washdown, sampling, material packaging and transport, surfacing, and demolition. This paper discusses the design rationale that shaped the development of the RWV with respect to capability, reliability, operability, decontaminability, extensibility, and maintainability. To meet an important subset of nuclear damage recovery tasks, the design embraced these often competing ideals.

201

Yanagisawa, K., Toshiba Corporation, Kawasaki, Kanagawa, Japan

Japanese Patent 60-256,100/A/; Japanese Patent Application 59-110910; 4 pp. (1985, December 17)

A method for decontaminating pipeways in BWR type reactors is described. The method is efficient and produces uniform results. After filling the pipeways with a decontaminating solution, gases are blown from a gas cylinder into the pipeways. The gas used can be air, nitrogen, oxygen, hydrogen or argon, depending on the state of the oxide films formed on the pipeway walls. Decontamination efficiency is enhanced by both the agi-

tation of the decontaminating solution by the blown gas and by the cleaning effect of the action of the gas bubbles themselves. According to such a cleaning method, the radiation dose is decreased from a range of 5-35 mR/hr, obtained in a conventional system, to a range of 3-10 mR/hr.

202

Zucker, M.S., Brookhaven National Laboratory, Upton, NY

The Assay of Holdup in Nuclear Fuel Plants - A Review

Transactions of the American Nuclear Society 53:192; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (p. 192) (1986)

Holdup refers to the various forms of special nuclear material (SNM) deposited in process equipment, duct work, surfaces in work areas of plants, etc., in a form such that it is effectively removed from the intended nuclear material flow pattern of normal manufacturing procedures. Often this material is in a form in which it is not easily removable, otherwise it would have been recovered as part of normal periodic clear out operations. The objectives of holdup measurements are to ascertain the amount, distribution, and how firmly fixed the SNM is. The purposes are varied and include some or all of the following: to reconcile a material balance which is necessary for determining security requirements for a decommissioned facility; to decide whether recovery efforts are economical; to evaluate health and safety requirements; and to maintain nuclear criticality control.

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Additional Questions Asked About Dismantling of Reactor

Broad Top Bulletin (Saxton, PA, July 23, 1986) (1986, July 23)

Questions dealing with the dismantling of the Saxton nuclear plant from local residents were answered at a public meeting by Saxton Nuclear Experimental Corporation (SNEC) officials. SNEC officials reported that more than 99 percent of the radiation on the site is inside the containment vessel, and that it will not be dismantled at this time. The officials promised to determine the amount of radioactivity that is in the 800 to 1600 cubic yards of radioactive materials to be removed from outside the containment area. When a local County Commissioner suggested that an independent inspecting team be on the site during decommissioning, the SNEC officials did not object to the suggestion. However, the SNEC officials stated that if the Public Utilities Commission rejects its request for the money to dismantle the structures (excluding the containment building), SNEC would have to rethink its decommissioning plans. Feelings that the facility was not properly maintained over its history were evident. Four unplanned releases of radiation occurred at the facility during operation. The releases occurred on May 14 and August 26, 1970 and on November 29 and December 15, 1971. According to the SNEC officials, the maximum radiation levels at the site boundary at the time of the releases would have been 0.387 millirem, 0.0018 millirem, 4.28 millirems and one millirem respectively. (Auth)(SET)(DCM)

204

Shippingport NPP Decommissioning

Energeticheskoe Stroitel'stvo za Rubezhom 6:21-23 (1985, December)

The status of decommissioning operations at the Shippingport nuclear power plant, which was shut down in 1982, is described. Data on dose rates in different components of the primary circuit are presented. During dismantling, it was decided not to decontaminate the primary circuit but to remove the reactor vessel intact. The design of the reactor vessel shipping cask, which is constructed of light concrete, is presented. Decommissioning is planned to be finished in 1988. Total decommissioning costs will constitute 12% of the cost of the NPP construction.

205

Concrete Demolition by Hydrojetting

Indian Concrete Journal 60(9):222-223 (1986, September)

A novel technique for demolishing concrete, evolved in Sweden, was successfully introduced into the United States in early 1985. Known as the Conjet concrete removal system, the technique has since been used to quickly demolish unsound concrete from the surface of bridge decks, parking garage floors and road pavements. The hydrojetting system deploys a high-pressure pump capable of maintaining continuous pressure up to about 1,400 kg per sq cm at the nozzle. While the nozzle is 2-mm in diameter, the cutting width can be extended up to 1.8 m or even up to 3.6 m depending upon the attachment of the robot unit. This cutting width, however, can be controlled by preprogramming. The system has a cutting capacity of about 10 square meters per hour or 24 to 30 meters per traffic lane for an eight-hour working shift. The main advantage of hydrojetting lies in its selective demolition of damaged concrete even while scarifying deep into unsound concrete, without causing any microcracking at the scarified surface.

206

Operationally Safe Ventilation Technology for the Dismantling of Nuclear Installations

Sulzer Technical Review (Switzerland) 68(1):42 (1986)

The ventilation equipment, designated for the power plant at Niederaichbach near Landshut, fulfills the following tasks: Supply fresh air to areas that are closed off from the outside but are still accessible; regulate the diversion of exhaust air from the control area and extract all radioactive aerosols from the exhaust air; and comply with internal air standards prescribed by industrial safety legislation, if persons are employed there. (Auth)

207

American Welding Society, Inc., Miami, FL

Recommended Practices for Plasma Arc Cutting

ANSI/AWS-C5.2-83; 21 pp. (1983)

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The history, basic process, safety, electrical requirements, potential hazards, and principles of operation of conventional plasma arc cutting are discussed. In addition, this American National Standard includes more detailed information on: (1) gas/water shielded plasma arc cutting; (2) water-injection plasma arc cutting; (3) process capabilities; (4) economics; (5) mechanized low-current low-speed cutting; (6) manual cutting; (7) high current cutting; (8) equipment for high-speed mechanized cutting and low-current low-speed cutting; and (9) installation requirements. (SET)(DCM)

208

Anpo, M., and K. Shimamura, Mitsubishi Heavy Industries Limited, Tokyo, Japan

Method of Dismantling a Reactor Container

Japanese Patent 60-93,399/A/; 4 pp. (1985, May 25)

The purpose of this method is to eliminate the requirement for water seal structures to the opening near the cooling inlet and outlet nozzles and to the opening below the reactor container, as well as prevent radioactive contamination to the periphery of the container and concrete walls. The reactor container is hoisted upward from the installed position and then placed laterally on the floor of a reactor cavity, while water seal cover is placed over the opening at the cavity floor after taking out the reactor container. Then, the opening is tightly closed so as not to introduce contaminated water to the opening corresponded so far to the coolant inlet and outlet nozzles of the reactor container, as well as to the space in the incore instrumentation space. The cavity containing the reactor container and other equipment is filled with water, and the contents of the cavity are dismantled with remote cutting equipment or by using other dismantling techniques.

209

Antoine, P., P. Biancale, B. Besson, Y. Berthion, J. Cherot, G. Coste, D. Greneche, G. Lhiaubet, A. Limongi, P. L'Homme, G. Petit, S. Sejourne, and J.J. Verdeau, Commission of the European Communities, Luxembourg, Luxembourg

Long Term Integrity of Buildings and Systems

EUR-9928; 363 pp. (1985)

The present study relates to the conditions of holding nuclear power stations in a safe state after their final shutdown. To assess the reasonable duration of the waiting period before complete dismantling of the installations, it was deemed necessary: to investigate the causes and consequences of the aging of a nuclear power station, with particular regard to the safety-relevant constituents such as the barriers against the dispersion of contamination; and to evaluate the possible problems of safety, maintenance and decommissioning cost. In the present document, the methodology is developed that is to apply in the particular case of a power station finally shut down which is to be decommissioned and dismantled later. For a detailed exercise of this methodology, the Framatome 900 MW(e) pressurized water reactor station has been taken as a reference plant. The plan which has been elaborated for this study and for the examination of the technical problems has been conceived so as to suggest to the author of a similar study for a particular power station, all the points he has to consider. One chapter of this document has been devoted to showing the basic differences between the 900 MW(e) PWR reference plant and the other types of nuclear power stations existing in the European Community (e.g., BWR, GCR, FBR) and to identify the consequences concerning the decommissioning and the long-term integrity of the installations.

210

Arasawa, H., K. Matsumoto, S. Yamaguchi, and K. Sumita

Controlled Cutting of Concrete Structure with Abrasive Water-Jet

Jet Cutting Technology, Proceedings of the Eighth International Symposium, Durham, United Kingdom, September 9-11, 1986; (pp. 211-218) (1986)

Some results of a recent experimental study on cutting conditions and cutting methods with abrasive water-jets for various test blocks are presented. The test blocks were made to simulate part of a concrete construction. Steel reinforcing bars (29 mm in diameter) were used in all blocks, and some of these blocks were covered with steel plate. The investigation showed the possibility of controlled cutting and dismantling of concrete structures, especially decommissioning of nuclear power plants.

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211

Bach, F.W., Hanover University, Fachbereich Maschinenbau, Federal Republic of Germany

Contribution to the Thermal Cutting of Thick-Walled Workpieces

Report; 295 pp. (1983, July 8)

The circumstances specific to the process of thermal cutting are evaluated with the aim of finding the possibilities of cutting up the components of a Light Water Reactor. There is a report on the structure of the reference Pressurized Water Reactor and on thermal cutting. The different cutting processes are described, and criteria determining selection of a process are given. Data are given on thermal cutting in the atmosphere for powder fusion cutting, oxygen lances, plasma cutting and plasma autogenous combination cutting. The description of details of thermal cutting under water concern autogenous burning, oxygen lances, plasma fusion cutting, plasma sawing, arc sawing, arc water jet cutting and arc water jet autogenous combination cutting. The manipulator techniques, measurements of aerosols and dust, and the use of thermal cutting processes with reference to shutting down a reference power station are discussed. In addition, criteria for the design of a nuclear power station from the cutting technique point of view are explained.

212

Baier, J., K. Blaseck, F. Krieger, R. Kuhn, and P. Leister, Noell (G.G.) GmbH, Wuerzburg, Federal Republic of Germany

Design and Testing of Remote Handling Systems for Reprocessing Plant Maintenance and for Nuclear Reactor Dismantling

Transactions of the American Nuclear Society 53:515-516; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 515-516) (1986)

In 1986 two important milestones will be reached in the field of remote handling technology in Germany: (1) The prototype of the manipulator carrier system with power manipulator (MTS) for the reprocessing plant in Wackersdorf will be completed and cold test operations will be

started; and (2) the dismantling manipulator with all special tools for the demolition of the Niederaichbach nuclear power station will be completed and cold tested under mockup conditions. Both systems were designed, constructed, and tested by Noell GmbH in Wuerzburg. The report describes main features of the design, the problems in fabrication and the first test results.

213

Bargagliotti, A., L. Caprile, F. Piana, and E. Tolle, Commission of the European Communities, Luxembourg, Luxembourg

Plasma Arc and Thermal Lance Techniques for Cutting Concrete and Steel

EUR-10402; 174 pp. (1986)

The plasma arc technique is used today in industrial practice for any metal, but mainly for cutting stainless steel, carbon steel and aluminum. In air the maximum thickness that was cut in the performed tests was 150 mm, both with ferritic and austenitic steel. Underwater the maximum thickness cut was 103 mm. The two types of torch used in the tests are those used today: the plasma-shaped electrode torch (WIPC) and the pointed electrode torch (DMC-GRUEN). Two different types of gas were compared: an argon-nitrogen mixture and an argon-hydrogen mixture. The second mixture adopted results in less dust emission. The production of dust and aerosols also depends on the cutting speed, on the kind of steel, but mainly on the environmental conditions; it is reduced up to 500 times under water. Dust and aerosols can jeopardize the efficiency of the system; moreover, the ambient air can have high-level radiation fields. Indirect and direct protections are needed (shields, remote control, robots, etc.). Tentative procedures for dismantling two types of BWR reactor are examined. Two series of tests demonstrated the feasibility of cutting the most geometrically difficult parts of the reactor internals. The thermal lance technique is used in industrial practice mainly for dismantling large reinforced concrete structures. This technique can be applied to dismantle nuclear facilities, even though it can cause some problems due to the gases, fumes and lapilli produced. In addition, the cost of this technique seems to be generally higher than the cost of other techniques. From the analyses done, the conclusion seems that both the above techniques are feasible for dismantling a nuclear power plant (NPP). The best solution is probably to analyze the different dismantling possibilities and problems of each case.

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214

Beaufre, J., Electricite de France, Direction de l'Equipement, Paris, France

Nuclear Power Plant Dismantling

CONF-8510412; Electric Power, Environment and Space Management, Proceedings of the Tenth Colloquium, Paris, France, October 3, 1985. Institut Francais de Gestion, Paris, France; (pp. 41-45) (1986)

To avoid important problems when a nuclear plant is stopped, and when new sites have to be found, the following solution is proposed: It is a question of keeping work perennality on nuclear sites and so, to find always simultaneously operating installations and other ones in construction or in re-construction.

215

Bennett, C.R., Atomic Energy of Canada Limited, Mississauga, Ontario, Canada

Introductory Remarks to the Workshop on Storage with Surveillance Versus Immediate Decommissioning for Nuclear Reactor Components and Buildings

CONF-8410213; Storage with Surveillance Versus Immediate Decommissioning for Nuclear Reactors, Proceedings of a Nuclear Energy Agency Workshop, Paris, France, October 22-24, 1984, 180 pp.; (pp. 26-43) (1985)

This paper looks at immediate versus delayed dismantling of nuclear reactors as well as no dismantling at all. Two necessary requirements for immediate dismantling are the availability of waste disposal sites and funds. A strong financial argument for delayed dismantling is based upon the theory of long term discounting. However, this theoretical premise neglects the history of social, fiscal and corporate instability that often has occurred during 50-year periods. Arguments for either immediate or delayed dismantling based on radioactive exposure are not conclusive because the total activity does not decay significantly after the first thirty years after reactor shut-down. Radiation fields from significantly decayed Co-60 sources can still be sufficient to necessitate remote handling techniques. The advantage

of avoiding the dismantling option altogether should be investigated because the risk to the public of leaving a reliable containment building intact can be shown to be negligible in relation to other daily risks. (Auth)(SET) (DCM)

216

Berkow, H.N., U.S. Nuclear Regulatory Commission, Washington, DC

Virginia Polytechnic Institute and State University: Proposed Issuance of Orders Authorizing Dismantling of Facility and Disposition of Component Parts, and Terminating Facility License

Federal Register 51(165):30455; DOCKET 50-124 (1986, August 26)

The NRC is considering issuance of orders authorizing Virginia Polytechnic Institute and State University (Virginia Tech or the licensee) to dismantle the reactor facility and dispose of the component parts, and termination of Facility Operating License No. R-26, in accordance with the licensee's application dated July 17, 1986. This article provides the details of these orders and an address to which one can write for further information. (Auth)(CAC)

217

Boomgaard, P.J.

Dismantling of a Suspension Reactor

Studieblad PTT (Netherlands) 39(11):321-326 (1984)

The KEMA Research Institute, Arnhem (Netherlands) has recently decided to dismantle the suspension reactor. In this paper, history and basic principles of the KSTR reactor are briefly described. Performance and testing during the years 1974-1977 and the present-day dismantling of the reactor are considered.

218

Brown, D.A., R.E. Gallagher, and R.L. Rider, Bechtel Eastern Power Corporation, Gaithersburg, MD

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Integrated Defueling System for Three Mile Island Unit 2

Transactions of the American Nuclear Society 53:502-503; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 502-503) (1986)

The unique clean-up requirements of Three Mile Island Unit 2 have posed first-of-a-kind challenges for the equipment, tools, and operators involved in the defueling effort. Various equipment components and specialty remote tools were designed as an integrated defueling system to provide a means of safely working above the reactor and removing core debris. The basic defueling system consists of support equipment and specialty remote tools for specific operations. This paper describes the different equipment and tools, and explains the key interfaces and features of the integrated defueling system.

219

Collins, N.W., Strachan & Henshaw, Bristol, United Kingdom

Developing Machines to Dismantle the Windscale Prototype AGR

Nuclear Engineering International 32(392):39-41 (1987, March)

The United Kingdom Atomic Energy Authority plans to demonstrate decommissioning technology by dismantling the Windscale prototype AGR. At the heart of the project are the machines for remote cutting and handling being designed, built and installed by Strachan and Henshaw. The complete system consists of the following: the decommissioning machine with its floor shield, a mast and support frame, a manipulator platform and lift system, a manipulator and the machine containment; and the handling system, which includes a transfer hoist, a reactor vault slewing beam and a sentencing cell slewing beam with interconnecting fixed beams, a larger waste handling hoist and the sentencing cell carousel floor. (Auth)

220

Conti, M., A. Garofalo, and M. Laraia, Comitato

Nazionale per l'Energia Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA), Directorate for Safety and Protection, Rome, Italy; Ente Nazionale per l'Energia Elettrica, Latina, Italy

Presentation of Italian Experience

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

This paper briefly discusses the field of recycling and/or reusing components resulting from the decommissioning of nuclear facilities in Italy. Included are the technical specifications assigned to ENEL which dictate the numerical limits for unrestricted release. Another technical specific concerning operating/administrative methodologies, destination of released materials, and registration of the quantity and type of such materials is also described. The authors conclude with a list of critical areas in the implementation of these general criteria. (CAC)

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Cregut, A.

Dismantling and Decontamination of Metal and Concrete Structures

Scientific Afternoon, Proceedings of an International Atomic Energy Agency General Conference - Thirtieth Regular Session, Vienna, Austria, September 1986, Preprint; (17 pp.) (1986, September)

The technical operations carried out during decommissioning of nuclear facilities include the demolition, disassembly, and dismantling of the radioactive parts as well as the processing, conditioning, transport, and storage of the waste products. The nuclear facilities are of very different types and sizes, such as power reactors, large fuel fabrication or reprocessing plants, small research units (i.e., pilot plants), irradiation facilities, etc. From a radiological point of view, these facilities are very different in terms of the types of materials used, levels and types of radioactivity induced, and the levels

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and physico-chemical forms required for decontamination. Such differences make it necessary to use a very wide variety of equipment and techniques for both decontamination and cutting as well as for transporting the equipment on site due to the necessity of using remote control. This paper discusses the various types of equipment and techniques used in dismantlement and decontamination. Included are three useful tables that outline techniques for cutting up metal components, demolishing concrete structures, and decontaminating metals and concretes. (Auth)(CAC)

222

Cucchi, G., Comitato Nazionale per l'Energia Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA), Bologna, Italy

Preliminary Decommissioning Measurements for Research Reactor RB-1

CONF-840512; Radiation - Risk - Protection, Proceedings of the Sixth International Radiation Protection Association Congress, Berlin, Federal Republic of Germany, May 7, 1984, Vol. 2; (p. 803) (1984)

As part of the development of the decommissioning operations for the RB-1 reactor, activation measurements of the steel reactor container have been made to determine exposure to workers during the dismantlement of the inner structures of reactors from which uranium has already been removed. In particular, the graphite parts of the inner structures were tested for radioactive contamination. These measurements also determine whether or not the steel container should be stored as a radioactive waste. The resulting data will be used with data from activation and contamination measurements of the reactor housing (e.g., concrete, etc.) to categorize the decommissioning operation as a SAFSTOR, ENCOMB, or DECON type. (CAC)

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de Souza Barros, I., and P.E. Cardoso, Associacao Brasileira de Soldagem, Sao Paulo, Brazil; Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte, Brazil

Aspects of Plasma Cutting in AISI 321 Stainless Steel

INIS-BR-511; CONF-8510361; Proceedings of the First Ibero American Welding Congress, the Sixth Latin American Welding Congress, and the 11th National Meeting of Welding Technology, Rio de Janeiro, RJ, Brazil, October 20, 1985; (17 pp.) (1985)

The utilization of plasma cutting techniques for cutting AISI 321 stainless steel heavy plates during fabrication of nozzles for nuclear reactors was evaluated. The effect of current, electric potential and cutting speed were studied. The superficial irregularity and the microstructure of the zone affected by the cut were analyzed by measurements of roughness, optical metallography and microhardness.

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Duverger de Cuy, G., G. Miachon, and J. Regnier, Commissariat a l'Energie Atomique, Paris, France

Process and Device for Cutting a Thin Wall with an Explosive Rope

French Patent 2,576,825/A; French Patent Application 85-01564; 11 pp. (1986, August 8)

On the wall of the structure to be cut is fixed a hollow section defining with the wall a duct in which is introduced an inflatable tube bearing the explosive rope. Before firing the tube is inflated and the explosive rope is closely applied on the wall. The method can be used for dismantling radioactive containers and enclosures, thus, minimizing the time that personnel are exposed to radiation.

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Dvorchak, B.

Dismantling of 25-Year-Old Nuclear Plant Raises Concerns

Oak Ridger (Oak Ridge, TN) (870421):8 (1987, April 21)

In 1982 General Public Utilities (GPU) Corp. asked the state Public Utilities Commission for \$12.5 million to dis-

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mantle a nuclear power plant which they constructed 25 years ago in Saxton, Pennsylvania. They were awarded \$5.6 million over 14 years and told to maintain the reactor building until 1997. In July 1987, the company announced to the Saxon community that they planned to decontaminate and dismantle five buildings within the plant, excluding the reactor building. However, some residents want the GPU to wait until the radioactivity decays to less potent levels and more is known about dismantling nuclear plants. In particular, the community members expressed a lack of trust in GPU because the company failed to inform them about radioactive leaks in the 1970s. (CAC)

226

Egashira, T., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development: Introduction

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (7 pp.) (1985)

The Japanese AEC established the "Special Committee for Reactor Decommissioning" in 1981 which published a report describing the government policies on reactor decommissioning in 1982. The report, entitled "The Long Term Program for Development and Utilization of Nuclear Energy," states that research and development of reactor decommissioning technologies should be conducted during the first half of the 1980s and decommissioning demonstrations of the JPDR should be conducted during the last half. Improvement of the technologies that result from this decommissioning experience should be realized by the time they are needed for commercial reactor dismantlement in the mid-1990s. (CAC)

227

Fiorini, O., G.F. Germani, and F. Pandarese

Nuclear Power Plant Heat Exchanger Tube Cutting by Means of a NdYAG Laser with Optical Fiber Beam Transport

Lasers in Manufacturing, Proceedings of the Third International Conference, Paris, France, June 3-5, 1986; (pp. 19-23) (1986)

The apparatus used to cut from the interior a 304 stainless steel tube with inner diameter 17.5 mm, 1 mm thick and 9 m from the nearest end, is described. The fiber was put in a stainless steel flexible bellow which assured both the flow of assisting gas, oxygen, and rotation of output coupler around tube axis. A Nd-YAG laser equipped with a quartz 1 mm core diameter, 12 m length fiber optics, was adopted. The input coupler was an 80 mm focal length lens. The output coupler was a single lens imaging system with 1:1 magnification factor. The resulting average power at the working point was 100 W with repetitive pulses of 2 ms duration and 70 Hz repetition rate. The time required for cutting one tube was 66 s.

228

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

Dismantling Procedure for Decommissioned Nuclear Power Plants

German Patent DE 2,854,330/C/; 3 pp. (1983, January 5)

A pit is excavated under the ground plate of the non-contaminated component part of the reactor or nuclear power station to be dismantled. The component part is then separated from the ground plate and let down into the pit. A supporting construction can be used to let down the component part into the pit.

229

Gelfort, E., J. Mischke, H. Blickwedel, and H. Haferkamp

Submerged Cutting of Nuclear Fuel Elements by High Speed Water Jets

Jet Cutting Technology, Proceedings of the Eighth International Symposium, Durham, United Kingdom, September 9-11, 1986; (pp. 315-322) (1986)

With two different shield nozzles submerged cutting of Al tubes with an air coated high speed water jet has been

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tested. Both nozzles work according to the water jet pump principle. Because of the improved design of the second nozzle used, the working distance could be increased up to 40% compared with the first nozzle type. With this improved shield nozzle, it is shown that an air coated high speed water jet is able to cut a fuel rod filled with ceramic pellets in simulated underwater conditions.

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Hamasaki, M., M. Katsumura, and H. Utsumi, Government Industrial Research Institute, Shikoku, Takamatsu, Japan

Laser Cutting of Concretes with Various Ballasts

Koon Gakkaishi 11(6):226-233 (1985, November)

The biological shield concrete and the radiation shield concrete which are a part of the atomic reactor must be demolished when the atomic reactor plant is decommissioned and dismantled. Laser cutting techniques are expected to become important methods for dismantling of the radioactive concrete shields. Cutting tests using a 5 kW output CO₂ laser were performed on a mortar; concretes with andesite, lime stone, and gray wacke as aggregate; and a concrete reinforced with mild steel rods. Results of the tests indicated that cutting performance varied with the material used as aggregate and that 100-mm-thick reinforced concrete could be cut. An added advantage is the safety aspect of the laser cutting technique which produced little dust and fume.

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Hamasaki, M., Y. Murao, and F. Tateiwa, Government Industrial Research Institute, Machinery and Metal Department, Shikoku, Takamatsu, Japan

Gouging the Answer to Nuclear Dismantling Problems

Welding and Metal Fabrication 49(10):585-587 (1981, December)

A plasma arc cutting technique has been developed for use in dismantling commercial pressure vessels and tested on those made of carbon steel plate with type 304 stainless steel cladding. Two gouging methods were tried: one employing a carbon stick electrode, the other a mild

steel wire or strip. The former method is the same as that used commonly in air, except that it was carried 20 cm underwater, using a d.c. constant voltage power source. The workpiece is preheated to about 1,000 degrees C using an oxy-fuel mixture via an oxygen torch. The fuel is propane and methylacetylene. The cladding was melted by the arc and blown away by a water jet. A traveling carriage permitted continuous gouging. The gouged section had an acceptable appearance but there were radiation hazards in changing the electrode. Water jet pressure with the carbon rod varied between 1 and 7 kg/cm. Gouging at 3 kg/cm was successful. The contact angle varied between 30 and 60 degrees. An increase in travel speed led to a reduction in gouging depth. Differing electrode diameters gave differing gouge widths. Optimum mild steel wire gouging occurred with a water pressure of 4 kg/cm and a contact angle of 60 degrees. As with carbon rods, gouge depth is reduced by increasing the cutting speed; it becomes deeper with open circuit voltage because the gouging current increases. The underwater gas cutting speed for 150 mm thick mild steel plate is 15-20 cm/min. (Auth)(SET)

232

Hodge, D.

Stainless Steel Profiling - A Review

Sheet Metal Industries 57(1):37-40, 69 (1980, January)

While the increasing use of stainless steel has brought wide ranging benefits to the engineering industry, it has also proved a major catalyst in the development of more efficient cutting methods and machines. In this article, the author examines two cutting processes which ten years ago were considered interesting but uncommercial yet have today established themselves as the most viable industrial methods for profiling stainless steel. The two processes under consideration are plasma-arc and laser cutting. These systems effectively cover almost the whole spectrum of stainless steel profiling from 1152-mm-thick plate down to 0.06-mm sheet. (Auth)

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

Overview of JPDR Decommissioning Program

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (10 pp.) (1985)

In May 1985, there were 28 nuclear power plants (21,000 MW electricity) in operation, supplying about 23% of the total electric power demand in Japan. In addition, there were 12 plants (12,000 MW electricity) under construction. In the latter half of the 1990s, some of those power plants will be decommissioned. In anticipation of future needs, the Japan Atomic Energy Commission set up a study program to develop necessary techniques for decommissioning nuclear power plants and to demonstrate actual decommissioning work in the Japan Power Demonstration Reactor (JPDR) plant. The JPDR, a 12.5 MW(e) BWR power plant, went into operation in 1963 and shut down in 1976. The JPDR decommissioning program consists of two major phases. Phase 1 involved the development of techniques needed for complete reactor dismantlement. This phase started in November 1981 and was scheduled to be completed by 1986. Phase 2 will be the actual dismantlement of the JPDR plant. Complete dismantlement is a practical selection in Japan from the viewpoint of site reuse. Phase 2 was scheduled to start after completion of Phase 1 and will take about six years to complete. The JPDR decommissioning program is outlined in this report. (CAC)(DCM)

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development of Reactor Decommissioning Technology

Report (1985, February)

This report on the development of reactor decommissioning technology has three parts. The first part describes the program of reactor decommissioning technology development and contains sections on decommissioning systems engineering; non-destructive measurement of radioactivity inside pipe; radioactive inventory estimation; reactor disassembly; decontamination for reactor decommissioning; radiation control; radioactive waste treatment, transportation, and storage;

and remote handling. The second part describes the JPDR dismantling plan and the third part outlines this plan. Many color photographs and illustrations are included. (CAC)

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Kaemmerling, M., and U. Borschel, Transnuklear GmbH, Hanau, Federal Republic of Germany

Process for Dismantling of Activated Containers in Decommissioned Nuclear Facilities

German Patent DE 2,907,738/C/; 2 pp. (1984, August 16)

The container is filled to the top with fluid materials for shielding purposes. Paraffin, tar, granulates, sand or bar-ytes are suitable filling matters. In the course of dismantling the containment enclosure and wall the filling materials are removed, and also used for conditioning the dismantled components in the ultimate storage form. The dismantling is carried out by remote-handling. The parts and filling materials are removed by means of a channel tube which penetrates the bottom of the containment, which is also dismantled.

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Kamike, K., H. Ishikawa, and S. Ohkawa, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

An Outline of Code System for Management of Reactor Decommissioning (COSMARD)

Report (1986, March)

In planning reactor dismantlement, a number of aspects should be evaluated such as costs, manpower, dismantlement processes, worker exposures, and radioactive wastes. These conditions are governed by various factors such as plant conditions and operational history, dismantling techniques, waste management policy, etc. In 1981, the Japan Atomic Energy Research Institute began the "Reactor Decommissioning Technology Development Program" to address these concerns. The program includes the development of the computer code system, COSMARD, which will analyze and determine the optimum dismantlement program for the Japan Power Demonstration Reactor (JPDR). This paper outlines the functions and objectives of COSMARD. (Auth)(CAC)

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Katsumura, M., Government Industrial Research Institute, Shikoku, Takamatsu, Japan

Cutting of Concrete Structures by Laser

Konkurito Kogaku 24(3):92-95 (1986, March)

In order to dismantle the biological shielding wall of a reactor with safety, the use of a laser beam cutting technique is being studied. Using this technique, the shielding wall can be cut, regardless of its constitution, and the operation can be remotely controlled. In the apparatus using an axial-flow CO₂ laser of maximum output 5 kW, the laser beam is focused with a KCL lens of diameter 75 mm, where an assist gas is blown with a nozzle. Here are involved the angle between beam center and nozzle, the distance between beam center and nozzle, and the focal distance within the concrete structure. To examine cutting characteristics of the laser beam method, the tests were made with specimens of mortar, aggregate mixed concrete and reinforced concrete.

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Kawasaki, M., Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Dismantling of a Reactor Plant

Konkurito Kogaku 24(3):89-92 (1986, March)

The decommissioning of a reactor plant differs from that of other facilities in that radioactive materials due to neutron irradiation remain in the concrete and other structural materials. This presents technical difficulties during its dismantling, which results in an increase in decommissioning costs. In the Japan Atomic Energy Research Institute, the dismantling of the Japan Power Demonstration Reactor is to start in fiscal 1986. The techniques for dismantling the JPDR's concrete structures are being developed and will be employed in the decommissioning of the reactor. These techniques include: (1) controlled blasting method - by the explosive energy of powder, cracks are made in a concrete structure; (2) mechanical cutting - a concrete structure is cut into pieces with a diamond blade or bit; and (3) water jet cutting - a concrete structure with iron reinforcement is cut off with an abrasive-containing high-pressure water jet.

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Kawasaki, M., T. Abe, and T. Nishizaki, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development of Inside Disk Cutter for Remote Cutting of Reactor Vessel

FAPIG (First Atomic Power Industry Group, Tokyo) 113:51-55 (1986, July)

Because of limited space in Japan it is necessary to dismantle decommissioned nuclear power plants so that their sites can be reused. Remote cutting and handling techniques will be used to dismantle highly activated or contaminated reactor components such as the reactor pressure vessel and primary system piping. This paper describes a pilot-stage inside disc cutter developed at the Japan Atomic Energy Research Institute for remote cutting of pipes connected to the reactor vessel. The development status of cutting methods for metallic components is also described. (Auth)

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Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Dismantling and Total Demolition of the Niederaichbach Nuclear Power Plant (KKN)

Report (1985)

The Niederaichbach Nuclear Power Plant was designed for a nominal output of 100 MW(e) and built near Landshut, Bavaria during 1966 to 1972. From 1972 to 1974, the plant was operated for 18 full power days with 40% of its nominal power. For economic and technical reasons, the plant was shut down for good in 1974. This report describes the steps of the decommissioning program and includes several diagrams and a workplan.

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Klein, W.J., WasteChem Corporation, Paramus, NJ

Underwater Compressing and Cutting Apparatus

U.S. Patent 4,648,989; 5 pp. (1987, March 10)

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This patent describes an underwater compressing and cutting apparatus applicable to activated or contaminated components of the core of a nuclear reactor. The apparatus comprises of: a frame; first squeezing means attached to the frame; first controllable displacing means attached to the frame; a first assembly that is movable by the controllable displacing means and comprising second squeezing means and sled means supporting the second squeezing means and slidable on the frame and having vertically extending, horizontally spaced sliding means joined by transversely extending means. The transversely extending means is displaceable by the controllable displacing means for displacing the slidable means and the second squeezing means together in two directions on the frame to compress and release the core components; the frame comprising a first horizontal removable member above and in contact with the vertically extending, horizontally spaced sliding means of the first assembly; the frame also comprising a second horizontal removable member below and supporting the vertically extending, horizontally spaced sliding means of the first assembly; and the frame also comprising removable vertical side members between the horizontal members and having surfaces against which the sled means slides.

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Konno, T., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development: Demolition Techniques for Biological Shield Concrete

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (15 pp.) (1985)

Biological shields for commercial nuclear power plants are massive and are constructed with heavily-reinforced concrete to meet the requirements for radiation shielding and for stability under seismic loading. After 30-40 years of reactor operation, the biological shield has received significant neutron-activation and, therefore, contains a high radionuclide inventory. To prevent excessive radiation exposure to workers involved with decommissioning and dismantling the nuclear power plant, remote han-

dling techniques should be used to dismantle the concrete biological shield. In 1981, the Japan Atomic Energy Research Institute (JAERI) began developing remote handling techniques for application to the decommissioning and dismantlement of the Japan Power Demonstration Reactor (JPDR). These techniques include (1) mechanical cutting; (2) abrasive-water jet cutting; (3) controlled blasting; and (4) thermal cutting. The development activity included designing and manufacturing experimental equipment and cutting tests to obtain performance data. Based on these test results, a practical dismantling system will be designed and manufactured for application to the JPDR. (Auth)(CAC) (DCM)

243

Kroeger, J., and J. Frese, Power-Clean Industry/NICO Industriereinigung AG, Luzern, Switzerland; Ingenieurbuero (Consulting Engineering Office) K&F, Hamburg, Federal Republic of Germany

High-Efficiency Exhauster System "PC 5 NA" (SUPER-VAC)

Report (1986, December)

This report describes the High Efficiency Exhauster System "PC 5 NA," a piece of equipment used in the course of back-fitting, revision, and decommissioning operations. The specifications, applications, and advantages of the system (also known as "SUPER-VAC") are listed in the context of its use by Power-Clean Industry, a decommissioning- and decontamination-contractor. (CAC)

244

Kudlicza, P.

Dismantling of Nuclear Installations: How Nuclear Power Plants Are Razed to the Ground - Conditions After Planned Shutdown Differ from Emergency Shutdown

Verein Deutscher Ingenieure Nachrichten 40(43):50 (1986, October 24)

The procedure for the decommissioning and dismantling of nuclear power plants, either planned or unscheduled, is divided into three main stages. At the first, the

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mechanical and electrical installations are put out of operation and the fuel is removed from the reactor core. Then the reactor is sealed with a radiation shield so that the components can be dismantled. Only in the last stage the final removal of the complete installation can be done, leading to the 'green pasture status'.

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Lazarev, Yu.N., V.N. Rozin, and A.V. Revin

On Removing a Nuclear Power Station from Operation

Elektricheskie Stantsii 12:6-7 (1986)

The removal of a nuclear power station from operation is discussed in terms of taking a number of technical decisions to immobilize radioactive equipment and materials from the exhausted resources in the station. The procedure is conducted in three stages: (1) conservation under inspection; (2) conservation with partial disassembly; and (3) disassembly and burial of the elements at agreed levels of contamination. It is stressed that the engineering of a nuclear power plant necessitates the examination of its long-term reliability, as demanded by a large power system. The possibility of reconstruction of the station, or its removal from operation, must be considered at the design stages.

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Lebedev, B.P.

To the Problem of NPP Dismantling When Lifetime Is Up

Energokhozyaistvo za Rubezhom 4:39-40 (1986, July-August)

The problems related to nuclear power plant dismantling are briefly reported. Up to the early 80s, more than 100 nuclear reactors have been decommissioned in the world. However, only one reactor has been completely dismantled.

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Luck, W., and W. Knichelmann, Transnuklear GmbH, Hanau, Federal Republic of Germany

Underwater Cutting Device

German Patent DE 3,416,620/C/; 9 pp. (1986, May 7)

An underwater cutting device for activated and contaminated components of nuclear reactor cores is described, by which components of different geometries and with different properties can be cut up in order to reduce their volume. It consists of a fixed and a movable part, each equipped with a compression jaw and a cutting knife, and which can be controlled via a hydraulic cylinder. The transport of the components into the cutting unit is done via rollers in both parts, which are connected to each other by a chain.

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Lui, Z., Beijing Institute of Atomic Energy, Beijing, China

Overhaul and Reconstruction of the HWRR-1 Reactor: A Decommissioning Project of Nuclear Reactors in China

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

The HWRR-1, a heavy water research reactor owned by the Beijing Institute of Atomic Energy (BIAE), came into operation in September 1958 with a power rating of 10 MW. After many years of operation, problems and system failures indicated a need for an evaluation of the HWRR-1 to decide the reactor's future. The apparent alternatives were to repair and upgrade the existing reactor or to shut down and decommission the HWRR-1 and build a new advanced research reactor. This report describes the comparison of the costs; construction completion times; equipment, buildings, and reactor components requirements (including their reuse, in the case of upgrading); and the engineering feasibility of the alternatives. The decision was made to upgrade the HWRR-1. The reactor's problems are defined, and the steps taken to correct the problems, and recondition and upgrade the reactor are described. The radioactive inventory and personnel exposure from the decommissioning are also given. (Auth)(CAC)(DCM)

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Luykx, F., Commission of the European Communities, Brussels, Belgium

Safety and Regulatory Aspects of Decommissioning

Scientific Afternoon, Proceedings of an International Atomic Energy Agency General Conference - Thirtieth Regular Session, Vienna, Austria, September 1986, Preprint; (9 pp.) (1986, September)

When decommissioning nuclear plants, two main radiation protection problems arise: (1) exposure of workers and the public during dismantlement, and (2) exposure due to radioactive waste management and disposal. Therefore, before a particular decommissioning strategy for a plant is chosen, a radiological impact assessment should be carried out to determine compliance with basic radiation protection principles. Such decommissioning regulations have been developed in the past mostly on a case-by-case basis, and only a few countries are developing national policies. Because many plants will be shut-down in the near future, a consistent regulatory approach is necessary. In particular, standards regarding acceptable levels of radioactivity in recoverable metals and equipment should be formulated on an international level. The work of the Commission of the European Communities in this field is reviewed in this paper. The problems related to the unrestricted release of waste, dismantling after unplanned events, and compliance with regulations are also briefly described. Auth(CAC)

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Matsumoto, A., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Health Physics, Tokai, Ibaraki, Japan

JPDR Decommissioning Program: Waste Management

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (16 pp.) (1985)

This paper discusses radioactive waste management practices in Japan and, more specifically, the radioactive waste management program used in dismantling the

Japan Power Demonstration Reactor (JPDR). The treatment and storage of both solid and liquid wastes is outlined. Included in the waste management program for dismantling the JPDR will be an estimation of the amount of wastes (low-level, extremely low-level, and nonradioactive) and special measures taken for the treatment and storage of activated metallic, contaminated metallic, concrete, and extremely low-level wastes. (CAC)(DCM)

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McDermott, K.J., M.D. Pavelek, and H.T. Roman, New Jersey Institute of Technology, Newark, NJ

Tomorrow's Mobile Robots in Today's Nuclear Power Plants

Transactions of the American Nuclear Society 53:507; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (p. 507) (1986)

A primary motivation for utilizing robots in nuclear power plants is maintenance economics and the nuclear industry's concern with reducing personnel radiation exposure to as low as reasonably achievable as recommended by the U.S. Nuclear Regulatory Commission (NRC). Recent studies by Battelle Columbus Laboratories, the Electric Power Research Institute, the NRC and others indicate that robots for surveillance and inspection can be retrofitted into existing boiling water reactor and pressurized water reactor plants, but economics must be evaluated on a case-by-case, site-specific basis, because nuclear power plants in the US are usually different in design. Application areas or robot functions being considered are broad and range from primary containment inspection, reactor maintenance, routine health physics tasks, and various operation and maintenance procedures, to facility decontamination and decommissioning, and post-accident recovery such as at Three Mile Island Unit 2. This paper will discuss the general use of robotic devices in nuclear power plants, the pioneering use of robotics technology at Three Mile Island nuclear power plant, and the field testing of mobile robots at Public Service Electric and Gas Company's Salem and Hope Creek nuclear plants.

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Menon, S., and K. Bragg, Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden; Organization for Economic Cooperation and Development, Nuclear Energy Agency, Paris, France

The OECD/NEA Cooperative Program Concerning Nuclear Installation Decommissioning Projects

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (7 pp.) (1985)

One of the primary objectives of the Nuclear Energy Agency of the OECD is to promote cooperation between its member countries on the safety and regulatory aspects of nuclear development. In the spirit of this objective, the NEA has organized a cooperative program to facilitate the exchange of scientific and technical information concerning the decommissioning of nuclear installations. The current paper describes the background of the program, its proposed scope and executive procedures. It also briefly describes the various projects that are included in the program at present. (CAC)

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Milne, R.

Breaking up Is Hard To Do (Windscale, Decommissioning)

New Scientist 112(1538):34-36 (1986, December 11)

The Windscale advanced-gas-cooled reactor is one of the most photographed nuclear structures in Britain. In 10 years' time, if all goes as planned, the famous silvery sphere enclosing the reactor will have vanished. However, dismantling and removing this early symbol of Britain's nuclear prowess is proving no easy task. Scientists and engineers are grappling with the range of problems which will need to be solved during the next three years if they are to keep close to their schedule. The schedule has already slipped by about two years. Technically, the land occupied by the reactor could become a green-field site again by 1996. Unanswered questions remain, though. For example, what will happen to the low- and intermediate-level radioactive waste created by decommissioning?

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Miraglia, F.L., U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, DC

Virginia Polytechnic Institute and State University, VPI Argonaut Reactor: Order Authorizing Dismantling of Facility and Disposition of Component Parts

Federal Register 51(213):40098-40099; DOCKET 50-124 (1986, November 4)

The U.S. Nuclear Regulatory Commission (NRC) has reviewed Virginia Polytechnic Institute and State University's application for authorization to dismantle and dispose of component parts of its Argonaut Reactor (VPI Argonaut Reactor). The NRC has found that the dismantling and disposal of component parts in accordance with the licensee's dismantling plan will be in accordance with the regulations in 10 CFR Chapter I, and will not be inimical to the common defense and security or to the health and safety of the public. An Environmental Assessment (EA) prepared by the NRC determined that the proposed action will not result in any significant environmental impact and that an Environmental Impact Statement need not be prepared. Accordingly, VPI was ordered to dismantle the reactor facility and dispose of the component parts in accordance with its dismantling plan and the NRC's rules and regulations. (DCM)

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Moeller, K., Kernforschungszentrum Karlsruhe GmbH, Project HDR-Sicherheitsprogramm, Karlsruhe, Federal Republic of Germany

Dismantling of Concrete with Explosive Charges - Description and First Results of Experiments in the HDR-Plant

Report (1986, September)

The German Federal Ministry for Research and Technology decided in late 1973 to use the Superheated Steam Reactor (HDR) for engineering safeguards studies. The HDR Safety Program is devoted to studies of the systems and components which are important to the safety of light water reactors under operating and accident conditions. The investigations performed on

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these systems and components serve the following general objectives: (1) improvement of knowledge about the sequence of accident events, the safety-related aspects of properties and structural behavior of the systems and components in specific accidents, and quantification of existing safety margins; (2) verification of the reliability of existing computation methods and of in-service inspections of these components; and (3) optimization and improvement of calculation procedures. In line with these objectives, the concrete decomposition experiments mainly serve to prove the feasibility of blasting steel reinforced concrete and to determine the resultant loads on the reactor internals, reactor containment, and adjacent structures. This report describes these experiments and the results. (Auth)(CAC)

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Mori, Y., Ministry of Transportation, Tokyo, Japan

Revised Experimental Program on the Nuclear Ship 'Mutsu'

Zosen Gijutsu (Japan) 18(9):33-40 (1985, September)

The experimental program for the nuclear ship "Mutsu" has been revised by the Government. The responsible organization for NS Mutsu was transferred to the Japan Atomic Energy Research Institute (JAERI) from the Japan Nuclear-ship Development Agency. The revised, new experimental program contains the following provisions: (1) experimental navigation of the NS Mutsu is conducted with the already loaded 1st reactor core for about one year; (2) the mooring port for the NS Mutsu is held to a minimum scale; (3) upon termination of the experimental navigation, the NS Mutsu is immediately decommissioned; and (4) power-up test and experimental navigation of NS Mutsu are made in fiscal 1989 to 1990. The policy of research and development with the NS Mutsu and the programs assigned to JAERI concerning the NS Mutsu are described.

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Ochiai, K., Toshiba Corporation, Kawasaki, Kanagawa, Japan; Nippon Atomic Industry Group Company Limited, Tokyo, Japan

Primary Shielding Walls for Nuclear Reactors

Japanese Patent 60-249,089/A/; Japanese Patent Application 59-105370; 4 pp. (1985, December 9)

A method is described which enables to surely judge the region in which the radioactivity level is high and a range which can be handled as ordinary industrial wastes corresponding to the primary shielding walls of respective nuclear reactors upon their dismantling, so that the amount of high-level radioactive wastes can be kept as low as possible. A plurality of through holes each with a diameter of several centimeters are perforated passing through the primary shielding walls of a nuclear reactor in the horizontal direction. Radioactivity measuring members are incorporated in each of the through holes. Upon planning the dismantling of a nuclear power plant, concrete and iron wire pieces are sampled from the inside of the through holes and the radioactivity thereof is measured by a Ge(Li) semiconductor detector or the like to estimate the distribution of the radioactivity intensity in concretes, iron wires, and impurities contained therein.

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Phillips, D.A.

Submerged Cutting of Reactor Components and Vessels

Transactions of the American Nuclear Society 27:760-761; CONF-771109; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 27-December 2, 1977; (pp. 760-761) (1977)

Dismantling of the sodium reactor experiment at Atomics International's Nuclear Development Field Laboratory in Chatsworth, California, required the development of remote operational techniques and the attendant remote tooling. An analytical estimate of the residual-induced radioactivity in the reactor vessels and components indicated that up to 1000 R/h could be expected at the reactor core elevation in the center of the empty core vessel. This resulted in the selection of water shielding for vessel cutup operations, the use of underwater plasma arc cutting with rotating mast manipulator for the basic vessel dissecting technique, and underwater explosive cutting for the internal piping. This article briefly describes the development of these techniques. (Auth)(CAC)

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Power Reactor and Nuclear Fuel Development Corporation (PNC), Tokyo, Japan

Handcuts for the Fourth DOE/PNC Joint Working Group Meeting on Waste Management

U.S. Department of Energy/Power Reactor and Nuclear Fuel Development Corporation (DOE/PNC) Joint Working Group Meeting on Waste Management, March 10-11, 1986 (1985)

This collection of handouts concerns the management of nuclear wastes in Japan. The first section contains a number of visual aids, diagrams, and illustrations. The second section contains an article on the design of the vitrification plant for the high-level liquid waste that is generated from the Tokai reprocessing plant. The third section describes the Radioactive Waste Storage Research Center of Japanese Atomic Energy Commission, and the final section is an overview of the waste dismantling facility. (CAC)

260

Rider, R.L., R.J. Wolfgang, and G.R. Skillman, Bechtel Eastern Power Corporation, Gaithersburg, MD

Unique Applications of Underwater Tooling: The TMI-2 Defueling Experience

Transactions of the American Nuclear Society 52:554-555; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 554-555) (1986)

The complex task of safely removing the damaged core from Three Mile Island Unit 2 (TMI-2) is under way. Many unique underwater operations are being performed in the cutting up and placing of debris into defueling canisters, and a wide range of problems is being encountered and resolved. The materials in the reactor vessel that must be manipulated include a diverse inventory such as submicron-sized debris, fuel pellets and larger size pieces of composite core debris, partially intact fuel assemblies, as well as an indeterminate damaged core mass.

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Rubrecht, R.C., P.V. Judd, and A.A. Katterhenry, NUS Operating Services Corporation, Clearwater Operations, Clearwater, FL; Electric Power Research Institute, Palo Alto, CA

Removal of a Tubesheet Sample from a Retired Point Beach Unit 1 Steam Generator - Final Report

EPRI-NP-4901; 140 pp. (1986, December)

The project described in the following report was undertaken by NUS Operating Services Corporation (NUSOSC) to remove a tubesheet sample from a steam generator that was retired from service due to corrosion damage to tubes particularly in the tubesheet. The field work was performed at the Wisconsin Electric Power Company's (WEPCO) Point Beach Nuclear Plant where two Westinghouse steam generators from the Unit 1 pressurized water reactor system are stored in an on-site storage building. The sample removed is for subsequent detailed analyses of causes of the corrosion in the crevice area between the Inconel tubes and the tubesheet. Three concepts to remove the sample were investigated by NUSOSC: drilling, plasma arc cutting, and electric discharge machining (EDM). The electric discharge machining technique was finally chosen to remove the sample. Although the report discusses all three concepts investigated, the primary emphasis is on the work activities undertaken by NUSOSC which resulted in the successful removal of a steam generator sample by EDM. A great deal of insight was gained regarding the problems involved in the removal of the sample in a high radiation environment using EDM.

262

Schreiber, J.J., U.S. Department of Energy, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (36 pp.) (1985)

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This report outlines the mission of the Shippingport Station Decommissioning Project (SSDP). The objectives of the SSDP are listed as follows: (1) to demonstrate safe and cost effective dismantlement of a large scale nuclear power plant; (2) to utilize subcontractors to increase technology base/experience; and (3) to provide technologies and industry standards for future projects. The bulk of this report contains technical drawings and visual aids. (CAC)

263

Stewart, J.A., and D.L. Charlesworth, Savannah River Laboratory, Aiken, SC

Design and Operation of a Remotely Operated Plutonium Waste Size Reduction and Material Handling Process

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 483-488) (1986)

Non-combustible Pu-238 and Pu-239 waste is generated as a result of normal operation and decommissioning activity at the Savannah River Plant, and is being retrievably stored there. As part of the long-term plan to process the stored waste and current waste for permanent disposal, a remote size reduction and material handling process is being cold-tested at Savannah River Laboratory. The process consists of a large, low-speed shredder and material handling system, a remote worktable, a bagless transfer system, and a robotically controlled manipulator. Initial testing of the shredder and material handling system and a cycle test of the bagless transfer system has been completed. Fabrication and acceptance testing of the Telerobot, a robotically controlled manipulator, has been completed. Testing is scheduled to begin in 3/86. Design features maximizing the ability to remotely maintain the equipment were incorporated. Complete cold-testing of the equipment is scheduled to be completed in 1987.

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Stewart, J.A., T.F. Schuler, and C.R. Ward, Savannah River Laboratory, Aiken, SC; NAGRA, Baden, Switzerland

Demonstration of a Remotely Operated TRU Waste Size-Reduction and Material Handling Process

DP-MS-86-71; CONF-8611139; Remote Handling Operations in Waste Processing, Decontamination, and Size-Reduction Facilities, Proceedings of a Conference, Washington, DC, November 12, 1986; (8 pp.) (1986)

Noncombustible Pu-238 and Pu-239 waste is generated as a result of normal operation and decommissioning activity at the Savannah River Plant and is being retrievably stored at the site. As part of the long-term plan to process the stored waste and current waste for permanent disposal, a remote size-reduction and material handling process is being tested at Savannah River Laboratory to provide design support for the plant TRU Waste Facility scheduled to be completed in 1993. The process consists of a large, low-speed shredder and material handling system, a remote worktable, a bagless transfer system, and a robotically controlled manipulator, or Telerobot. Initial testing of the shredder and material handling system and a cycle test of the bagless transfer system were completed. Initial Telerobot run-in and system evaluation was completed. User software was evaluated and modified to support complete menu-driven operation. Telerobot prototype size-reduction tooling was designed and successfully tested. Complete nonradioactive testing of the equipment is scheduled to be completed in 1987.

265

Sullivan, A.H., and C. Renaud, European Organization for Nuclear Research, Geneva, Switzerland

Decommissioning of a Tunnel Used as a Shield for a High-Energy Proton Beam

CONF-840512; Radiation - Risk - Protection, Proceedings of the Sixth International Radiation Protection Association Congress, Berlin, Federal Republic of Germany, May 7, 1984, Vol. 3; (pp. 795-798) (1984)

When high-energy particle accelerators and related facilities are designed, considerable effort is made to adequately shield them and to safely handle any radioactivity induced by high-energy particle interactions. A radiation problem that will arise in the future, but which

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receives relatively little attention at the design stage, is the eventual disposal of the large quantities of low-level radioactivity, particularly in the shielding. This issue must be faced when the accelerator comes to the end of its useful life. This paper presents a study of this problem that was made when an obsolete proton beam tunnel was removed to make way for the injector for an electron positron collider (LEP) being constructed at CERN. In particular, this paper discusses the residual radioactivity left in the shielding material after the more usual isotopes have had time to decay. This is a major consideration in determining the length of storage time necessary before those materials can be freely recycled. (CAC)

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Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden

Technology and Costs for Decommissioning the Swedish Nuclear Power Plants

SKB Technical Report 86-18; 66 pp. (1986, May)

Procedures and costs involved in decommissioning a nuclear power plant are described in this study. The study shows that, from the viewpoint of radiological safety, a nuclear power plant can be dismantled immediately after it has been shut down and the fuel has been removed, which is estimated to take about one year. Special equipment need only be developed for dismantlement of the reactor vessel and for demolishing of heavy concrete structures. The dismantling can be accomplished in about five years, with an average labor force of about 200 men. In order to limit the labor requirement and the dose burden to the personnel, the material is taken out in as large pieces as possible. Although the primary focus of this study is on immediate dismantling, advantages and disadvantages of other dismantling schedules are discussed. (Auth)(SET)(DCM)

267

Takamura, S., H. Maeta, M. Watanabe, T. Kato, and H. Kawakami, Japan Atomic Energy Research Institute, Tokyo, Japan

Dismantling of the Liquid Helium Temperature Loop (LHTL)

JAERI-M-85-133; 143 pp. (1985, September)

The Liquid Helium Temperature Loop (LHTL) was dismantled in March, 1984. Construction of the LHTL, which was installed in a horizontal experimental hole of JRR-3, was completed in February of 1967. The loop was used until the last operation in March, 1983 as an in pile irradiation apparatus for the study of fundamental aspects of radiation damage in materials and radiation effects of materials for superconducting magnets. This report describes the planning, safety and practice of the dismantling of LHTL, in addition to the list of works obtained using the loop.

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Tanaka, M., and S.-I. Miyasaka, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

JPDR Decommissioning Program: Data Collection During JPDR Dismantlement

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (15 pp.) (1985)

The Japan Atomic Energy Research Institute (JAERI) is developing many reactor dismantlement technologies which will be used in the Japan Power Demonstration Reactor (JPDR) dismantlement. These are: (a) radioactive inventory estimation; (b) nondestructive measurement of radioactivity inside pipe; (c) reactor disassembly and demolition; (d) decontamination for reactor decommissioning; (e) radiation control; (f) radioactive waste treatment, transportation, and storage; (g) remote handling; and (h) decommissioning systems engineering. During the JPDR dismantlement, a wide variety of engineering and administrative data will be collected. These data will be used to examine the applicability of these technologies to large commercial power reactors. These technologies will be modified if necessary. Administrative data such as manpower, worker exposure, radioactive waste quantity, and cost of dismantling will be used to assess a computer program, COF/MAND, which evaluates and plans the JPDR dismantlement. The code will be improved as necessary for application to large commercial power reactor dismantlement. (Auth)(CAC)

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Tanaka, M., and H. Nakamura, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan.

JPDR De-commissioning Program: Dismantling Procedure

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (10 pp.) (1985)

The Japan Power Demonstration Reactor (JPDR) dismantlement was scheduled to start in 1986 and continue through 1991. All facilities will be removed except for the administration building, warehouse, and machine shop. The JPDR site will then be renovated and landscaped. In this activity, the dismantlement technologies developed for the JPDR will be utilized and tested, and dismantlement data will be collected for future usage in the dismantlement of commercial reactors. This presentation describes the dismantling procedure for the reactor pressure vessel and biological shield and stresses the application of disassembly techniques that were developed for the JPDR. (CAC)(DCM)

270

Tarroni, G., C. Melandri, T. de Zaiacomo, C.C. Lombardi, and M. Formignani, Comitato Nazionale per l'Energia Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA), Bologna, Italy

Characterization of Aerosols Produced in Cutting Steel Components and Concrete Structures by Means of a Laser Beam

Journal of Aerosol Science 17(3):587-591; Aerosols in Science, Medicine, and Technology, Abstracts of the Association for Aerosol Research (Ges fuer Aerosolforsch) 13th Annual Conference, Garmisch-Partenkirchen, Federal Republic of Germany, September 25-27, 1985; (pp. 587-591) (1986)

The technique of cutting based on the use of a laser beam is studied as a possible method in nuclear plant dismantling. The technique implies a relevant problem of

contamination due to high aerosol production. The high temperature value locally reached in the cutting zone causes material vaporization with emission of very fine primary particles. In such conditions aerosol coagulation is very fast and leads to aggregates. Direct investigation on the primary particles is impossible at the moment due to the short life-time involved. The research discussed has been aimed at finding the characteristics of the aerosol removable from the cutting zone by ventilation and evaluating the morphology of the particles that diffuse at approximately 50 cm from the generation point, or settle on the cutting-box base.

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Tas, A., and G. Teunissen, Netherlands Energy Research Foundation, Petten, Netherlands

Reactor Vessel Dismantling at the High Flux Materials Testing Reactor Petten

Atomkernenergie/Kerntechnik 48(3):162-173 (1986, August-September)

The project of replacing the reactor vessel of the high flux materials testing reactor (HFR) originated in 1974 when results of several research programs confirmed severe neutron embrittlement of aluminum alloys. The situation suggested a limited life of the existing facility. This report describes the dismantling philosophy and organization, the design of special underwater equipment, the dismantling of the reactor vessel and thermal column, and the conditioning and shielding activities needed to produce a working area for the installation of the new vessel with no access limitations due to radiation. Finally an overview of the segmentation, waste disposal and radiation exposure is given. The total dismantling, segmentation, and conditioning activities resulted in a total collective radiation dose of 300 mSv.

272

Tatsumi, T., Hitachi Limited, Tokyo, Japan

Method of Freezing Type Dismantling for Wasted Reactors

Japanese Patent 60-233,597/A; Japanese Patent Application 59-88297; 3 pp. (1985, November 20)

A method is introduced to enable to operate a cutting device in the air by placing a working table on ice while

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utilizing the ice as radiation shielding materials thereby prevent the diffusion of air contaminations. Upon dismantling a BWR type reactor, ice is packed into a reactor container and a pressure vessel and frozen state is maintained by cooling coils disposed to the outer circumference of the pressure vessel. Then, an airtight hood is covered over the pressure vessel and a working table is rotatably disposed therein. Upon working, when the upper layer ice is melted by a heat pump and discharged, the airtight hood is lowered to a predetermined level. After freezing the melted portion again at the lowered level, cutting work is conducted by an operator in the hood. The cut pieces are conveyed after hoisting the airtight hood by a crane. The pressure vessel is dismantled by repeating the foregoing procedures. In this way, cut pieces can be recovered without falling them to the reactor bottom as in the conventional work in water. In addition, since the procedures are conducted while covering the airtight hood, diffusion of air contaminations can be prevented.

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Titzler, P.A., and C.R. Allan, Westinghouse Hanford Company, Richland, WA

Evaluation of Glovebox Sectioning Using Weld Splitting Techniques

Transactions of the American Nuclear Society 53:499-501; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 499-501) (1986)

A weld splitting method is being evaluated for sectioning austenitic stainless steel components. Testing consists of sectioning simulated stainless steel gloveboxes to determine the acceptability of using dissimilar metal splitting methods. The weld splitting mechanism, similar to liquid-metal embrittlement, results in a coating of the grain boundaries with a splitting agent such as copper through the material separation path. When copper is brought into contact with stainless steel during a welding operation and a critical stress level is present in the parent metal, the splitting phenomenon occurs. This technique has the advantage of sectioning without producing fines and smoke, and the disturbances to the far side of the material are minimized.

274

Ushakov, B.A.

NPP Decommissioning

Atomnaya Tekhnika za Rubezhom 2:19-22 (1986, February)

Different variants of nuclear power plant (NPP) decommissioning are considered. Characteristics of special mechanisms used for equipment decontamination and dismantling are presented. Presently, there are about 135 NPPs being decommissioned in the world. Among these are power, research, and test reactors, laboratory-scale facilities, and fuel cycle plants. In the near future large NPPs that have reached the end of their service life will be decommissioned in a number of countries. In IAEA's recommendations for NPP decommissioning processes, three stages are outlined: (1) NPP survey; (2) conservation with partial dismantling of equipment; and (3) reactor dismantling and further utilization of the decommissioning site. During the nearest years most of the plants planned for decommissioning will be transferred to the first or second stages. (SET)(DCM)

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Ushio, S.

Japanese Research Reactor To Be Decommissioned by Warehousing

Nucleonics Week 27(42):9 (1986, October 16)

The Japan Atomic Energy Research Institute (JAERI) is moving an outdated reactor 34 meters into a "large waste warehouse" at Tokai during October and November. JAERI developed the know-how for the unprecedented reactor removal method jointly with Shimizu Construction Company. It was developed as a part of the JAERI project to modify its Japan Research Reactor (JRR)-3. The removal of the 2,250-metric-ton JRR-3 will cost an estimated \$10-million, a part of the \$212-million program to replace JRR-3 with a 20-MW(t) research reactor. JAERI removed heavy water from the 10-MW(t) JRR-3 after its operation was suspended in 1983. On October 14, Shimizu workers lifted the reactor about 4 meters with 36 jacks, each capable of raising 100 metric tons. From October 20 to 27, they are slated to move the entire reactor 34 meters on steel rails, using four of the 100-metric-ton jacks, into the warehouse. Finally, from November 5

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to 7, Shimizu is scheduled to lower the reactor 14 meters onto the warehouse floor. A steel frame measuring 12 cubic meters already covers JRR-3, which is 10 meters wide. This method minimizes worker exposure to radioactivity and has other advantages, including shorter time period for plant removal than decommissioning, and better economics. However, LWRs are too heavy for such removal, the institute officials said. After the old JRR-3 is removed, JAERI will build a new 20-MW(t) light water-moderated, light water-cooled JRR-3 that will consume about 20% enriched uranium, with criticality targeted for 1989. The old heavy water-moderated, heavy water-cooled plant began operation in 1962. (Auth)

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Ushio, S.

A Decommissioning Schedule for the Japan Power Demonstration Reactor (JPDR)

Nucleonics Week 27(50):4 (1986, December 11)

The decommissioning schedule for the Japan Power Demonstration Reactor (JPDR) has been formulated by the Japan Atomic Energy Research Institute (JAERI). JAERI officials have said that the site of the 12.5-MW reactor at Tokai will become a "green field" by the middle of fiscal year 1991. The tools to cut the plant components have been developed. The schedule calls for removal of reactor peripheral equipment by FY-87 (ending March 1988). That will be followed by the dismantling and removal of both reactor core and pressure vessel through the end of FY-88. Radiation shield removal is slated for the middle of FY-90, with the containment scheduled to be removed by early FY-91. Turbine and peripheral equipment will be removed between FY-87 and early FY-90 while turbine housing will be dismantled by FY-91. Fuel removal is slated to be finished by the end of FY-91. Fuel storage facilities will be removed between FY-89 and early FY-90, with the fuel housing removal scheduled for mid-FY-90. The entire test decommissioning will be finished by early FY-91. (Auth)(SET)(DCM)

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Ushio, S., and A. MacLachlan

Japanese Prototype Decommissioning Project Is Underway

Nucleonics Week 27(30):10 (1983, July 24)

The Japan Atomic Energy Research Institute (JAERI) has begun the decommissioning of the Japan Demonstration Reactor (JPDR) at Tokai Village. This project to decommission and dismantle the 12.5-MW direct-cycle, forced-circulation BWR will be the prototype decommissioning exercise in a country where all power reactors are eventually expected to have to be dismantled due to the lack of suitable new sites. The estimated cost is 20-billion Yen (U.S. \$122-million). Dismantling operations at JPDR are starting in 1986 with the completion of radiological inventories. Reactor dismantling will begin in 1987. Restoration of the site will begin in 1991. JPDR was operated by JAERI at Tokai Village for 17,000 hours from October 1963 to March 1976 and generated about 140-million kilowatt-hours. The JPDR radiological inventory is estimated between 6,000 and 7,000 curies. JAERI, in partnership with plant vendors, has developed various tools such as plasma arc saws, abrasive water jets, diamond saws, and controlled blasting. Robotics technology, blasting techniques, and computer software have also been developed. (SET)(DCM)

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Vitiello, T., Studsvik Energiteknik AB, Nykoping, Sweden

Technical Status of the Garigliano Project

Report (1985, November 18)

The Garigliano Nuclear Plant was designed for a maximum output of 160 MW(e) and was started in 1964. The plant was shut down in 1978 for repair. In 1983 ENEL decided not to restart the plant and to do the activities for putting the plant in the stage one of decommissioning. The operative activities will begin after the transport of the fuel elements out of the plant and after the treatment of the radioactive waste (resins, sludges) that is now in tanks. This report briefly discusses the current status of the plant as of November 11, 1985. (Auth)(CAC)

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Wada, M., Japan Science and Technology Agency, Atomic Energy Bureau, Technology Development Division, Tokyo, Japan

Decommissioning Policy for Nuclear Installations in Japan

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Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (6 pp.) (1985, November)

This paper discusses the decommissioning policy for nuclear facilities in Japan, beginning with a general overview of the development of atomic energy in this country. The basic policy of nuclear reactor decommissioning, based on the "Long-Term Program on Nuclear Energy Development and Utilization" published in 1982 by the Atomic Energy Commission, is also outlined. The discussion further includes sections on dismantlement techniques and tests, upgrading laws and safety regulations, and international cooperation concerning dismantlement technology. (CAC)

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Wiedemann, L.W., and P.N. Standish, West Valley Nuclear Services Company, Inc., West Valley, NY

Use of a Cutting and Cleaning System at the West Valley Demonstration Project - March 1985-January 1986

DOE/NE-44139-8; 59 pp. (1986, April)

This report describes the use of a commercially available ultra high pressure water cutting and cleaning system at the West Valley Demonstration Project (WVDP) Facility. This system, known as the Ultra High Pressure System (UHP), has been successfully used at the WVDP in such applications as removing concrete from the internals of a cement mixer drum, cutting conventional and high density concrete in both clean and radioactively contaminated areas of the Facility and underwater cutting of aluminum canisters previously used for storage of spent nuclear fuel assemblies. The advantages of the system include savings in manpower, reduction in radiation exposure, adaptability to remote operations, and no structural damage to surrounding materials. This report describes the equipment associated with the UHP System and the cost expected for the capital equipment, consumable materials and special toolings. Details of the various cutting and cleaning operations performed at the WVDP are provided as well as a list of future projects. (Auth)(SET)

281

Wu, Y., S. Yu, H. Jiang, and H. Yu, Jiaotong University, Welding Division, Shanghai, China

Study of Tandem Double-Electrode Underwater Arc Cutting Technique

ISTIC-TR-C-000073; 9 pp. (1986)

A tandem double-electrode underwater arc cutting technique has been developed. It is effective in cutting thick work pieces and is therefore a competitor to underwater plasma arc cutting methods. The paper deals with the significance of distributive ratio of plate thickness during cutting and the influence of technological parameters upon the ratio. The last part of the paper is a brief account of the effects of the nozzle arrangement on cutting quality and of the different connections of nozzles with the welders on cutting speed.

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Yokota, M., and N. Ujihara, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

JPDR Decommissioning Program: Disassembly Techniques for Steel Structures

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (19 pp.) (1985)

This paper discusses the development of remote handling techniques for disassembling reactors. The emphasis is on techniques that are efficient and that will generate a minimum of by-products such as the gas, fume, and dross that typically result from reactor dismantlement. The techniques described include an arc saw, a plasma arc, a rotary disk knife, and a shaped explosive. The paper includes a number of drawings and diagrams. (CAC)(DCM)

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Yoshizaki, M., Ishikawajima-Harima Heavy Industries Company Limited, Tokyo, Japan

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Method of Dismantling a Nuclear Reactor Pressure Vessel

**Japanese Patent 60-230,098/A/; Japanese Patent
Application 59-85921; 3 pp. (1985, November 15)**

A method is introduced for dismantling a nuclear reactor pressure vessel which will reduce the radiation exposure dose, facilitate the recovery of cutting wastes and decrease the amount of necessary materials. First, the lower opening of the pressure vessel is closed with a cover, and the vessel is surrounded with materials or structural members, such as shielding walls or the pedestal cover. The space thus created between the pressure

vessel and the shielding walls is filled by injection of a synthetic resin. After the resin solidifies, water is injected into the inside of the pressure vessel and between the pressure vessel and the resin layer to form a water sealing layer. The pressure vessel is then cut along its circumference using an appropriate cutting technique, such as water-submerged gas cutting, into manageable pieces. Molten metal, formed during the cutting process, is quenched by the water sealing layer and falls to the bottom of the enclosure. After completion of the cutting work, the water sealing layer is withdrawn and the resin layer is heated to melting and allowed to fall where the metal cutting wastes become embedded in the resin.

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National Council on Radiation Protection and Measurements 21st Annual Meeting

CONF-850419; Proceedings of the National Council on Radiation Protection and Measurements 21st Annual Meeting, Washington, DC, April 3, 1985, 285 pp. (1986)

This book presents the papers given at a conference on radioactive waste management. Topics considered at the conference included quantities and sources of radioactive wastes, the processing of low-level wastes, a combined radioactive/hazardous waste disposal facility, high-level wastes, spent fuel disposal, the status of the WIPP, marine disposal, the disposal of uranium mill tailings, the decommissioning of nuclear facilities, regulations, US NRC activities, and the EPA's high-level waste and low-level waste standards.

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Measures for the Treatment and Disposal of Radioactive Wastes - Interim Report

Genshiryoku Shiryo 166:1-35 (1984, November)

An interim report on the treatment and disposal of radioactive wastes, made by the subcommittee on the countermeasures to radioactive wastes, is described as follows: (1) the ground disposal of low level and ultralow level radioactive wastes, including the grouping of wastes and the practices of disposal and management; and (2) the treatment and disposal of high level radioactive wastes and TRU wastes, that is, basic idea, the items of research and development in respective institutions and the practices of treatment and disposal. In the disposal of low level radioactive wastes, the promotion of their ground disposal according to the levels of radioactivity including also reactor decommissioning wastes is increasingly required. In the treatment of high level and TRU wastes, on the basis of the research and development made so far, the techniques of disposal have to be established as early as possible.

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Appleton, P.R., and D.R. Poulter, United Kingdom Atomic Energy Authority, Culcheth, Warrington, United Kingdom

Preliminary Risk Assessment for the Transport of Reactor Decommissioning Waste in the United Kingdom

CONF-860604; Packaging and Transportation of Radioactive Materials (PATRAM '86), Proceedings of an International Symposium, Davos, Switzerland, June 16-20, 1986. International Atomic Energy Agency, Vienna, Austria, Vol. 1; (pp. 397-405) (1987)

It has been decided to decommission the UKAEA Windscale Advanced Gas-cooled Reactor (WAGR) to a 'green field' site to provide information on procedure and costs. This paper describes a risk assessment for the transport to a suitable repository of 200 large concrete packages containing about 700 t of resulting waste material. The packages are cubic with external dimensions a little over 2 m. Prototypes have been drop tested from heights of 0.65 m and 5 m and they sustained insufficient damage to impair the containment and shielding significantly. An impact equivalent to a 15 m drop was calculated to be necessary to expose the package contents. An event tree approach was adopted to determine the frequency of severe mechanical and thermal loading during road and rail transport. Collisions with a second vehicle or fixed object, falls from bridges, serious fires and crane failure during unloading were considered. The frequency of rail accidents sufficiently severe to expose the package contents was calculated to be about 5×10^{-7} per year. The frequency of these severe impacts in conjunction with a serious fire was found to be two orders of magnitude smaller. The package weight would limit the vehicle speed on United Kingdom roads and no accident which could expose the package contents was considered plausible. Preliminary calculations indicated that the consequences of a transport accident (increased gamma radiation and dispersion of flammable waste by fire) would be relatively minor. It was concluded that transport risks should not present obstacles to the decommissioning of the WAGR.

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Barnes, S.M., L.L. Petkus, T.F. Murawski, C.C. Chapman, and J.M. Pope, West Valley Nuclear Services Company, Inc., West Valley, NY

Reference Vitrification Process and Equipment Description with Results from Checkout Testing

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

DOE/NE-44139-32; 23 pp. (1986, November 24)

The vitrification equipment designed to solidify the high-level wastes stored at the Western New York Nuclear Service Center has been installed in a cold testing facility at the site. This system is presently in the checkout testing phase. This report provides a description of the reference vitrification flow sheet, the process equipment, and summarizes the first six integrated simulated waste slurry processing tests. (Auth)

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Costello, J.M., Australian Atomic Energy Commission, Lucas Heights Research Laboratories, Lucas Heights, Sutherland, New South Wales, Australia

Disposal of Radioactive Waste

CONF-8508199; Proceedings of a Nuclear Energy Symposium, Sydney, Australia, August 7, 1985; (pp. 5-7); Nuclear Spectrum 1(2):5-7 (1985, September)

This paper reviews updated national developments in geologic disposal and gives a brief summary of experience in the waste management aspects of decommissioning nuclear reactors.

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Eisenstatt, L.R., West Valley Nuclear Services Company, Inc., West Valley, NY

Selection of the West Valley Demonstration Project Low-Level Waste Form

DOE/NE-44139-23; 22 pp. (1986, November 12)

This report provides an analysis of potential waste forms for low-level waste that will be immobilized in the Radwaste Treatment System at the West Valley Demonstration Project (WVDP). Based upon a comparison of waste form and system properties, cement was selected as the optimal low-level waste form for the WVDP. The waste form properties considered were development status, leach resistance, radiation stability, and thermal stability. The system properties considered were process simplicity, system fabrication time, and process safety. (Auth)

290

Eisenstatt, L.R., West Valley Nuclear Services Company, Inc., West Valley, NY

Description of the West Valley Demonstration Project Reference High-Level Waste Form and Canister

DOE/NE-44139-26 (1986, July 28)

Information on the West Valley Demonstration Project (WVDP) reference high-level waste (HLW) form and canister is given. The WVDP will solidify the liquid HLW remaining at the commercial nuclear fuel reprocessing plant at West Valley, New York. The reference waste form is borosilicate glass with a zeolite loading of 10 weight percent and a waste sludge loading of 23 weight percent. The glass formers that will be added to the waste during vitrification include Si, Al, B, and Na. Twenty-eight-day and longer-term leach tests show that the glass has adequate leach resistance. The room temperature density of the glass is 2.7 grams per cubic centimeter. Glass viscosity is 100 poise at 1049 degrees C. Upper and lower linear expansion coefficients are 99.02×10^{-6} per degree C and 10.76×10^{-6} per degree C, respectively. The glass transition temperature is about 470 degrees C. The reference canister will be fabricated from stainless steel 304. The length will be 300 cm, and the diameter will be 61 cm. The canister wall will be sheet with a minimum thickness of 0.34 cm. The bottom will be a flanged and reverse dished head with a thickness of 0.48 cm; the top will be an ASME flanged and dished head. The lifting flange will be fabricated from square bar. Each canister will be uniquely labeled on the shoulder and side of the canister. The maximum gamma dose rate of an average canistered waste form at time of production is expected to be 8,500 R/hr. Canistered waste standing in 25 degrees C air will have a centerline temperature of less than 45 degrees C. The weight of a 100 percent full glass filled canister will be 2,480 kg. (Auth) (LCM)

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Ellgas, R.A., Harvard University, Cambridge, MA

Monitoring and Surveillance of Decommissioned Nuclear Waste Repositories

Dissertation Abstracts International, Section B: 47(3):551 (1986, September)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

High-level nuclear wastes must be isolated from human exposure because of the health hazards they create. In the U.S., the most likely disposal method will involve permanent emplacement in repositories in deep geological formations. After these repositories are decommissioned, a set of stresses on the waste isolation system can conceivably lead to groundwater migration and release of radionuclides to the biosphere in approximately 500-600 years. A monitoring and surveillance system is developed that could detect short-term failures, assess the consequences of biosphere releases, and compute the risks of erroneous decisions on the existence of radiocontaminants in groundwater. An original data acquisition protocol is proposed for detecting changes in background values of monitored parameters. This protocol includes detection system design (instrumentation and detector spatial distribution) and management (sample scheduling).

292

Hirling, J., International Atomic Energy Agency, Division of Nuclear Fuel Cycle, Waste Management Section, Vienna, Austria

Status of the IAEA Waste Management Program

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 9-16) (1986)

The IAEA's on-going Waste Management Program includes the areas of handling, treatment, conditioning, storage and disposal in land and at sea of various radioactive wastes, the assessment of environmental consequences of radionuclide releases as well as the decontamination and decommissioning of nuclear facilities. The main activity of the IAEA in these fields is: to collect, review and disseminate information, to develop internationally agreed guidelines, to encourage and sponsor research and to provide technical advice and training for Member States upon request. Along with the growing interest of Member States in recent years in waste management, the Agency's activities in the area have gathered added momentum. In the last five years about 80 scientific and technical reports have been prepared, ten coordinated research programs were concluded and seven have been initiated. Seventeen developing countries receive technical assistance in the field of waste management.

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Hirling, J., J.I. Zhu, and L. Konstantinov, International Atomic Energy Agency, Vienna, Austria

Overview of IAEA Activities in the Field (Radioactive Waste)

IAEA Bulletin 28(1):10-14 (1986, Spring)

Since the IAEA's inception in 1957, radioactive waste management has been an important program element because of its impact on the development and use of nuclear energy. Over the last three decades the program emphasis has varied according to the actual needs of nuclear energy's technological development. Agency programs, which are prepared for several years in advance in consultation with appropriate organizations and experts of Member States, also are reviewed by competent forums. Care is always taken during program preparation so that a proper balance is maintained between the activities related to the interests of both developed and developing countries. The current waste management program is structured to cover the following important areas: (1) handling, treatment, conditioning, and storage of radioactive waste; (2) decontamination and decommissioning of nuclear facilities; (3) underground disposal of radioactive waste; and (4) sea dumping and environmental consequences of radionuclide releases.

294

Jacobs, D., Weston (Roy F.), Inc., Oak Ridge, TN

Decommissioning of Nuclear Facilities

CONF-850419; Proceedings of the National Council on Radiation Protection and Measurements 21st Annual Meeting, Washington, DC, April 3, 1985, 285 pp.; (pp. 185-192) (1986)

The decommissioning of nuclear facilities represents a potentially large volume of radioactive waste. The actual volumes that will be sent to low-level waste facilities depends on the method used for decommissioning and the levels of residual activity that can be acceptably stabilized on-site. The levels of activity in wastes that arise from decommissioning range from highly irradiated fuel to material that contains essentially no radioactivity above background.

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Kato, K., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Health Physics, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development: Treatment of Radioactive Wastes

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (12 pp.) (1985)

During the decommissioning of nuclear power plants, large quantities of radioactive wastes such as metals and concrete are generated in a relatively short period of time. To establish technologies for decommissioning waste management, developmental efforts are being conducted in the following areas: (a) containment of highly activated wastes; (b) volume reduction of metallic wastes by cutting and compaction; (c) cement solidification of concrete rubble; (d) immobilization of contaminants; (e) packaging of wastes for storage and disposal; (f) measurement and identification of extremely low-level wastes; (g) decontamination for reuse or simple disposal; and (h) evaluation of dismantling waste management system. This report outlines the four major items of this list: containment of highly activated wastes; volume reduction of metallic wastes by cutting and compaction; measurement and identification of extremely low-level wastes; and decontamination for reuse and simple disposal. (Auth) (CAC)

296

Larsson, A., K. Andersson, and S. Wingefors, Swedish Nuclear Power Inspectorate, Stockholm, Sweden

Role of Regulatory Authorities in Radioactive Waste Management in Sweden

CONF-860314; Siting, Design and Construction of Underground Repositories for Radioactive Wastes, Proceedings of an International Symposium, Hannover, Federal Republic of Germany, March 3-7, 1986. International Atomic Energy Agency, Vienna, Austria; (pp. 115-124) (1986)

The Swedish Nuclear Fuel and Waste Management Company (SKB) is directing its long term research and development efforts towards further development of proposed methods for the final disposal of high level waste arising from the reprocessing of spent fuel and direct disposal of spent fuel. The SKB is also looking for alternative disposal methods. The Swedish Nuclear Power Inspectorate and the National Institute of Radiation Protection are the two authorities involved in the supervision of the safety and radiation protection of nuclear facilities in operation. The licensing of new facilities is an important part of their work. Furthermore, the two authorities have a fairly large research and development program, often in cooperation with the SKB and the utilities and with the participation of foreign organizations. The National Board for Spent Nuclear Fuel supervises the research and development program of the SKB. It proposes to the Swedish Government an appropriate fee for the waste handling program, including the decommissioning of nuclear facilities.

297

McConnell, J.W., Jr., R.M. Neilson, Jr., and R.D. Rogers, Idaho National Engineering Laboratory, Idaho Falls, ID

Testing Waste Forms Containing High Radionuclide Loadings Coming from Decommissioning and Back Fitting

EGG-M-02986; CONF-860905; Spectrum '86, Low, Intermediate and High Level Waste Management - Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986; (25 pp.) (1986)

The Low-Level Waste Data Base Development - EPI-COR-II Resin/Liner Investigation Program of the U.S. Nuclear Regulatory Commission (NRC) is obtaining information on radioactive waste during NRC-prescribed tests and in a disposal environment. This paper describes the resin solidification task of that program, including the present status and results to date.

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

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

Costs and Radiological Impacts of Decommissioning Nuclear Reactor Stations and Delayed Off-Site Waste Disposal

Nuclear Safety 27(3):359-368 (1986, July-September)

Of the three reactor decommissioning alternatives considered by the Nuclear Regulatory Commission in its recently proposed regulation, DECON, ENTOMB, and SAFSTOR, only the last is acceptable if on-site storage of radioactive waste or spent fuel is required. This article presents SAFSTOR decommissioning scenarios from recent literature for multireactor and single-reactor sites. It describes SAFSTOR decommissioning with off-site disposal or with on-site storage of radioactive waste, spent fuel, or both. A comparison of costs and radiological impacts shows that reactors can be decommissioned economically and safely by safe storage followed by deferred decontamination even if off-site disposal facilities for radioactive waste are temporarily unavailable.

299

Neuder, S.M., and W.E. Kennedy, Jr., U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Onsite Disposal of Radioactive Waste - Methodology for the Radiological Assessment of Disposal by Subsurface Burial

NUREG-1101 (Vol. 2) (1987, February)

This volume describes the criteria and technical methodology used by NRC staff to evaluate requests by licensees for approval of onsite disposal by burial in soil. The technical methodology includes the ONSITE/MAXI1 code for calculating radiological exposure from various pathways, the MOCMOD84 code, and analytical methods for calculating contaminant transport and concentration of radionuclides in flowing groundwater. Radiological exposure analyses include the following pathways: (1) exposure to direct gamma from any surface contamination or buried waste; (2) drinking water from a well contaminated by migration of radionuclides; (3) ingesting agricultural products derived from radionuclide-contaminated soil; and (4) inhaling radionuclides resuspended at the burial site. Licensee-proposed disposal activities are evaluated in terms of radiological impact on public health and safety and the environment.

The estimated committed effective dose equivalent resulting from the technical evaluation will usually be the determining factor in the authorization of the proposed disposal. (Auth)

300

Park, P.K., D.R. Kester, I.W. Duedall, B.H. Ketchum, I.W. Duedall, B.H. Ketchum, P.K. Park, and D.R. Kester, National Oceanic and Atmospheric Administration, National Ocean Service, Ocean Dumping Program, Rockville, MD

Radioactive Wastes and the Ocean: An Overview

Radioactive Wastes and the Ocean: Wastes in the Ocean, Volume 3, D.R. Kester (ed.). John Wiley and Sons, Inc., New York, NY; (pp. 3-46) (1983)

Beginning in 1944, the ocean has been receiving radioactive wastes from nuclear weapon and power productions. Comprehensive scientific studies of radioactivity in the marine environment were initiated in 1946. A liter of seawater and 1 kg of deep-sea sediment have 13 and 40-1500 Bq, respectively, of natural radioactivity. The variety and magnitude of radioactive wastes being generated depend mainly on the nuclear fuel cycle being used; the cycle consists of uranium mining, uranium enrichment, nuclear fuel fabrication, irradiation of fuel elements in a nuclear reactor, and spent-fuel reprocessing or disposal. Dismantling worn-out reactors produces large amounts of radioactive rubble. Whether or not the wastes generated by each step of the fuel cycle can be disposed safely in the ocean is a challenge to our scientific understanding of marine processes. Though the relationship between radiation exposure and its consequent biological alteration has been studied extensively, estimating the extent of biological damage from low doses of ionizing radiation is uncertain and difficult. Thus the establishment of a realistic safe dose still awaits scientific consensus. Oceanic disposal strategies consist of dilution or containment; an additional strategy is isotopic dilution.

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Platt, A.M., Battelle Pacific Northwest Laboratories, Richland, WA

Alternatives for Managing Postfission Nuclear Wastes from the LWR Fuel Cycle

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CONF-760701; Management of Waste from the LWR Fuel Cycle, Proceedings of an International Symposium, Denver, CO, July 11-16, 1976; (pp. 118-127) (1976)

There are several alternatives for the back end of the LWR fuel cycle, ranging from discarding spent fuel as a waste to reprocessing the spent fuel and recycling the plutonium and uranium. The technologies for managing wastes from reactors, wastes from facilities used in the back-end options, and wastes produced by decommissioning and dismantling fuel-cycle and waste-management facilities are detailed, including those being developed or used by other nations. They are classified as commercialized, available, or under development. Commercialized technology is that in routine use in a nuclear industry. Technology is classified as available if design, construction, and verification could be initiated with reasonable technical risk based on present knowledge. Those under development range from new concepts just starting into research and development to those nearly available. Commercial or available technologies are shown to exist for essentially all operations required to manage the nuclear waste created by the back end of the LWR fuel cycle. (Auth)

302

Price, M.S.T., and I. Lafontaine, Commission of the European Communities, Luxembourg, Luxembourg

System of Large Transport Containers for Waste from Dismantling Light Water and Gas-Cooled Nuclear Reactors, Volume 1

EUR-10232 (Vol. 1); 141 pp. (1985)

The purpose of this volume is to introduce the main types of nuclear reactors in the European Community (EC), select reference plants for further study, estimate the waste streams from the reference reactors, survey the transport regulations, and assess existing containers. (Auth)(SET)

303

Ryvken, L.E., West Valley Nuclear Services Company, Inc., West Valley, NY

High-Level Waste Characterization at West Valley - Progress Report for the Period 1982-1985

DOE/NE-44139-14; 144 pp. (1986, June 2)

This is a report on the work that was carried out at West Valley under the Waste Characterization Program. This Program covered a number of tasks in support of the design of facilities for the pretreatment and final encapsulation of the high level waste stored at West Valley. In particular, necessary physical, chemical, and radiological characterization of high-level reprocessing waste stored in two vaulted underground tanks was carried out over the period 1982-1985. (Auth)

304

Saro, S., and J. Toelgyessy

Radioactive Waste Disposal, Chapter 4

Environmental Radioactivity. Alfa, Bratislava, Czechoslovakia; (pp. 177-252) (1985)

Radioactive wastes are classified by the areas of their occurrence, by the level and type of radioactivity and the nature of emitted radiation. Described are spent fuel element storage, processing and long-term burial in geological or iceberg formations and on the sea bottom or under it. Deactivation of radioactive materials uses chemical, physical, physico-chemical and biological methods. The disposal of radioactive gases and aerosols and the decommissioning of nuclear reactors are also discussed.

305

Steenblik, R.

Real, Untold Cost Story

Coaltrans (United Kingdom) 1(1):15, 17, 19 (1986, June)

This article identifies the major invisible costs of nuclear energy, including waste disposal and decommissioning as well as the more widely understood actual combustion and running costs. It is suggested that energy planners should listen to critics who maintain that nuclear power is more expensive than alternatives such as coal.

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Tusa, E.H., P.T. Anttila, H. Haerkoenen, and E.K. Peltonen, Imatran Voima Oy, Helsinki, Finland; Industrial Power Company Limited, TVO, Helsinki, Finland

Final Disposal of Low and Intermediate Level Wastes from Nuclear Power Plants in Finland

CONF-960314; Siting, Design and Construction of Underground Repositories for Radioactive Wastes, Proceedings of an International Symposium, Hannover, Federal Republic of Germany, March 3-7, 1986. International Atomic Energy Agency, Vienna, Austria; (pp. 231-239) (1986)

Finland produces 35-40% of its electricity from its four nuclear power plant units. The plant utilities are responsible for management of the radioactive waste, including its final disposal. LLW and ILW are presently treated and stored at the power plant sites; the amounts of waste are moderate. The suitability of the bedrock of the power plant sites for final disposal was assessed in 1982, and the principle of disposing of LLW and ILW at the sites was approved. During 1983-1985 the site investigations were complemented by additional field investigations, more detailed repository design and related safety analyses. The location and layout of the repositories at both sites are determined on the basis of geological conditions. The Loviisa repository consists of a cavern for solidified waste and tunnels for dry waste. The Olkiluoto repository consists of a waste cavern with two silos. Provisions have been made for later enlargement of the repositories for decommissioning waste. After operation the repositories will be backfilled and sealed. The safe final disposal will be based on the principle of multiple barriers. The performance of each disposal system will be evaluated with a comprehensive safety analysis and will be expressed in terms of the total health risk for various release scenarios. Results are to be presented to the authorities in preliminary safety analysis reports by the end of 1986. Construction of the repositories will be started during 1988, in which case the repositories could be commissioned by the end of 1992.

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WasteChem Corporation, Paramus, NJ

Successful Disposal of Dresden Units 2 and 3 Local Power Range Monitors (LPRM's)

WasteChem Newsletter (870100):1 (1987)

In August 1986, Commonwealth Edison's Dresden Station and WasteChem Corporation as prime contractor successfully disposed of Depleted LPRM's (Local Power Range Monitors) at the Hanford, Washington burial site. The shipment included the associated LPRM fission chambers containing transuranic and SNM (special nuclear material) isotopes. The Dresden LPRM/Fission chamber disposal is WasteChem's third pool cleanout project. Previous services have been rendered to: TVA's Browns Ferry plant; Niagara Mohawk's Nine Mile Point 1 Plant; GPUN's Oyster Creek plant; CP&L's Brunswick plant, and a demonstration project for Northeast Utilities Millstone 2 plant. WasteChem is now providing fuel pool services for Commonwealth Edison's Quad Cities plant. The company also provides Volume Reduction and Solidification systems for processing of liquid radioactive waste. (Auth)(SET)

308

Watts, R.E., T. Allen, S.A. Castle, J.P. Hopper, and R.L. Oelrich, Westinghouse Materials Company of Ohio, Feed Materials Production Center, Cincinnati, OH

Feed Materials Production Center Waste Management Plan

FMPC-2040 (Rev. 1); 172 pp. (1986, December 31)

In the process of producing uranium metal products used in Department of Energy (DOE) defense programs at other DOE facilities, various types of wastes are generated at the Feed Materials Production Center (FMPC). Process wastes, both generated and stored, are discussed in the Waste Management Plan and include low-level radioactive waste (LLW), mixed hazardous/radioactive waste, and sanitary/industrial waste. Scrap metal waste and wastes requiring special remediation are also addressed in the Plan. The Waste Management Plan identifies the comprehensive programs developed to address safe storage and disposition of all wastes from past, present, and future operations at the FMPC. Waste streams discussed in this Plan are representative of the wastes generated and waste types that concern worker and public health and safety. Budgets and schedules for implementation of waste disposition are also addressed. The waste streams receiving the largest amount of funding include LLW approved for shipment by DOE/ORO

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to the Nevada Test Site (NTS) (MgF₂, slag leach filter cake, and neutralized raffinate); remedial action wastes (waste pits, K-65 silo waste); thorium; scrap metal (contaminated and noncontaminated ferrous and copper scrap); construction rubble and soil generated from decontamination and decommissioning of outdated facilities; and low-level wastes that will be handled through the Low-Level Waste Processing and Shipping System (LLWPSS). Waste Management milestones are also provided. The Waste Management Plan is divided into eight major sections: Introduction; Site Waste and Waste Generating Process; Strategy; Projects and Operations; Waste Stream Budgets; Milestones; Quality Assurance for Waste Management; and Environmental Monitoring Program.

309

Yoshida, Y., Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Radioactive Waste Management in Decommissioning of Nuclear Facilities

Applied Radiation and Isotopes - International Journal of Radiation Applications and Instrumentation, Part A 37(1):88 (1986)

This report describes characteristics of decommissioning wastes, and the experiences in management of wastes from dismantling and remodeling of the facilities at the Japan Atomic Energy Research Institute (JAERI). The related technology development and management of the extremely-low-level radioactive wastes arising in large quantities with decommissioning are also introduced. Wastes arising from decommissioning or remodeling of the nuclear facilities are composed of mainly activated or contaminated metal wastes and structure materials. The metal wastes include large equipment such as tanks, and structure materials include concrete containing very low levels of radioactivity. Results of a trial of a PWR plant of 1,200 MW(e) in West Germany, show that about 90% of the decommissioning wastes arising from the controlled areas may be managed as non-radioactive wastes. JAERI decommissioning technology includes: development of containers for high-level radioactive wastes such as the reactor internal structure and packages for low-level wastes; volume reduction by cutting and compaction of metal wastes; solidification of concrete wastes; and evaluation of decommissioning waste management systems. The development of the instrument for identifying the extremely-low-level radioactive wastes is also in progress. (Auth)(SET)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

310

Cregut, A., R. Lurie, P. Antoine, B. Cornu, and P. Lourme, Commissariat à l'Energie Atomique, Centre d'Etudes Nucleaires de la Vallee du Rhone, Institute de Protection et de Surete Nucleaire/ Unite Centrale de Declassement des Installations Nucleaires, Marcoule, France

Decommissioning of the AT1 Reprocessing Plant

IPSN/UDIN-85/1347 (1985)

This report describes the decommissioning of AT1 which was designed and built for the reprocessing of mixed oxide fuel elements coming from the FBR program. This facility operated very successfully from 1969 to 1979 and reprocessed the fuel elements from RAPSODIE and some fuel elements from PHENIX with burn-up ranging from 0 to 100,000 MW D/t. After ten years of operation, the plant was definitively shut down. This report includes sections on the description of the facility; final shut down operations, decommissioning, and dismantling operations; hot cells dismantling strategy; and remote handling system for decommissioning. Diagrams, photographs, and decommissioning program schedules are included. (Auth)(CAC)

311

Goertz, R., Brenk Systemplanung, Federal Republic of Germany

Decommissioning of Nuclear Facilities in the Federal Republic of Germany: Experience and Ongoing Activities

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (14 pp.) (1985)

This paper provides an overview of the past and present decommissioning activities in the Federal Republic of Germany. The introductory section shows the locations of the nuclear power plants in Germany and summarizes reactor types, status, and power capacity of each. The following sections further detail the decommissioning experience, ongoing decommissioning activities, and topics related to decommissioning. Several illustrations are included. (CAC)

312

Hoovler, G.S., P.M. Myers, and C.S. Caldwell, Babcock and Wilcox Company, Lynchburg, VA

Research Reactor and Fuel Development/Production Facility Decommissioning Technology and Experience

Transactions of the American Nuclear Society 53:129-130; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 129-130) (1986)

This paper discusses the technology and experience gained in a series of reactor and fuels development facility decommissioning programs carried out by Babcock and Wilcox at its U.S. Nuclear Regulatory Commission (NRC)-licensed sites in Lynchburg, Virginia. Areas of generic application to future projects are particularly emphasized. The projects included one test and one research reactor, four low-power critical experiment facilities, and two buildings that housed plutonium/uranium fuels development laboratories. These projects were comprehensive; they included developing the decommissioning and quality assurance plans, interfacing with the NRC, performing the actual decontamination/dismantling work, performing predecontamination and final radiological surveys, and volume reducing, packaging, certifying, classifying and shipping the radioactive waste for disposal.

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Abel, E., United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Harwell, Didcot, Oxfordshire, United Kingdom

Robotic Devices for Nuclear Plant

Atom 355:5-12 (1986, May)

Robots can present cost effective alternatives to man and conventional manipulators in nuclear facilities. The author describes the historical background to the development of servomanipulators and robots, the types of application areas suited to robots, and makes recommendations for further developments.

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Albano, R.

Possibilities for Coordinating the Different Systems Which at Present Regulate Civil Nuclear Liability

CONF-8509344; Status, Prospects and Possibilities of International Harmonization in the Field of Nuclear Energy Law, N. Pelzer (ed.), Nuclear International Jura '85, Proceedings of the Seventh International Conference on Nuclear Laws, Konstanz, Federal Republic of Germany, September 29, 1985, 645 pp.; (pp. 320-330) (1986)

At present, there exist four systems in the field of liability associated with the operation of nuclear power plants. The author emphasizes the need to seek a coordination between these systems and reviews a few important items as, for example, (1) the possibilities of eliminating the existing limitation in the scope of application of the Paris-Convention; (2) the possibility of eliminating the limitation of liability for international transport of nuclear substances in non-contracting states; and (3) the possibility of applying the nuclear liability system also to decommissioned plants.

315

Brudermueller, G., Kernkraftwerk-Betriebsgesellschaft mbH, Eggenstein-Leopoldshafen, Federal Republic of Germany

MZFR - The First German-Developed Nuclear Power Plant - A Review

ATW, Atomwirtschaft, Atomtechnik 31(2):80-82 (1986, February)

A brief review of the development and operation of MZFR, the special characteristics of the plant and the reasons for closing it down.

316

Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Institut de Protection et de Surete Nucleaire, Fontenay-aux-Roses, France

CEA Protection and Nuclear Safety Institute Annual Progress Report, 1985

CEA-IPSN-RA-1985; 168 pp. (1986)

This annual progress report of the CEA Protection and Nuclear Safety Institute describes the progress made in the research activities conducted by each section of the different departments of the Institute. The areas of research include: reactor safety analysis; fuel cycle facilities analysis; associated safety research programs (criticality, sites, and transport); radioecology and environmental radioprotection techniques; data acquisition on radioactive waste storage sites; radiation effects on man; studies on radioprotection techniques; nuclear material security including security of facilities, security of nuclear material transport, and monitoring of nuclear material management; nuclear facility decommissioning; and public information. (Auth)(SET)

317

Cregut, A.

Decommissioning in France

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (20 pp.) (1985)

This paper is an outline of the decommissioning activities in France. Topics covered include general aspects,

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policy and philosophy, regulations, acquired experience, research and development, ongoing actions, future actions, and current trends. Schedule charts of decommissioned reactors and decommissioned plants and laboratories are also included. (CAC)

318

d'Agraves, B.C., G.D. Cero, R. Debeir, E. Mascetti, J. Toornvliet, and A. Volcan, Commission of the European Communities, Joint Research Centre, Ispra, Italy

VAK III Sealing System for LWR Fuel Assemblies: Long-Term Results Obtained by JRC-Ispra After the Last Verification Campaign at the Kahl Facility (FRG) in February 1986

CONF-860654; Proceedings of the Institute of Nuclear Materials Management 27th Annual Meeting, New Orleans, LA, June 22-25, 1986; (pp. 454-461) (1986)

The VAK III system uses ultrasonic in situ verifiable seals aimed at the safeguarding of LWR fuel assemblies. Developed at JRC-Ispra, it has been field tested on BWR fuel assemblies for several years at the VAK reactor of Kahl (FRG), where the last demonstration campaign took place in February 1986, prior to decommissioning the plant. In completion of this long term experiment, all VAK III seals have been successfully reidentified in actual conditions, after irradiation periods of 18, 24 and 30 months. Some of them, along with older prototypes, were also pulled off and the corresponding breaking forces measured; indicating that irradiation has a limited effect on the traction magnitude.

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DeLaney, E.G., U.S. Department of Energy, Division of Facility and Site Decommissioning, Washington, DC

Decommissioning of Nuclear Facilities: Feasibility, Needs and Costs

Nuclear Energy Prospects to 2000 and Beyond, Proceedings of an International Energy Agency/Nuclear Energy Agency High-Level Workshop, Paris, France, November 5-7, 1985, Preprint; (7 pp.) (1985)

This paper summarizes a report which was prepared by an NEA Working Group on Decommissioning at the request of the Fuel Cycle Committee. Decommissioning is defined and the three major alternatives or "stages" of decommissioning are described. Factors in selecting the optimum stage for the decommissioning of a nuclear facility are also described. Past decommissioning experience with small test, training, and power demonstration reactors and fuel cycle facilities is reviewed. It is concluded that these methods are feasible for decommissioning large facilities. Ongoing maintenance and repair on commercial reactors and fuel cycle facilities and post-accident recovery work also provide valuable, applicable experience. Several major decommissioning projects which are underway or will begin in the next few years will provide additional valuable experience. Although current technology is feasible for use in decommissioning large commercial units, other areas of development to reduce worker exposure, waste volumes, and costs are described. A projection of the nuclear power plants that could conceivably be decommissioned through the year 2025 is made based on a very conservative assumption of a 25-year operating lifetime. A projection of the waste volumes resulting from these power plant decommissionings is also made based on a very conservative assumption of immediate dismantlement. According to this projection, the volume of decommissioning wastes generated over the next decade will be small but may become significant by the turn of the century. The volume of decommissioning waste from one reactor, however, is estimated to be about as much as the volume of low- and intermediate-level wastes from the reactor's total lifetime operations. Cost estimates for the various stages of decommissioning 1,300 MW(e) LWRs and PHWRs are presented. The estimates are compared to the lifetime generating costs on a discounted basis. Comparisons were made for discount rates between 0 and 10 percent and for plant operating lifetimes of 20, 25 or 30 years. The decommissioning costs are shown to be a small fraction of the total energy generation cost for all discount rates and for plant operating lifetimes of 20 years or longer. (Auth)(CAC)(DCM)

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Deublein, O., Kernkraftwerk Lingen GmbH, Darmer/Lingen, Federal Republic of Germany

Lingen: A Survey of the German Kernkraftwerk Lingen (KWL) Plant - Background to the KWL Project

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Nuclear Engineering International 13(150):929 (1968)

The Kernkraftwerk Lingen (KWL) was founded on March 3, 1964 by the Vereinigte Elektrizitätswerke Westfalen AG (VEW), AEG-Telefunken to build and operate the station. This article is a brief history of the plant which is a 240 MW(e) BWR with superheat. (Auth) (CAC)

321

Ezure, H., and M. Katagiri, Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan; Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Reactor Engineering, Tokai, Ibaraki, Japan

JPDR Decommissioning Program: Estimation of Radioactive Inventory in JPDR

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (10 pp.) (1985)

The radioactive inventory of a nuclear reactor in a shutdown can be classified into the following categories: (1) the radioactive inventory induced by neutron activation in a reactor pressure vessel, its internals, biological shield concrete, etc., and (2) the radioactive materials deposited on inner and outer surfaces of the piping system and on the building floor. According to the categories each inventory was estimated using the results which were calculated by a computer code system and measured by nondestructive/destructive measurement methods. Based on these results, radioactive wastes and radiation dose rates were estimated. (Auth)(CAC)

322

Flasch, J.

Shutdown of Plants Proposed

Post-Crescent (Appleton, WI) (860501) (1986, May 1)

Nuclear power plants in Wisconsin should be shut down as soon as ways are found to accomplish that without harming the state, according to a resolution given preliminary approval today by the state's Radioactive Waste Review Board. The resolution will be sent back to the review board's Policy Advisory Council before it is formally adopted at the next meeting. The action came during the Radioactive Waste Review Board's monthly meeting at the Shawano County Courthouse. The resolution requested that, at the very least, the state's atomic power plants be closed when their licenses expire. The plants would then be "decommissioned" and their radioactive cores be disposed of in a repository.

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Francioni, W.M., F. Reidinger, and W. Goerlich

Measured Distribution of Activation Products, Including Tritium, in the Biological Shielding of the Shutdown Research Reactor DIORIT

Atomkernenergie/Kerntechnik 49(1-2):95-99 (1986, November-December)

Annular core samples were taken from the biological shielding of the research reactor DIORIT, which is no longer in operation. In this report, details of the first core sample and of its measured activation profile are presented. The core sample was removed at a height close to the reactor centerline, roughly at the level of maximum neutron flux. The distribution of activation products in the thermal shielding (grey cast iron) and in the neighboring colemanite concrete was analyzed. In addition, the tritium distribution in the concrete was measured. Tritium had diffused as far as the neighboring baryte concrete. (Auth)

324

Fuller, P.E., American Nuclear Insurers, Farmington, CT

Nuclear Liability Considerations of Decommissioning for the Health Physicist

CONF-870706; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S2 (1987)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

The nuclear insurance pools, through American Nuclear Insurers (ANI) and the Mutual Atomic Energy Liability Underwriters (MAELU), have been providing third party nuclear liability and property damage insurance to the nuclear industry since 1957. Due to the increase in decommissioning activities during recent years, the pools have heightened their interest and involvement in decommissioning activities. Through this involvement, important liability considerations have been formulated that can provide assistance to reduce the insured's risk during and subsequent to decommissioning a nuclear facility. This paper summarizes these considerations, provides an insurer's perspective on potential nuclear liability, and places emphasis on those areas that should have the highest interest for the health physicist. Comments are presented relative to the past and continuing efforts of establishing satisfactory but economically feasible radioactivity levels for property and materials which are to be released for unrestricted use. (Auth)

325

Gardner, F.W., Chem-Nuclear Systems, Inc., Albuquerque, NM

Northrop Triga Facility Decommissioning Plan Versus Actual Results

Transactions of the American Nuclear Society 53:129; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (p. 129) (1986)

This paper compares the Triga facility decontamination and decommissioning plan to the actual results and discusses key areas where operational activities were impacted upon by the final U.S. Nuclear Regulatory Commission (NRC)-approved decontamination and decommissioning plan. Total exposures for fuel transfer were a factor of 4 less than planned. The design of the Triga reactor components allowed the majority of the components to be unconditionally released.

326

Hajicek, J., Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou, Ustredni Informacni Stredisko pro Jaderny Program, Pisek, Czechoslovakia

Conception of a Data Information System on Nuclear Power Plant Economics

INIS-mf-10515; CONF-8511236; Proceedings of a Meeting on the Information Needs of the Nuclear Program - National Seminar, Pisek, Czechoslovakia, November, 4, 1985; (pp. 19-22) (1985)

The system being prepared will contain selected technical data on nuclear power plants, capital costs, number of workers needed for the construction of the plant, costs of electric power generation, number of operating personnel and costs of decommissioning the nuclear power plant. The data will be processed on a EC 1055 computer using the USS program package. The main source of data will be published literature. An experimental file with 120 entries has been processed, and output forms were designed.

327

Higton, B., Scmag Limited, Motherwell, Scotland

Robotics for the Inspection of Irradiated Plant

Robotics in NDT, Proceedings of an IEE Colloquium, London, United Kingdom, October 15, 1986, (Digest No. 101) 3/1-4; (p. 22) (1986)

A system designed for the automated inspection of irradiated components from a decommissioned nuclear plant is described. The equipment, known as 'PURIST', is installed at the Joint Research Council's Atomic Energy Research Establishment at Ispra, northern Italy and is to be used for the PISC III round robin NDT trials.

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Hlubek, W., and G. Knoerzer, Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen, Federal Republic of Germany

25 Years of Successful Operation at Kahl Experimental Atomic Power Station

VGB Kraftwerkstechnik 65(12):1116-1125 (1985, December)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

The experimental atomic power station at Kahl on the Main was the first German nuclear power plant built to produce electricity. Construction commenced in June 1958. Initial criticality was achieved in December 1960 and full load at 15 MW (electrical output) was attained in January 1962. In spite of various modifications within the framework of the experimental programs the average value of availability from commissioning amounted to almost 70%. The most important technical contributions emerged particularly from the materials program and the fuel element irradiation program. In 1985 after 25 years of operation the Kahl plant is being decommissioned. Dismantlement plans have begun.

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Hoffman, W.D., West Valley Nuclear Services Company, Inc., West Valley, NY; EG&G Idaho, Inc., Idaho Falls, ID

Nuclear Communications: Not Too Hot To Handle

CONF-8604121; Public Involvement: The Critical Path in Siting Controversial Facilities, Proceedings of the Nuclear Energy Low-Level Waste Management Program Conference, New Orleans, LA, April 2, 1986; (pp. 78-80) (1986)

West Valley, New York is the site of the world's only commercial nuclear fuel reprocessing plant. Its operation from 1966 to 1972 generated 600,000 gallons of liquid high-level nuclear waste. The West Valley Demonstration Project is charged with converting these wastes to a stable solid as well as decontaminating and decommissioning the plant. The U.S. Department of Energy directs the work of the site operator, the West Valley Nuclear Services Company, part of the Westinghouse Waste Technology Services Division. This presentation discusses the programs in place at the West Valley Demonstration Project working to generate acceptance from the media, environmental groups, public officials, and the local community. The merits of an open versus a closed information policy are deliberated.

330

Hopkins, D.R., U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

Rule To Amend the Transportation Provisions Pertaining to the Shipment of Low Specific Activity (LSA) Material

Federal Register 51(207):39271 (1986, October 27)

The proposed rule would modify the low specific activity (LSA) regulations to cover additional types of LSA (e.g., materials for decommissioning operations) and to establish limits on potential hazards from external radiation resulting from accidental releases of LSA materials in transit. NRC concerns that failure of a package containing a large quantity of LSA materials in an urban environment could have severe consequences, including protracted loss of public transportation networks, causes this rule change to be considered urgent. The proposed rule would also propose a number of changes intended to broaden the LSA category while limiting the potential impacts of accidental package failure. The NRC would continue to regulate Type B quantities of LSA material shipped in a single package. The wide applicability of the rules to be imposed make inappropriate the alternatives of modifying individual licenses to impose the requirements. The rule would reduce the risk of loss of public transportation networks as a result of a transportation accident involving LSA material at a cost of as yet unknown magnitude to be borne by the regulated industry. The cost figures to the affected licensees are pending the completion of a Department of Transportation report. Two staff-years of effort will be required to complete the rulemaking action. (Auth)

331

Huber, B., Commission of the European Communities, Directorate-General for Research, Science and Education, Brussels, Belgium

The Community's Research and Development Program on Decommissioning of Nuclear Installations - First Annual Progress Report (Year 1985)

EUR-10740; 146 pp. (1986)

This is the first Annual Progress Report of the European Community's 1984-88 program of research on the decommissioning of nuclear installations. Research and development projects concerning the following subjects are included: (1) long-term integrity of building and systems; (2) decontamination for decommissioning

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purposes; (3) dismantling techniques; (4) treatment of specific waste materials (steel, concrete and graphite); (5) large containers for radioactive waste produced in the dismantling of nuclear installations; (6) estimation of the quantities of radioactive wastes arising from the decommissioning of nuclear installations in the Community; and (7) influence of installation design features on decommissioning. Also included are the following guiding principles: certain guiding principles in the design and operation of nuclear installations with a view to simplifying their subsequent decommissioning; and guiding principles in the decommissioning of nuclear installations which could form the initial elements of a Community policy in this field. Testing of new techniques under real conditions, within the framework of large-scale decommissioning operations undertaken in Member States is also covered in the report. (Auth) (SET)(DCM)

332

Hubert, E.H., University of Liege, Liege, Belgium

Scientific, Technical, Economic and Legal Problems Inherent in the Decommissioning of Nuclear Installations

Electricite (Belgium) 183:59-64 (1986, December)

Decommissioning of nuclear plants brings numerous problems. They depend, amongst other factors, on the type, design, constructional features and application of the reactor, on the safety measures adopted in the design and during operation, and on the technology and equipment for executing the work. It is concluded that safe dismantling of nuclear plants without danger to humans and the environment is possible with existing equipment and that further progress towards easing the task is likely. Costs are very high but financing could be helped by extending plant life. Certain Belgian legal aspects justify further investigation.

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International Atomic Energy Agency, Vienna, Austria

Reactor Coolant and Associated Systems in Nuclear Power Plants - A Safety Guide

IAEA Safety Series. No. 50-SG-D13; 70 pp. (1986)

This Safety Guide outlines the design requirements for the reactor coolant and associated systems (RCAS) and the features required in order to achieve their safety functions. It covers design considerations for various reactor types and encompasses the safety aspects of the functions of the RCAS both during normal operation and following postulated initiating events, and to some extent also for decommissioning.

334

Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Reactor Engineering, Tokai, Ibaraki, Japan

Reactor Engineering Department Annual Report - April 1, 1985-March 31, 1986

JAERI-M-86-125; 247 pp. (1986, August)

Research and development activities in the Department of Reactor Engineering in fiscal 1985 are described. The work of the Department is closely related to development of a multipurpose very high temperature gas cooled reactor, High Conversion Light Water Reactor and Fusion Reactor, and development of liquid metal fast breeder reactor carried out by Power Reactor and Nuclear Fuel Development Corporation. The report includes achievements in fields such as nuclear data and group constants, theoretical method and code development, reactor physics experiments and analysis, fusion neutronics, shielding, reactor and nuclear instrumentation, reactor control and diagnosis, reactor decommissioning technology, and activities of the committee on reactor physics.

335

Kawasaki, M., S.-I. Miyasaka, E. Tachikawa, and H. Ezure, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development Program - Phase 1: Part 1 - Evaluation of Radioactive Inventory in LWR System, and Part 2 - Research and Development on LWR System Decontamination

Report

CHAPTER 2 NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

In 1984, the Japan Atomic Energy Research Institute (JAERI) participated in the Coordinated Research Program on Decommissioning and Decontamination, a research agreement between the International Atomic Energy Agency (IAEA) and JAERI. Phase 1 of the program involves the development of dismantlement techniques, including estimation of radioactive inventory, decontamination, disassembly, waste management, radiation control, and systems engineering. This report describes the progress and results of phase 1 and contains two parts: (1) Evaluation of Radioactive Inventory in LWR System, and (2) Research and Development on LWR System Decontamination. (CAC)

336

Kernkraftwerk Lingen GmbH, Darms/Lingen, Federal Republic of Germany

Lingen Nuclear Power Plant - Annual Report 1985

INIS-mf-10319; 22 pp. (1986)

Report on the legal and scientific foundations, operation in the decommissioning phase, staff, balance sheet, and profit-and-loss account in 1985.

337

Kikuyama, T., Japan Atomic Energy Research Institute, Tokai Research Establishment, Department of Japan Power Demonstration Reactor, Tokai, Ibaraki, Japan

Reactor Decommissioning Technology Development: Future Research Program

Proceedings of a Japan Atomic Energy Research Institute (JAERI) Workshop on Reactor Decommissioning, November 25-29, 1985, Preprint; (5 pp.) (1985)

The Japan Atomic Energy Research Institute (JAERI) has been developing technologies for reactor decommissioning which will be applied to the Japan Power Demonstration Reactor (JPDR) dismantlement. Practical data regarding the utilization and potential of these technologies will be collected throughout the decommissioning program. This paper discusses how such data will

be applied to the decommissioning of commercial power reactors and identifies the problem areas of decommissioning. These issues comprise the work of the JAERI future research program and are described in this context. (CAC)(DCM)

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Koster, R., and W. Bechthold, Kernforschungszentrum Karlsruhe GmbH, Institut fuer Nukleare Entsorgungstechnik, Karlsruhe, Federal Republic of Germany

Conditioning of Low and Intermediate Level Wastes

Radioactive Waste Management and the Nuclear Fuel Cycle 7(2):151-164 (1986)

This report describes the conditioning of low-level wastes (LLW) and intermediate-level wastes (ILW) from nuclear power plant operation and decommissioning and spent LWR fuel reprocessing.

339

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

Nuclear Decommissioning

Nuclear Energy 26(1):15-22 (1987, February)

Sufficient work has now been done, on a world-wide basis, to justify confidence that full decommissioning of nuclear installations, both plant and reactors, can be carried out safely and efficiently. Projects in several countries should confirm this in the next few years. In the United Kingdom, good progress has been made with the WAGR and supporting development work is finding solutions to resolve uncertainties. Estimates from several sources suggest that decommissioning costs can be kept to an acceptable level.

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Lefevre, J.J., Commissariat a l'Energie Atomique, Paris, France

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

French Experience and Plans (Radioactive Waste)

IAEA Bulletin 28(1):45-47 (1986, Spring)

Experience acquired over 40 years through an extensive nuclear power program has enabled France to develop a corresponding comprehensive waste management policy. It covers rules and regulations, health and safety aspects for both the short and long terms, technologies (from installation design to decommissioning), and the conditioning, transport, and disposal of wastes.

341

Lough, W.T., Commonwealth of Virginia, State Corporation Commission, Richmond, VA

Public Attitudes Toward Nuclear Power Plant Decommissioning

Transactions of the American Nuclear Society 54:41; CONF-870601; Proceedings of an American Nuclear Society Annual Meeting, Dallas, TX, June 7-11, 1987; (p. 41) (1987)

A public workshop using a group process known as the nominal group technique (NGT) was conducted with ten citizens of Louisa County, Virginia, to discuss the decommissioning of the North Anna nuclear power plant. The workshop was conducted on May 21, 1986, in Mineral, Virginia. In light of the significant part social concerns have played in the development of nuclear power, it seemed sensible that the social implications of decommissioning be examined as well. The results should be illuminating to the nuclear industry as well as to the general public. The purpose of the workshop was to obtain the concerns and preferences of the group with respect to decommissioning. It was anticipated that such a process would (a) aid public utility commissions in decisions made about decommissioning, (b) give the ratepayers a sense of having participated in the policy-making process, and (c) illustrate a group idea generation technique (NGT), that is superior to open forums and other group techniques. The NGT comprised of an initial silent idea generation phase in which the participants quietly sat together and individually recorded their ideas about a particular problem statement. The problem statement posed to the North Anna group was: What are your concerns with respect to the potential impacts from decommissioning the North Anna nuclear power plant?

At the end of a specified time, each individual, in round-robin fashion, recorded on a flip chart in full view of the group a single idea. This continued until all ideas were presented. The second phase consisted of a brief discussion period in which the ideas were clarified and reformulated as necessary. A priority selection phase, using a nominal voting process, followed. In summary, the participants were most concerned about the potential health and safety effects from decommissioning. The potential impacts from the lost tax base and loss of employment for the labor force were also rated high. The estimated cost of decommissioning and consequent increase in rates were not a major concern. (Auth)/(DCM)

342

McKenzie, J.M., B.G. Self, T.J. Crawford, and L.A. Suber, Sandia National Laboratories, Albuquerque, NM

FAID/SPAR Field Tests at Kahl: A Final Report

Nuclear Materials Management 15:462-465; CONF-860654; Proceedings of the Institute of Nuclear Materials Management 27th Annual Meeting, New Orleans, LA, June 22-25, 1986; (pp. 462-465) (1986)

LWR fuel assemblies are convenient units for item accounting. A application of a fuel assembly seal which gives both integrity and a unique identity to the fuel assembly offers the potential of increased safeguards over present methods. This is particularly the case if the seal can be read at frequent intervals. The BWR Kahl reactor has been used to field evaluate FAID type ultrasonic seals. Twenty-four seals were applied to fresh fuel assemblies before their being placed in the reactor core. At convenient times when the reactor was shut down and the fuel moved to the spent fuel storage pool, the seal's identity and integrity were checked with a seal pattern reader (SPAR). After the reactor was decommissioned all seals were reidentified and their integrity checked. Five seals were removed from their fuel assemblies and embrittlement of the fracture link observed. Several seals were in the reactor core for three years.

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Miller, C.E., Jr., U.S. Department of Energy, Richland Operations Office, Surplus Facilities Management Program Office, Richland, WA

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Shippingport Station Decommissioning Project

Technical Advisory Group to the Cooperative Programme for Decommissioning, Meeting, Paris, France, November 12-13, 1985 (1985)

This report describes the Shippingport Station Decommissioning Project (SSDP). The mission of SSDP is to decommission the government-owned portion of the Shippingport Station which encompasses the following objectives: (1) to demonstrate safe and cost effective dismantlement of a large scale nuclear power plant; (2) to utilize subcontractors to increase the technology base/experience; and (3) to develop technology transfer and thereby provide know-how and industry standards for future projects. This report discusses the particulars of the project and includes many diagrams and visual aids. (CAC)

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Moya, M.M., and W.M. Davidson, Sandia National Laboratories, Albuquerque, NM

Sensor-Driven, Fault-Tolerant Control of a Maintenance Robot (for Nuclear Reactor)

Proceedings of the 1986 IEEE International Conference on Robotics and Automation, San Francisco, CA, April 7-10, 1986, Vol. 1; (pp. 428-434) (1986)

A robot system has been designed to do routine maintenance tasks on the Sandia Pulsed Reactor (SPR). The use of this remote maintenance robot (RMR) is expected to significantly reduce the occupational radiation exposure of the reactor operators. Reactor safety was a key issue in the design of the robot maintenance system. Using sensors to detect error conditions and intelligent control to recover from the errors, the RMR is capable of responding to error conditions without creating a hazard. A description is given of the design and implementation of a sensor-driven, fault-tolerant control for the RMR. Recovery from errors is not automatic; it does rely on operator assistance. However, a key feature of the error recovery procedure is that the operator is allowed to reenter the programmed operation after the error has been corrected. The recovery procedure guarantees that the moving components of the system will not collide with the reactor during recovery.

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Ostrow, S.L., O.I. Oztunali, and T.J. Grant, Ebasco Services, Inc., New York, NY

Intact Decommissioning of Nuclear Power Plants: Radiological Consequences

Transactions of the American Nuclear Society 52:35; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (pp. 35) (1986)

Intact decommissioning is a new alternative method for decommissioning nuclear power plants. It has potential advantages over the much studied mothballing, entombment, and immediate dismantlement options. Ebasco Services, under contract to the National Environmental Studies Project of the Atomic Industrial Forum, investigated the feasibility and radiological consequences of intact decommissioning for reference pressurized water reactor (PWR) and boiling water reactor (BWR) plants. In intact decommissioning, the bulk of the most highly radioactive items in the plants would be left in place (without the extensive construction work of entombment) within an established, sealed boundary, which would provide long-term containment of the enclosed radionuclides without maintenance and surveillance (required in mothballing and entombment). Radioactive items outside the boundary would be removed. The intact method would then provide a permanent decommissioning solution (like immediate dismantlement).

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Palau, G.L., and K.D. Auclair, Bechtel Eastern Power Corporation, Middletown, PA

Training Program Requirements for Remote Equipment Operators in Nuclear Facilities

Transactions of the American Nuclear Society 53:494-495; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (pp. 494-495) (1986)

As a result of the experiences in using remote equipment in the recovery effort at Three Mile Island Unit 2 (TMI-2), guidelines for the development of remote equipment operator training programs have been generated.

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Phillips, A.B., D.E. Prull, R.A. Ristinen, and J.J. Kraushaar, University of Colorado, Department of Physics, Boulder, CO

Residual Radioactivity in a Cyclotron and Its Surroundings

Health Physics 51(3):337-342 (1986, September)

Neutron-induced gamma-ray-emitting radionuclides in components and surroundings of the University of Colorado 1.3-m sector-focusing cyclotron have been measured with Ge(Li) and HPGe detectors. These measurements were made before decommissioning of the cyclotron and before approving release of the accelerator components and building space for other uses. In addition to the activities expected from previous published work, 13.3-y europium-152 and 8.6-y europium-154 were found in the concrete shielding with specific activities of tens of Bq/kg (a few nCi/kg). (Auth)

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Scheer, S.A., and J.R. Alexander, West Valley Nuclear Services Company, Inc., West Valley, NY

Measuring Success Utilizing Earned Value at the West Valley Demonstration Project

DOE/NE-44139-21; 43 pp. (1986, July)

The West Valley Nuclear Services Company, a wholly owned subsidiary of the Westinghouse Electric Corporation, operates the West Valley Demonstration Project for the U.S. Department of Energy and employs a wide spectrum of Project Management disciplines. The \$450M project represents the highest standards for safe management and clean-up of nuclear waste in the United States, one of the most sophisticated ever undertaken by either Westinghouse or DOE. This paper describes the history and scope of the technical aspects of the West Valley Management Control System, including how cost and schedule information is integrated to provide a comprehensive procurement measurement system, and the automated tools used by the management team to accomplish their goal. (Auth)

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Shouldis, V., and L. Goetz

The Year in Review - Decommissioning

Messenger (Hillsboro, NH) (870102):54-55 (1987, January 2)

Henniker Against the Nuclear Dump (HAND), a group of people who are opposed to a nuclear dump in their area, presented an oral report to the Henniker, New Hampshire, selectmen linking Seabrook to the need for a nuclear waste dump. Testimony presented focused on the decommissioning of Seabrook. The speakers suggested that the Hillsboro area would be a likely candidate for the burial site as a result of the DOE's dump search. They also feel the cost of decommissioning would cripple Public Service customers. The Henniker selectmen voted to intervene in the hearings of the Nuclear Decommissioning Finance Committee and also voted to push for legislation to prevent the operation of Seabrook until the commission completes its hearings and to urge Public Service Company of New Hampshire and other Seabrook owners to consider converting the plant to a safer energy source. (Auth)(SET)(DCM)

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Shurcliff, A.W., Massachusetts Institute of Technology, Energy Laboratory, Boston, MA

The Local Economic Impact of Nuclear Power

Technology Review 79(3):40-47 (1977, January)

The purpose of this article is to provide a preliminary overview of the consequences to local economies of nearby nuclear power plants. Information for the study was drawn from unpublished and published data and interviews with local government officials, power companies, and trade union leaders. The total economic impact of these huge power plant facilities upon the rural communities in which they have been built has, so far, not been overwhelming. U.S. Bureau of Census and U.S. Department of Labor statistics do not show variations which correlate with the presence or absence of a nuclear power plant. The size of the project and pool of locally skilled workers will determine the impact of possible job prospects. After the plant goes "on line," employment tends to fall to relatively low levels. Nuclear power plants usually require little in the way of costly public services from the tax districts in which they are located. The laws of individual states govern the amount of revenue an

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individual area receives. The economic impact suddenly changes upon completion of the power plant, and it will change once more upon plant decommissioning. Only inconclusive information exists on who will pay for decommissioning and for managing the radioactive areas which remain and how local property taxes will be affected. Forecasts of future economic impacts must be qualified as speculative because many questions remain unanswered. It is not known what will happen to tax benefits when nuclear plants are decommissioned nor whether the cost of denying public access to entombed radioactive structures (for the 100 or more years considered necessary by the Nuclear Regulatory Commission) will become a burden upon local taxpayers. (SET)(DCM)

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Swanson, R.

Nuclear Decommissioning - The Financial R and R Problems

Transactions of the American Nuclear Society 53:73; CONF-861102; Proceedings of an American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, DC, November 16-21, 1986; (p. 73) (1986)

From a financial standpoint, nuclear decommissioning issues can be synthesized into two primary concerns. The first concern is that actual decommissioning costs are recovered from users of nuclear generation. The second concern - one of reliability - is that amounts so recovered are actually available in current available funds when decommissioning occurs. These concerns, of course, are not new. They have been present from the very beginning of the civilian nuclear program. The issue of recoverability has been the subject of numerous rate proceedings of electric utilities. The one constant of these proceedings has been agreement that the customers who utilize the kilowatts generated by nuclear energy should pay the rates to provide funds for decommissioning. The rate-making issues have been (a) what amount is necessary and (b) how that amount should be provided, i.e., on a straight-line basis or some other basis such as a sinking fund methodology. The scope of this paper insofar as recoverability is concerned is limited to the latter issue. The dollar estimates will be left to engineers.

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Swinth, K.L., L.A. Rathbun, P.L. Roberson, and G.W.R. Endres, Pacific Northwest Laboratory, Richland, WA

Beta Measurement Evaluation and Upgrade

PNL-5750 (Part 5); Pacific Northwest Laboratory Annual Report for 1985 to the DOE Office of the Assistant Secretary for Environment, Safety and Health, Part 5 - Overview and Assessment; (pp. 25-26) (1986, February)

This program focuses on the resolution of problems associated with the field measurement of the beta dose component at Department of Energy (DOE) facilities. The change in DOE programs, including increased efforts in improved waste management and decontamination and decommissioning (D&D) of facilities, coupled with beta measurement problems identified at Three Mile Island has increased the need to improve beta measurements. In FY 1982, work was initiated to provide a continuing effort to identify problems associated with beta dose assessment at DOE facilities. The problems identified resulted in the development of this program. The investigation includes (1) an assessment of measurement systems now in use; (2) development of improved calibration systems and procedures; (3) application of innovative beta dosimetry concepts; (4) investigation of new instruments or concepts for monitoring and spectroscopy; and (5) development of recommendations to assure an adequate beta measurement program within DOE facilities.

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Thunborg, S., Sandia National Laboratories, Albuquerque, NM

A Remote Maintenance Robot System for a Pulse Nuclear Reactor

Proceedings of the 1986 IEEE International Conference on Robotics and Automation, San Francisco, CA, April 7-10, 1986, Vol. 1; (pp. 442-447) (1986)

The author presents a remote maintenance robot system for use in a hazardous environment. The system, which

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is operational, consists of a turntable, robot and hoist subsystems which operate under the control of a supervisory computer to perform coordinated programmed maintenance operations on a pulsed nuclear reactor.

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U.S. Department of Energy, Washington, DC

Nuclear Reactors Built, Being Built, or Planned: 1986

DOE/TIC-8200-R50; 42 pp. (1987, March)

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, 1986. Information is presented in five parts, each of which is categorized by primary function or purpose: civilian, production, military, export, and critical assembly. Classes of reactors included are: Central-Station Electric Power Plant; Dual-Purpose Plant; Experimental Power Reactor; General Irradiation Test Reactor; High-Power Research and Test Reactor; Research Reactor; University Research and Teaching Reactor; Export Reactor; and Critical Assembly. Initial commercial-operation dates for power reactors and criticality dates are given in tabular form. A statistical summary shows the number of reactors in every category except critical facilities. Shutdown and dismantled reactors in these categories are included since such facilities have made significant contributions to reactor technology.

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Urbanek, J., Vysoka Skola Strojní a Elektrotechnická, Plzen, Czechoslovakia; Skoda, Zavod Energetické Strojirenstvi, Plzen, Czechoslovakia;

Production Cost of Electric Power from Nuclear Power Plants

INIS-mf-10501; CONF-8410447; Results of Research and Development for Nuclear Power Plants with WWER-1000 Type Light Water Reactors: In Commemoration of the 125th Anniversary of SKODA, Plzen, Czechoslovakia, October 2, 1984; (pp. 63-69) (1984)

A breakdown is made of the costs of generating 1 kWh of electric power, and the values of the items are given for

nuclear and conventional power plants in the Czechoslovak situation. Certain controversial items are discussed, such as the costs of decommissioning the nuclear power plant at the end of its service life, the question of zero price of spent fuel, etc.

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von Hlubek, W., and G. Knoerzer, Rheinisch-Westfälisches Elektrizitätswerk AG, Essen, Federal Republic of Germany

Experience in Building and Operating the Kahl Nuclear Power Station

ATW, Atomwirtschaft, Atomtechnik 30(12):614-623 (1985, December)

In November 1985, the Kahl Experimental Nuclear Power Station (VAK) can boast of a record of twenty-five years of operation without any accident and almost without periods of maloperation. This first power reactor to be erected in the Federal Republic of Germany demonstrated the feasibility of safe electricity generation in nuclear power plants. Extensive programs of fuel testing over many years and irradiation programs for reactor materials produced important findings. Also the original idea of using VAK as a center of training and advanced training has been put into practice. These efforts were devoted not only to training the operating crews of future nuclear power plants, but also to helping the managers of German electric utility companies to acquire important experience. Also after its decommissioning, VAK is to continue to supply important results up until its final disposal.

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Whitehead, W., Atomic Energy Control Board, Ottawa, Ontario, Canada

Decommissioning of Nuclear Facilities in Canada - A Summary

Factors Relevant to the Recycling and Reuse of Components Arising from the Decommissioning of Nuclear Installations, Papers Presented at an International Atomic Energy Agency Technical Committee Meeting, Vienna, Austria, April 21-25, 1986 (1986, April)

CHAPTER 2. NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Canadian nuclear facilities have recently been decommissioned or are currently undergoing decommissioning and include three uranium mine/mill facilities, two power reactor facilities, and a fuel fabrication plant. In addition, two low-level radioactive waste management sites require decommissioning, pending formulation and acceptance of suitable approaches. This report begins with an introductory section on the Atomic Energy Control Board (AECB) which regulates the development, application, and use of atomic energy in Canada. The following sections contain brief descriptions of nuclear facilities recently decommissioned or currently undergoing decommissioning. Included in these are the associated decommissioning activities and radiological/environmental criteria as prescribed by the AECB. The final section discusses the most recent regulatory initiatives concerning decommissioning and includes the AECB address to which one can send requests for AECB Consultative Documents (Auth)(CAC)

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Winkelmann, I., and P. Gesewsky, Bundesgesundheitsamt, Institut fuer Strahlenhygiene, Neuherberg, Federal Republic of Germany

Measuring Special Nuclides in Samples from the Decommissioned Gundremmingen Nuclear Power Station

IS-4-27; 29 pp. (1983, June)

In addition to the radiochemical analyses of samples taken from the off-gas filter system for determining special radionuclides, analyses since 1982 also covered

samples taken from other components of the Gundremmingen nuclear power station. The specimens were taken by the operator and sent to the Federal Health Office for examination. They were notch impact test specimens, scraping samples, flux monitor specimens (activation wires), and concrete specimens taken from the biological shield. The analyses were intended to determine the number and kind of long-lived, pure beta-emitters (such as Ni-63 and Ca-45), or decay nuclides (such as Fe-55 or Ni-59) induced by electron capture, or the nuclides Na-22 and Ba-133. Radiochemical analyses, as well as gamma-spectrometric analyses were conducted.

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Zhang, J.K., G.N. Okeke, and C.H.B. Mee

Present Status and Future Studies of Radiation Shielding in Reprocessing Plant, Radioactive Waste Facility and Decommissioning of Power Reactor

Nippon Genshiryoku Gakkaishi 28(2):139-146 (1986, February)

This is a report on one of the activities of the Research Committee on Shielding of Radiation Facilities (April 1984 - March 1986), Atomic Energy Society of Japan. The Committee studied the present status of the radiation shielding used in reprocessing plants, in radioactive waste facilities, and in the decommissioning of power reactors. Shielding requirements for experimental fusion reactors still in operation were also studied. As a result, a variety of shielding problems peculiar to these facilities were chosen for future study.

Chapter 3

**FORMERLY UTILIZED SITES REMEDIAL
ACTION PROGRAM**

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CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

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

St. Louis Airport Site Annual Site Environmental Report, St. Louis, Missouri - Calendar Year 1985

DOE/OR/20722-100 (Rev. 1); 52 pp. (1986, September)

During 1985, the environmental monitoring program was continued at the St. Louis Airport Site (SLAPS) in St. Louis County, Missouri. The ditches north and south of the site have been designated for cleanup as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). The monitoring program at the SLAPS measures radon gas concentrations in air; external gamma radiation doses; and uranium, thorium, and radium concentrations in surface water, groundwater, and sediment. Potential radiation doses to the public are also calculated. During 1985, annual average radon levels in air at the SLAPS were below the DOE Derived Concentration Guides (DCG) for uncontrolled areas. External gamma monitoring in 1985 showed measured annual gamma dose rates ranging from 3 to 2087 mrem/yr. Average annual concentrations of thorium-230, radium-226, and total uranium in surface waters remained below the DOE DCG. Although there are no DCG for sediments, all concentrations of total uranium, thorium-230, and radium-226 were below the FUSRAP Guidelines. (Auth) (SET)(DCM)

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

Wayne Interim Storage Site Annual Site Environmental Report, Wayne, New Jersey - Calendar Year 1985

DOE/OR/20722-103; 62 pp. (1986, August)

Environmental monitoring of the Wayne Interim Storage Site (WISS), a DOE facility in Wayne, NJ, continued in 1985. The WISS is presently used for the storage of soils contaminated with low-level radioactivity. Monitoring results show that the WISS is in compliance with DOE concentration guides and radiation protection standards. Derived Concentration Guides represent the concentra-

tions of radionuclides in the air or water that would limit the radiation dose to 100 mrem/yr. The monitoring program at the WISS measures uranium, radium, and thorium concentrations in surface water, groundwater, and sediment; radon and thoron gas concentrations in air; and external gamma radiation dose rates. Potential radiation doses to the public are also calculated. During 1985, annual average thoron concentrations at the WISS ranged from 1 to 11 percent of the DOE guide. Annual average radon concentrations ranged from 13 to 39 percent of the DOE guide. The highest measured external dose rate at the WISS was 606 mrem/yr. Radon concentrations and external gamma dose rates at the site were lower than those measured in 1984. Radionuclide concentrations in surface water were equal to background levels, and groundwater concentrations were similar to 1984 levels. For sediments, insufficient data are available to permit the establishment of trends. The calculated total radiation dose to the maximally exposed individual at the WISS, was 7 percent of the DOE radiation standard. (Auth)(SET)

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

Environmental Monitoring Report for the Colonie Interim Storage Site, Colonie, New York - Calendar Year 1984

DOE/OR/20722-53; 23 pp. (1985, July)

During 1984, an environmental monitoring program was initiated for the Colonie Interim Storage Site (CISS), Colonie, New York. The site is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a United States Department of Energy (DOE) program to identify, clean up or otherwise control sites where low-level radioactive contamination remains from the early years of the nation's atomic energy program. The monitoring program at CISS measures the uranium and radium concentrations in surface water, groundwater, and sediment and external gamma radiation exposure levels. Potential radiation doses to the public are also calculated. All environmental samples are analyzed to determine compliance with applicable environmental quality standards. DOE Order 5480.1A, Chapter XI, provides applicable Concentration Guide (CG) limits for radionuclides in controlled and uncontrolled areas. During 1984, Uranium concentrations in surface water were below the DOE CG except for one location upstream of

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the CISS. Radium concentrations in surface water were below the DOE CG. In groundwater, both uranium and radium concentrations were below the CG. External gamma radiation exposure levels were all below the DOE Radiation Protection Standard. Radiation exposures to a hypothetically maximally exposed individual from ingestion of surface water with the highest average concentration of depleted uranium would result in a 50-year dose commitment to the bone of approximately 890 mrem. This exceeds the dose commitment of 750 mrem resulting from ingestion of water containing depleted uranium at the DOE CG. (Auth)

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

Environmental Monitoring Report for the Wayne Interim Storage Site, Wayne, New Jersey - Calendar Year 1984

DOE/OR/20722-54; 31 pp. (1985, July)

During 1984, an environmental monitoring program began at the Wayne Interim Storage Site (WISS), located in Wayne and Pequannock Townships, New Jersey. The site is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a United States Department of Energy (DOE) program to identify, decontaminate, or otherwise control sites where low-level radioactive contamination remains from the early years of the nation's atomic energy program. The monitoring program is conducted by Bechtel National, Inc., Program Management Contractor for FUSRAP. The monitoring program at WISS measures radon-222 and radon-220 gas concentrations in air; radium, uranium, and thorium concentrations in surface water, groundwater, and sediment; and external gamma exposure rates. Radiation doses to the public are also calculated. All environmental samples are analyzed to determine compliance with applicable environmental quality standards. DOE Order 5480.1A, Chapter XI, provides applicable Concentration Guide (CG) limits for radionuclides in controlled and uncontrolled areas. During 1984, radon-222 and radon-220 concentrations in air were all below the DOE CG limit of 3 pCi/l and 10 pCi/l, respectively. Uranium, radium, and thorium concentrations in surface water were all below DOE CG limits. Radium-228 levels in groundwater from two on-site wells located within existing burial areas exceeded DOE CG limits for uncontrolled areas. Two external gamma radiation monitoring locations at the

site boundary had exposure rates above the DOE Radiation Protection Standard. (Auth)

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

Environmental Monitoring Report for the Former Middlesex Sampling Plant and Middlesex Municipal Landfill Sites, Middlesex, New Jersey - Calendar Year 1984

DOE/OR/20722-56; 42 pp. (1985, July)

During 1984, the environmental monitoring program was continued at the former Middlesex Sampling Plant (MSP) and former Middlesex Municipal Landfill (MML) sites, located in the Borough of Middlesex, New Jersey. The sites are part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a United States Department of Energy (DOE) program to decontaminate or otherwise control sites where low-level radioactive contamination remains from the early years of the nation's atomic energy program. The environmental monitoring program is carried out by Bechtel National, Inc., Program Management Contractor for FUSRAP. The monitoring program at the MSP and MML measures the uranium and radium concentrations in surface and groundwater, the radon gas concentrations in air, and external gamma radiation exposure rates. Potential radiation doses to the public are also calculated. All environmental samples collected are analyzed to determine compliance with applicable environmental quality standards. DOE Order 5480.1A, Chapter XI, provides applicable Concentration Guide (CG) limits for radionuclides in controlled and uncontrolled areas. During 1984, average concentrations of uranium and radium-226 in groundwater and surface waters monitored for both the MSP and MML remained below the DOE CG for uncontrolled areas. Annual average radon levels in air at both the MSP and MML were below the CG for uncontrolled areas. External gamma monitoring in 1984 showed all monitoring locations at both sites reporting gamma exposure rates below DOE Radiation Protection Standards. All radiation doses to the public were within DOE standards and consistent with 1983 exposure rates. (Auth)

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

CHAPTER 3. FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

Hazelwood Interim Storage Site Environmental Monitoring Summary, Hazelwood, Missouri - Calendar Year 1984

DOE/OR/20722-57; 14 pp. (1985, July)

The routine environmental monitoring program for the Hazelwood Interim Storage Site includes surface water, groundwater, and sediment sampling as well as radon gas and external radiation measurements to determine the sites compliance with Department of Energy (DOE) Concentration Guides (CGs) provided in DOE Order 5480.1A, Chapter XI. The CGs represent the concentration of a radionuclide in air or water that would limit the dose to the most highly exposed individual to equal to or less than accepted radiation protection standards. This report summarizes the various environmental sampling, monitoring, and analytical procedures and the extent of conformance with the CGs. Prior to initiation of remedial action work, Bechtel National Inc. (BNI), Program Management Contractor for FUSRAP, began baseline sampling of surface water in the vicinity of the site in April 1984. Sampling of groundwater from existing wells commenced in June 1984, and radon and external radiation sampling locations were installed in September 1984. All surface water samples showed concentrations of uranium, radium-226, and thorium-230 below the DOE CG limits for uncontrolled areas. Similarly, groundwater samples from the monitoring wells all showed uranium, radium-226, and thorium concentrations below the respective DOE CGs. There are no limits for uranium, radium, or thorium in sediments. However, decontamination of HISS is being conducted to the DOE FUSRAP proposed guidelines for radionuclides in soil. Sediment samples showed thorium-230 levels above these guidelines. Radon gas samples were all below DOE CG limits. Two of the external gamma radiation readings were above the DOE Radiation Protection Standard. The highest external radiation concentrations occurred during the initial 2-week sampling period. (JWF)

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

St. Louis Airport Storage Site (SLAPSS) Environmental Monitoring Summary, St. Louis, Missouri - Calendar Year 1984

DOE/OR/20722-59; 11 pp. (1985, July)

Radiological surveys conducted in 1976 and 1978 by Oak Ridge National Laboratory determined that the St. Louis Airport Storage Site (SLAPSS) and the drainage ditches north and south of McDonnell Boulevard were radioactively contaminated above remedial action program guidelines. The SLAPSS property has not yet been designated for consideration for remedial action under FUSRAP. However, routine radiological monitoring of the site has been authorized. The monitoring program and results are detailed in this report. The routine environmental monitoring program for SLAPSS and the off-site ditches includes surface water and sediment sampling of Coldwater Creek, groundwater sampling of six monitoring wells within the site boundary, radon gas monitoring, and external gamma radiation measurements. This report summarizes the various experimental sampling, monitoring, and analytical procedures. Environmental monitoring results listed in individual tables are the arithmetic averages of individual results. For comparative purposes, guidelines or limits from both DOE and NRC are provided as footnotes in the various tables. In addition, as the various monitoring results are reported, DOE Concentration Guidelines are provided to show how the monitoring results would have compared had the site been owned by DOE. (JWF)

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

Maywood Interim Storage Site Environmental Monitoring Summary, Maywood, New Jersey - Calendar Year 1984

DOE/OR/20722-60; 15 pp. (1985, July)

During 1984, an environmental monitoring program was initiated for the Maywood Interim Storage Site (MISS), Maywood, New Jersey. The site is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a United States Department of Energy (DOE) program to identify, clean up, or otherwise control sites where low-level radioactive contamination remains from the early years of the nation's atomic energy program. The monitoring program at MISS measures the uranium, thorium, and radium concentrations in surface water, groundwater, and sediment, as well as radon gas and external gamma radiation exposure levels. All environmental samples are analyzed to determine compliance with applicable environmental quality standards. DOE Order 5480.1A, Chapter XI, provides applicable Concentration

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Guide (CG) limits for radionuclides in controlled and uncontrolled areas. During 1984, uranium, radium-226, and thorium-232 levels in surface water were below DOE CGs for uncontrolled areas. There were no existing groundwater wells at the MISS; however, wells were installed in 1984 and sampling will begin in 1985. All sediment samples were below DOE FUSRAP proposed guidelines for radionuclides in soil. Radon concentrations were below DOE CG levels. External gamma exposure rates were below the DOE guideline in all but one location. (JWF)

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

Post-Remedial Action Report for Lodi Residential Properties - 1985, Lodi, New Jersey

DOE/OR/20722-89; 42 pp. (1986, August)

Bechtel National, Inc. (BNI) removed radioactive contamination from residential properties on Trudy Drive, Hancock Street, Avenue F, and Avenue C in Lodi, New Jersey as part of work being conducted under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). The purpose of this report is to document post-remedial action sampling performed by BNI at these properties near the Stepan Company plant located in Maywood. This report briefly describes the origin of the radioactive contamination on the properties, the methods used to determine the extent of it, and the types of remedial action performed. It also identifies the guidelines used in performing the remedial action, documents final excavation limits and depths, and provides data on the current radiological status of each property. (Auth)(SET)

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

Middlesex Sampling Plant and Middlesex Municipal Landfill Annual Site Environmental Report, Middlesex, New Jersey - Calendar Year 1985

DOE/OR/20722-97, 80 pp. (1986, August)

The environmental monitoring program continued during 1985 at the Middlesex Sampling Plant (MSP) and the Middlesex Municipal Landfill (MML). Environmental samples were collected and analyzed to determine if radionuclide concentrations in air and water are in compliance with applicable U.S. Department of Energy (DOE) Derived Concentration Guides (DCG). The DCG represent the concentration of radionuclides in air or water that would limit the radiation dose to 100 mrem/yr. The limits were revised from 500 mrem/yr in 1984 to 100 mrem/yr in 1985. The monitoring program at the MSP and MML measures uranium and radium concentrations in surface water, groundwater, and sediment; radon gas concentrations in air; and external gamma radiation dose rates. During 1985, the highest annual average radon levels in air at the MSP and MML were 17 percent and 10 percent, respectively, of the DCG. The highest annual average gamma dose rate at the MSP was 167 mrem/yr; at the MML the highest annual average dose rate was 13 mrem/yr. The highest average annual concentrations of uranium in surface water monitored at the MSP and MML were 13 percent and 1 percent, respectively, of the DOE DCG. There are no specific limits for uranium or radium concentrations in sediments; however, cleanup of the MML and vicinity properties at the MSP is being conducted in accordance with the DOE FUSRAP guidelines for radionuclides in soil. Highest annual average concentrations of uranium and radium-226 at the MSP were 7.7 and 3.5 pCi/g, respectively. The highest uranium concentration at MML was 3.3 pCi/g, while the highest radium-226 concentration was 0.7 pCi/g. Elevated levels of radiation still exist in areas where remedial action has not yet been completed, such as several areas surrounding the storage pile at the MSP. With this exception, both sites are in compliance with DOE DCG and the radiation protection standard. (Auth)(SET)(DCM)

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

Hazelwood Interim Storage Site Annual Site Environmental Report, Hazelwood, Missouri - Calendar Year 1985

DOE/OR/20722-99 (Rev. 1); 57 pp. (1986, November)

Environmental monitoring continued at the Hazelwood Interim Storage Site (HISS) located in Hazelwood, Missouri during 1985. Low-level radioactively contaminated

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soils are stored there. Monitoring results show that the HISS is in compliance with the DOE Derived Concentration Guides (DCGs) and radiation protection standards. While 1984 limits were based on a radiation protection standard of 500 mrem/yr, the new 1985 limits are based on a standard of 100 mrem/yr for long-term exposure and 500 mrem/yr for short-term exposure. To determine whether the site is in compliance with DOE standards, environmental measurements are expressed as percentages of the applicable DCG, while the calculated doses to the public are expressed as percentages of the applicable radiation protection standard. The monitoring program at the HISS measures uranium, radium, and thorium concentrations in surface water, groundwater, and sediment; radon gas concentrations in air; and external gamma radiation exposure rates. Potential radiation doses to the public are also calculated. During 1985, annual average radon concentrations ranged from 10 to 23 percent of the DCG. The highest average annual concentration of uranium in surface water monitored in the vicinity of the HISS was 0.7 percent of the DOE DCG, for radium-226 it was 0.3 percent of the applicable DCG, and for thorium-230 it was 1.8 percent. While there are no concentration guides for stream sediments, the highest concentration of uranium was 19 pCi/g, the highest concentration of radium-226 was 4 pCi/g, and the highest concentration of thorium-230 was 300 pCi/g. Radon concentrations, external gamma dose rates, and radionuclide concentrations in groundwater at the site were lower than those measured in 1984; radionuclide concentrations in surface water were roughly equivalent to the 1984 levels. The calculated radiation dose to the maximally exposed individual at the HISS, considering several exposure pathways, was 5.4 mrem, which is 5 percent of the radiation protection standard. (Auth)(SET)

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Bechtel National, Inc., Oak Ridge, TN

Hazelwood Interim Storage Site Annual Site Environmental Report, Hazelwood, Missouri - Calendar Year 1986

DOE/OR/20722-143; 61 pp. (1987, June)

During 1986, the environmental monitoring program was continued at the Hazelwood Interim Storage Site (HISS), a U.S. Department of Energy (DOE) facility located in the City of Hazelwood, Missouri. Originally known as the Cotter Corporation site on Latty Avenue in Hazelwood, the HISS is presently used for the storage of

soils contaminated with residual radioactive material. The HISS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program to decontaminate or otherwise control sites where residual radioactive material remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has mandated DOE to remedy. As part of the decontamination research and development project authorized by Congress under the 1984 Energy and Water Appropriations Act, remedial action is being conducted at this site and at vicinity properties by Bechtel National, Inc. (BNI), Project Management Contractor for FUSRAP. The environmental monitoring program is also carried out by BNI. The monitoring program at the HISS measures radon gas concentrations in air; external gamma radiation levels; and thorium, uranium, and radium concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess its potential effect on public health, the radiation dose was calculated for the maximally exposed individual (MEI). Based on the scenario described in this report, the MEI at the HISS would receive an annual external exposure approximately equivalent to two percent of the DOE radiation protection standard of 100 mrem/yr. This exposure is less than the exposure a person would receive during a round-trip flight from New York to Los Angeles (due to greater amounts of cosmic radiation at higher altitudes). The cumulative dose to the population within an 80-km (50-mi) radius of the HISS that would result from radioactive materials present at the site would be indistinguishable from the dose that the same population would receive from naturally occurring radioactive sources. Results of the 1986 monitoring show that the HISS is in compliance with the DOE radiation protection standard. (Auth)(DCM)

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Bechtel National, Inc., Oak Ridge, TN

St. Louis Airport Site Annual Site Environmental Report, St. Louis Missouri - Calendar Year 1986

DOE/OR/20722-145; 59 pp. (1987, May)

The environmental monitoring program continued during 1986 at the St. Louis Airport Site (SLAPS) in St. Louis County, Missouri. The monitoring program at the SLAPS measures radon gas concentrations in air; exter-

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nal gamma dose rates; and uranium, thorium, and radium concentrations in surface water, ground water, and sediment. To verify that the SLAPS is in compliance with the DOE radiation protection standard (100 mrem/yr) and assess its potential effect on public health, the radiation dose was calculated for the maximally exposed individual. Based on the scenario described in this report, the maximally exposed individual would receive an external exposure approximately equivalent to 4.7 percent of the DOE radiation protection standard of 100 mrem/yr. This exposure is approximately the same as a person would receive from increased cosmic radiation during a round-trip flight from New York to Los Angeles (due to greater amounts of cosmic radiation at higher altitudes). The dose to the population within an 8-km (50-mi) radius of the SLAPS that would result from radioactive materials present at the site would be indistinguishable from the dose the population would receive from naturally occurring radioactive sources. Results of the 1986 monitoring show that the SLAPS is in compliance with the DOE radiation protection standard. (Auth)(SET)

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Bechtel National, Inc., Oak Ridge, TN

Colonie Interim Storage Site Annual Site Environmental Report, Colonie, New York - Calendar Year 1986

DOE/OR/20722-146 (1987, June)

The environmental monitoring program continued at the Colonie Interim Storage Site (CISS) during 1986. The monitoring program at the CISS measures external gamma radiation levels as well as uranium and radium-226 concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with the Department of Energy (DOE) radiation protection standard and to assess the potential effect of the site on public health, the radiation dose was calculated for the maximally exposed individual. Based on the conservative scenario described in the report, the maximally exposed individual would receive an annual external exposure approximately equivalent to 5 percent of the DOE radiation protection standard of 100 mrem/yr. This is approximately equivalent to the exposure a person would receive during a round-trip by air from New York to Los Angeles due to increased cosmic radiation at higher altitudes. The cumulative dose to the population within an 80-km (50 mi) radius of the CISS that would result from

radioactive materials present at the site would be indistinguishable from the dose that the same population would receive from naturally occurring radioactive sources. Results of 1986 monitoring show that the CISS is in compliance with the DOE radiation protection standard. (Auth)(SET)

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Bechtel National, Inc., Oak Ridge, TN

Wayne Interim Storage Site Annual Site Environmental Report, Wayne, New Jersey - Calendar Year 1986

DOE/OR/20722-147; 70 pp. (1987, May)

During 1986, the environmental monitoring program was continued at the Wayne Interim Storage Site (WISS), a U.S. Department of Energy (DOE) facility located in the Township of Wayne, New Jersey. The WISS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program to decontaminate, or otherwise control sites where residual radioactive material remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has mandated DOE to remedy. As part of the decontamination research and development program authorized by Congress under the 1984 Energy and Water Appropriations Act, remedial action is being conducted at this site and at vicinity properties by Bechtel National, Inc. (BNI), Project Management Contractor for FUSRAP. The environmental monitoring program is also carried out by BNI. The monitoring program at the WISS measures radon and thoron gas concentrations in air; external gamma radiation levels; and thorium, uranium, and radium concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess its potential effect on public health, the radiation dose was calculated for the maximally exposed individual (MEI). Based on the conservative scenario described in this report, the MEI at the WISS would receive an annual external exposure approximately equivalent to one percent of the DOE radiation protection standard of 100 mrem/yr. By comparison, the average American receives a dose of one mrem/yr from watching color television. The cumulative dose to the population within an 80-km (50-mi) radius of the WISS that would result from radioactive materials present at the site would be indistinguishable from the dose that the same population would receive from natu-

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rally occurring radioactive sources. Results of the 1986 monitoring show the the WISS is in compliance with the DOE radiation protection standard. (Auth)(DCM)

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Bechtel National, Inc., Oak Ridge, TN

Maywood Interim Storage Site Annual Site Environmental Report, Maywood, New Jersey - Calendar Year 1986

DOE/OR/20722-148; 70 pp. (1987, June)

During 1986, the environmental monitoring program was continued at the Maywood Interim Storage Site (MISS), a U.S. Department of Energy (DOE) facility located in the Borough of Maywood and the Township of Rochelle Park, New Jersey. The MISS is presently used for the storage of low-level radioactively contaminated soils. The MISS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program to identify, decontaminate, or otherwise control sites where residual radioactive materials (exceeding current guidelines) remain from the early years of the nation's atomic energy program, or from commercial operations causing conditions that Congress has mandated DOE to remedy. As part of the decontamination research and development project authorized by Congress under the 1984 Energy and Water Appropriations Act, remedial action is being conducted at this site and at vicinity properties by Bechtel National, Inc. (BNI), Project Management Contractor for FUSRAP. The environmental monitoring program is also carried out by BNI. The monitoring program at the MISS measures thoron and radon gas concentrations in air; external gamma radiation levels; and thorium, uranium, and radium concentrations in surface water, ground water, and sediment. To verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess the potential effect on public health, the radiation dose was calculated for the maximally exposed individual (MEI). Based on the conservative scenario described in the report, the MEI would receive an annual external exposure approximately equivalent to one percent of the DOE radiation protection standard of 100 mrem/yr. This exposure is less than the exposure a person would receive during a round-trip flight from New York to Los Angeles (due to greater amounts of cosmic radiation at higher altitudes). The cumulative dose to the population within an 80-km (50-mi) radius of the MISS that would result from radioactive materials present at the site would be

indistinguishable from the dose the same population would receive from naturally occurring radioactive sources. Results of the 1986 monitoring show that the MISS is in compliance with the DOE radiation protection standard. (Auth)(DCM)

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Bechtel National, Inc., Oak Ridge, TN

Middlesex Sampling Plant and Middlesex Municipal Landfill Annual Site Environmental Report, Middlesex, New Jersey - Calendar Year 1986

DOE/OR/20722-149; 83 pp. (1987, May)

The environmental monitoring program was continued during 1986 at the former Middlesex Sampling Plant (MSP) and former Middlesex Municipal Landfill (MML) sites, located in the Borough of Middlesex, New Jersey. The monitoring program at the MSP and MML measures radon gas concentrations in air; external gamma radiation levels; and uranium and radium concentrations in surface water, ground water, and sediment. To verify that the sites are in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess their potential effect on public health, the radiation dose was calculated for the maximally exposed individual. Based on the conservative scenarios described in the report, an individual, at the MSP would receive an annual external exposure approximately equivalent to 10 percent of the DOE radiation protection standard. By comparison, the incremental dose received from living in a brick house versus a wooden house is about the same. At the MML, the annual external exposure to the maximally exposed individual would be less than 1 percent of the standard. The cumulative dose to the population within a 80-km (50-mi) radius of the sites that would result from radioactive materials present at the MSP and MML would be indistinguishable from the dose that the same population would receive from naturally occurring radioactive sources. Results of the 1986 monitoring show that the MSP and MML are in compliance with the the DOE radiation protection standard. (Auth)(SET)

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Carrier, R.F., and W.D. Cottrell, Oak Ridge National Laboratory, Biology Division, Oak Ridge, TN; Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

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Radiological Survey of the Perimeter Fence Line of the Former Cotter Site, Hazelwood, Missouri (LM002)

ORNL/TM-10007; 52 pp. (1986, December)

A radiological survey was conducted in 1983 by the Oak Ridge National Laboratory along the perimeter fence line of the former Cotter site at 9200 Latty Avenue, Hazelwood, Missouri. During the 1960s and 1970s, process wastes and residues generated by the production and refining of uranium materials were stored at the site (currently owned by the Jarboe Realty and Investment Company). Subsequent to the removal and transport of the stored wastes along with a portion of the top soil to other locations, it was found that the soil remaining on the site contained radioactive residuals. This report describes the survey of the regions along the fence line that surrounds the property on all sides. Included are gamma scans of the grid blocks on each side of the fence line; sampling of surface soil; sampling of subsurface soil from auger holes; and gamma logging of auger holes. The results of soil sample analyses demonstrate radionuclide soil contamination with maxima for Ra-226, Th-230, and U-238 at 1700, 77,000, and 1200 pCi/g, respectively. These concentrations were found in surface soil taken from 0 to 0.15 m. The depth of contamination ranges from the surface to 1.7 m. The maximum contamination measured during this survey was found at an average depth of 0.36 m. (Auth)

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Cottrell, W.D., R.F. Carrier, and C.A. Johnson, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN; Oak Ridge National Laboratory, Biology Division, Oak Ridge, TN

Radiological Survey of Properties in the Vicinity of the Former Cotter Site, Hazelwood/Berkeley, Missouri (LM003)

ORNL/TM-10008; 116 pp. (1987, May)

A radiological survey was conducted in 1984 by the Oak Ridge National Laboratory of private properties adjacent to the former Cotter site at 9200 Latty Avenue, Hazelwood/Berkeley, Missouri. During the 1960s and 1970s, process wastes and residues generated by the production and refining of uranium materials were stored at

the site (currently owned by the Jarboe Realty and Investment Company). Subsequent to the removal and transport of the stored wastes, along with a portion of the top soil, to other locations, it was found that the soil remaining on the site contained radioactive residuals. This report describes the survey of the properties adjacent to the site. Included were gamma exposure rates at the ground surface and at 1 m above the surface throughout the site; sampling of surface soil; sampling of subsurface soil from auger holes; gamma logging of auger holes; and, sampling of sediment and surface waters receiving drainage from the site. The results of the survey demonstrated some degree of radioactive contamination over most of the area surveyed. The major contaminant was Th-230 with Ra-226 and U-238 occurring in lesser amounts. The maximum concentrations of Ra-226, Th-230, and U-238 found in soil were 1400, 81,000, and 990 pCi/g, respectively. The maximum depth at which contamination was measured was 2 m. Although samples of drainage waters showed no evidence of contamination, migration of the radioactive materials was indicated by elevated concentration of Ra-226, Th-230, and U-238 in sediment samples taken from those waters. The pattern of radionuclide contamination observed in most soil and sediment samples is typical of the wastes and residues which had been stored at the former Cotter site. (Auth)

379

Golchert, N.W., Argonne National Laboratory, Occupational Health and Safety Division, Argonne, IL

Site Surveillance and Maintenance Program for Palos Park - Report for 1986

ANL-87-8; 39 pp. (1987, April)

The results of the environmental monitoring program conducted at Site A/Plot M in the Palos Park Forest Preserve area for CY 1986 are presented. The monitoring program is the ongoing remedial action that resulted from the original radiological characterization of the site. The program consists of sample collection and analysis of air, surface and subsurface water, and bottom sediment to determine the migration pathway of water from the burial ground (Plot M) to hand-operated picnic wells; establish if buried radionuclides other than hydrogen-3 have migrated; and generally characterize the radiological environment of the area. The program was expanded late this year to study the migration of non-radiological hazardous waste constituents that may have been buried

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with the radioactive waste. This was done by analyzing borehole water samples for selected heavy metals and organic compounds. Earlier studies had determined that hydrogen-3 (as tritiated water) migrated from the burial ground and was present in minute concentrations in two nearby hand-pumped picnic wells. Hydrogen-3 in the Red Gate Woods picnic well continued to show the same pattern of elevated levels in the winter and low concentrations in the summer, but the magnitude of the winter peak was significantly less than in earlier years. Tritiated water continues to be detected in a number of wells, boreholes, and surface streams. For many years it was the only radionuclide found to have migrated. Recent measurements indicate the presence of strontium-90 in borehole water next to Plot M. However, the results of the program established that the radioactivity remaining at Site A/Plot M does not endanger the health or safety of the public visiting the site or those living in the vicinity. (Auth)

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New Jersey Department of Environmental Protection, Trenton, NJ

Radiological Survey of Sheffield Brook, Wayne, New Jersey

Report (1982, October)

The purpose of the radiological ground survey along Sheffield Brook and its tributaries was to define the extent of offsite radiological contamination identified in the aerial survey of Wayne, New Jersey. The ground survey involved taking field measurements of direct radiation and samples of soil, sediment, water, and air for radiological analyses. This report discusses the findings of this survey and includes sampling procedures, analytical techniques, and obtained data. The final section compares the radiological data with radiological standards. (Auth)(CAC)

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Voigt, W.R., U.S. Department of Energy, Office of Remedial Action and Waste Technology, Washington, DC

Certification of the Radiological Condition of Thirty-Two Private Properties Located in Middlesex and Piscataway, NJ

Federal Register 51(236):44362-44364 (1986, December 9)

The Department of Energy (DOE) has completed radiological surveys and taken remedial actions to decontaminate twenty-five properties in Middlesex, New Jersey. The properties were found to contain small quantities of naturally occurring radioactive material resembling the residue from uranium ore processing conducted at the nearby Middlesex Sampling Plant when it was operated under contract to the Manhattan Engineer District and the Atomic Energy Commission. In addition, there were seven designated properties previously thought to be contaminated where no remedial action took place. This article further details these findings and includes a statement of certification issued by DOE which lists the thirty-two properties associated with the plant as part of the Formerly Utilized Sites Remedial Action Program. (Auth)(CAC)

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Williams, J.K., and B.A. Berven, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Results of Radiological Measurements Taken in the Niagara Falls, New York, Area (NF002)

ORNL/TM-10076; 54 pp. (1986, November)

The results of a radiological survey of 100 elevated gamma radiation anomalies in the Niagara Falls, New York, area are presented in this report. These radiation anomalies were identified by a mobile gamma scanning survey during the period October 3-16, 1984, and were recommended for an onsite survey to determine if the elevated levels of radiation may be related to the transportation of radioactive waste material to the Lake Ontario Ordnance Works for storage. In this survey, radiological measurements included outdoor gamma exposure rates at 1 meter above the surface; outdoor gamma exposure rates at the surface, range of gamma exposure rates during scan; and uranium, radium, and thorium concentrations in biased surface soil samples. The results show 38 anomalies (35 located along Fletcher Road and 3 associated with other unrelated locations) were found to exceed Formerly Utilized Sites Remedial Action Program (FUSRAP) remedial action guidelines and were recommended for formal characterization sur-

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veys. (Since the time of this survey, remedial actions have been conducted on the 38 anomalies identified as exceeding FUSRAP guidelines, and the radioactive material above guidelines has been removed.) The remaining 62 anomalies are associated with asphalt driveways and parking lots, which used a phosphate slag material (previously identified as cyclowollastonite, synthetic CaSiO_3). This rocky-slag waste material was used for bedding under asphalt surfaces and in general gravel applications. Most of the contaminated soil and rock samples collected at the latter anomalies had approximately equal concentrations of Ra-226 and U-238 and, therefore, are not related to materials connected with the Niagara Falls Storage Site (NFSS), including material that was transported to the NFSS. (Auth)

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Yalcintas, M.G., and D.E. Fields, Oak Ridge National Laboratory, Oak Ridge, TN

Correlation Between Gamma Radiation Levels and Soil Thorium Concentrations at the FUSRAP Sites in New Jersey

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S13 (1987)

Processing of thorium ores was performed in Maywood, New Jersey, between 1916 and 1956. During the course of thorium processing, the wastes from the operations were pumped to dikes next to the plant. Construction in the area caused the dispersal of waste into adjacent areas. The U.S. Department of Energy (DOE) adopted a policy of assigning an independent verification contractor to ensure the effectiveness of remedial action performed within the Formerly Utilized Sites Remedial Action Project (FUSRAP). The Radiological Survey Activities (RSA) group of the Oak Ridge National Laboratory (ORNL) has been assigned the responsibility for this task at the Maywood, New Jersey site. During this effort, it is important to estimate the concentration of thorium in soil rapidly and accurately over large areas. In this study, a correlation is described between the thorium concentration and the gamma readings of the site. The statistical analysis of the data indicates that this correlation is site-specific and depends on the depth of the radionuclide. Data are presented, and the method of analysis is described. (Auth)(DCM)

Chapter 4

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Bernhardt, D.E., G.M. Sandquist, W.V. Bluck, L. Jensen, and N. Meldgin, Rogers & Associates Engineering Corporation, Salt Lake City, UT; CH2M Hill, Salt Lake City, UT; U.S. Environmental Protection Agency, Chicago, IL

Remediation/Risk Assessment of Thorium Contaminated Sites in West Chicago

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S13 (1987)

Monazite ore processing operations were conducted at the Rare Earths Facility (REF) in West Chicago, Illinois, from the 1930's to 1973. The facility, which was owned and operated by several corporations, is presently owned by Kerr-McGee Chemical Corporation. Tens of thousands of cubic meters of radioactive waste materials from processing monazite ore were removed from the REF site and widely distributed to various locations in the West Chicago area. Studies and investigations have been conducted to identify these locations and determine the levels of contamination. The U.S. Environmental Protection Agency (EPA), the U.S. Nuclear Regulatory Commission (NRC), and the City of West Chicago studies have identified two major sites containing about 10,000 cubic meters each of thorium residuals; over 100 residential or commercial properties in West Chicago contaminated with the thorium residuals; a contaminated river and creek; and other contaminated properties in the West Chicago area. The two major sites are the West Chicago Sewage Treatment Plant and Reed-Keppler Park (West Chicago City park). The EPA placed these off-site contaminated areas on the proposed National Priorities List (NPL) for remediation. Subsequently, many of the sites have been remediated by Kerr-McGee. The paper focuses on the Remedial Investigation field studies and risk assessments performed by EPA, and mitigations performed by Kerr-McGee at the sites and the criteria for performing the actions. (Auth) (DCM)

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EG&G Energy Measurements Group, Las Vegas, NV

An Aerial Radiological Survey of the RMI Facility and Surrounding Area, Ashtabula, Ohio

EGG-10282-1107; 18 pp. (1986, November)

An aerial radiological survey was conducted over a 75-square-kilometer (30-square-mile) area surrounding the RMI facility in Ashtabula, Ohio during the period between September 4 and 13, 1985. The RMI facility is a contractor to the U.S. Department of Energy. The primary work done at the facility is to take ingots of depleted or slightly enriched uranium and extrude them into rods or tubes. The survey was conducted at an altitude of 46 meters (150 ft). A second, more detailed survey was also performed over the RMI facility. This survey was conducted at an altitude of 30 meters (100 ft) and covered an area of about 2.6 square kilometers (1 sq mi) centered over the facility. Over most of the survey area, exposure rates varied from about 8 to 11 mR/hr. Several areas of increased radioactivity were observed in addition to increased radioactivity over the RMI facility (exposure rates of up to 44 mR were detected). The increased radioactivity over the RMI facility was due to uranium; however, no evidence of uranium was found off site. A second site exhibiting increased radioactivity was located near a railroad siding. The anomalous radiation there was due primarily to elevated concentrations of radium. Ground samples from this location were found to contain 130,000 pCi/g of radium-226. Two other regions of anomalous radiation were found on the shore of Lake Erie, near Pinney Dock. One of these sites contained elevated concentrations of potassium-40 (K-40). The spectrum from the second site indicated the source to be thorium. A fifth site was a facility located a few hundred meters east of the RMI plant. The spectrum from this site also indicated an increased amount of thorium. Finally, a sixth source was located in the eastern portion of the survey area. The spectrum from this site was found to be high in cesium-137 (Cs-137). (Auth)(DCM)

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Eng, J., D.W. Hendricks, J. Feldman, and P.A. Giardina, New Jersey Department of Environmental Protection, Trenton, NJ; U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Low-Level Radioactive Waste from Rare Metals Processing Facilities

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EPA-520/3-79-002; CONF-790209; Low-Level Radioactive Waste Management, J.E. Watson, Jr. (ed.), Proceedings of the Health Physics Society 12th Midyear Topical Symposium, Williamsburg, VA, February 11-15, 1979, 550 pp.; (pp. 49-60) (1979, May)

In the past, problems of disposal of byproducts, tailings, and wastes from rare metals and thorium producing facilities have received the attention of radiological agencies. Many of the raw ores used by these processing facilities were rich in natural radioactivity and the residues of production were often not disposed of properly. Mill tailings from the uranium mining industry have only recently come under federal regulation. It can be expected that similar attention will be focused on the environmental impacts of the rare metals processing industry as illustrated by interest in the problems of Parkersburg, WV, and Albany, OR. One other site in Akron, NY, does not appear to be an immediate problem, but its situation is typical of the many yet unsurveyed inactive rare metal facilities in the country. The radiological problems presented by and the decontamination activities which may be required of these rare metal facilities are examined. (Auth)

387

Eng, J., A.D. White, and R. Hopper, New Jersey Department of Environmental Protection, Trenton, NJ

Measurement of Radon and Radon Progeny in Radium Contaminated Residential Properties in New Jersey

CONF-860203; Health Physics Considerations in Decontamination and Decommissioning, Proceedings of the Health Physics Society 19th Midyear Topical Symposium, Knoxville, TN, February 2-6, 1986, 594 pp.; (pp. 303-310) (1986, February)

As part of a radiological investigation and remedial action program, 45 homes affected by radium contaminated soil were monitored quarterly since Fall 1983. Elevated levels of radon and radon progeny were found in homes built on former radium contaminated landfill areas. Radon progeny levels in excess of 0.1 Working Levels (WL) were lowered by installing ventilation systems in the basement. The remaining homes with radon progeny levels less than 0.1 WL were not remediated.

Both sets of homes were monitored quarterly through 1985. Radon measurements were made over 3-5 days with the activated carbon canister manufactured by the NJ Department of Environmental Protection based on a U.S. Department of Energy's Environmental Measurements Laboratory design. Radon progeny measurements were made over 5-7 days with the Radon Progeny Integrating Sampling Unit (RPISU) designed by the U.S. Environmental Protection Agency. This paper will evaluate the impact of seasonal and home use factors on radon, radon progeny and equilibrium factor.

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Jensen, L., and J. Feldman, U.S. Environmental Protection Agency, Chicago, IL

Legal and Ethical Issues Raised in Considering Residential Decontamination Options for Technologically-Enhanced Radioactive Contamination

CONF-860203; Health Physics Considerations in Decontamination and Decommissioning, Proceedings of the Health Physics Society 19th Midyear Topical Symposium, Knoxville, TN, February 2-6, 1986, 594 pp.; (pp. 161-170) (1986, February)

A large number of residential and commercial properties have been identified as having radioactive contamination resulting from disposal of radioactive residues from ore extraction operations, usually radium, thorium or uranium. The U.S. Department of Energy has addressed many of the sites associated with the Manhattan Project through its FUSRAP program. But now, the U.S. Environmental Protection Agency is faced with removal of residues from other operations under its Superfund program. High removal and disposal costs are often difficult to balance against the comparatively low value of properties affected. Soil screening techniques must be rapid and present a relatively high level of assurance that criteria are not exceeded. Yet, private lives are affected. Considerations in making cost-benefit decisions are discussed here.

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Page, R.G., and E.Y.S. Shum, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Disposal of Thorium and Uranium Wastes

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CONF-840512; Radiation - Risk - Protection, Proceedings of the Sixth International Radiation Protection Association Congress, Berlin, Federal Republic of Germany, May 7, 1984, Vol. 3; (pp. 1389-1392) (1984)

Some of the sites formerly used for processing thorium and uranium in the United States are known today to be contaminated with residual radioactive materials. In many cases, the total amount of contaminated soil is large, but the activity concentrations of radioactive materials are low enough to justify their disposal on privately owned lands or storage onsite. Another alternative is to transport the materials offsite to a licensed radioactive materials disposal (commercial) site. However, packaging and transporting these wastes to such a site is costly and may present a risk to public health. The Nuclear Regulatory Commission in late 1981, created a Branch Technical Position which reviewed options for approving license applications for the disposal of uranium and thorium. This paper discusses the technical bases, rationale, and dose calculations for establishing activity levels in wastes under each disposal option. (CAC)

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Prewett, S.V., D.E. Bernhardt, and L.W. Cole, Aerojet Heavy Metals Company, Jonesboro, TN

Remedial Action for a Depleted Uranium and Thorium Waste Pond

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 411-418) (1986)

Aerojet Heavy Metals Company (AHMC) completed the decommissioning program for an inactive evaporation pond at its facility near Jonesboro, Tennessee during the summer of 1985. The pond had previously been used for process liquid wastes containing depleted uranium (DU) and thorium contamination. The remedial program included a series of projects by several companies. AHMC coordinated and administered all phases of the program. Rogers and Associates was responsible for the final phases of the program. The use of full-time construction monitoring and surveillance and materials testing provided assurance and documentation that the remedial project was completed in accordance with the

design criteria and the construction specifications. Detailed certification sampling indicated that the associated project area had been cleaned up according to the specified radiological guides. The inventory in the 30,000 cubic meter disposal cell is about 0.48 TBq (13 Ci) of U-238 as depleted uranium and 0.03 TBq (1 Ci) of Th-232.

391

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

Naturally-Occurring Radioactive Materials

EPA-520/4-77-005; Radiation Protection Activities, 1976; (pp. 7-24) (1977, August)

Radiation protection activities reported for 1976 include the assessment of health and environmental problems associated with sources of natural radioactivity. Sources discussed include: uranium mill tailings disposal sites; radon in drinking water supplies; levels of radioactivity in caves supervised by the National Park Service; and radioactivity in phosphate rocks used for fertilizers and construction materials. The preparation of a bibliography on radioactivity in fossil fuels is reported and the impact of the 1976 Toxic Substances Control Act and the Resource Conservation and Recovery Act on recommendations concerning exposure to naturally-occurring radioactive materials is discussed.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium Site Streets, Colorado, March 1986 - Final Report

PB-86-224-896; 72 pp. (1986, March 24)

Denver Radium Site Streets is located in Denver, Colorado. The operable unit is comprised of eight street segments in the Cheesman Park area and one segment in the upper downtown area. The nine contaminated street segments are owned by the City and County of Denver and extend approximately 4.5 miles through largely residential areas. The Denver Radium Site Streets contain

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a 4- to 6-inch layer of radium-contaminated asphalt. The contaminated layer is underlain by compacted gravel road base and is usually overlain by 4 to 12 inches of uncontaminated asphalt pavement. There is an estimated 38,500 cubic yards of contaminated material covering approximately 832,000 square feet. The selected remedial action for the site includes: leaving the contaminated material in place; improving institutional controls; and removing any contaminated material excavated during routine maintenance, repair, or construction activities in the affected streets to a facility approved for storage or disposal of contaminated material.

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Williams, R.G., and S.J. Olshansky, Colorado State University, Hazards Assessment Laboratory, Fort Collins, CO

Quality of Life and Community Satisfaction in Proximity to Hazardous Waste

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 179-188) (1987)

The NIMBY (Not in My Back Yard) Syndrome characterizes the social and political problems associated with siting hazardous waste facilities: given a rational choice, people naturally prefer that hazardous wastes be located somewhere other than in their own backyard. While little research addresses these political and social effects, some qualitative case studies, anecdotal evidence, and environmental disasters lead one to believe that hazardous waste sites are disruptive to communities. Media coverage of hazardous waste sites also leads one to believe that the majority of people in proximity to such sites are distraught, that economic development in the area is negatively effected and property values decline, and that, in general, satisfaction with one's community suffers and the quality of life decreases. Regarding these assumptions, this paper reviews survey data collected in West Chicago, Illinois, where a hazardous waste site (Lindsay Light and Chemical) is located. At this urban site, disposal of radioactive wastes began in the early 1930s. Thorium processing was started in 1936 and subsequently provided thorium ore to the Manhattan Engineer District in the 1940s. In 1954, Lindsay Light and Chemical expanded their plant for the purpose of producing thorium nitrate, and continued production until 1963. This study of the surrounding community was designed to determine the unique effects of radioactive hazardous waste on overall levels of community satisfaction. (Auth)(CAC)

Chapter 5

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM

- **Design, Planning, and Regulations**
- **Environmental Studies and Site Surveys**
- **Site Stabilization and Reclamation**
- **Waste Disposal**
- **General Studies**

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Uranium Mill Tailings Reclamation Act - Domenici Amendment No. 1729 to the Sen- ate Bill S.1004

Congressional Record 132(41):S3793-S3799 (1986,
April 8)

Mr. Domenici submitted an amendment intended to revitalize the U.S. uranium industry and provide for reclamation and other remedial action with respect to active uranium and thorium processing sites, and to provide for a plan for the reorganization, self-financing, and eventual commercialization of the U.S. uranium enrichment program and facilities. The costs incurred by the owner or licensee for reclamation or remedial action performed by the owner or licensee under this Act will be reimbursed from the Uranium Mill Tailings Fund established in this amendment. This fund, established in the Treasury of the United States, will consist of: (1) contributions from States in which active sites are located; (2) contributions from owners or licensees of active sites; (3) contributions made by the Secretary of Energy; (4) fees received from owners or operators of civilian nuclear power reactors; (5) assessments paid by a licensee of a civilian nuclear power reactor for failure to comply with the U.S. Uranium Usage Requirement; and (6) all interest earned on sums in the fund. (Auth)(SET)(DCM)

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Uranium Mill Tailings Radiation Control Act - Procedure Before Agencies

Environment Report 23(19):1425+ (1985)

The Environmental Protection Agency (EPA) improperly failed to regulate toxic discharges into water from inactive uranium mill tailings piles when the agency prepared regulations under the Uranium Mill Tailings Radiation Control Act. EPA acknowledged before rules were issued that problems existed with water contamination at inactive mill sites, yet failed to adopt standards.

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Chilk, S.J., U.S. Nuclear Regulatory Commission,
Washington, DC

Uranium Mill Tailings Regulations: Groundwater Protection and Other Issues (10 CFR Part 40)

Federal Register 51(130):24697-24715 (1986, July
8)

The Nuclear Regulatory Commission (NRC) is proposing to amend its regulations governing the disposal of uranium mill tailings. The proposed changes are intended to incorporate into existing NRC regulations the groundwater protection regulations published by the Environmental Protection Agency (EPA) for these wastes. This action is being taken to comply with the mandate in the Uranium Mill Tailings Radiation Control Act and the NRC Authorization Act for FY 1983 to conform the NRC regulations to the standards promulgated by the EPA. (Auth)

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Hernandez, J.W., Jr., U.S. Environmental Protec-
tion Agency, Washington, DC

Title 40 CFR Part 192 - Standards for Remedial Action at Inactive Uranium Pro- cessing Sites, Advance Notice of Proposed Rulemaking

Federal Register 48(3):605-606 (1983)

EPA has issued final remedial action standards (40 CFR Part 192, Subpart A) for the control of tailings piles at inactive uranium processing sites. This notice announces that the Agency will consider whether different standards than 40 CFR Part 192, Subpart A would be more appropriate for control of tailings piles at those designated sites that have been established as having "medium" or "low" priority for carrying out remedial actions. Specifically, since most of these sites have much lower population densities than the "high" priority sites, the following questions have been raised: (1) should the standards be less restrictive at such sites, and/or (2) should the standards place primary reliance on control of access (such as through fences) rather than physical control of tailings (such as by thick earthen covers) to avoid radiation exposure, so as to reduce costs of disposal of tailings at these sites? (Auth)(SET)

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Ramos, S.J., B.A. Berven, and C.A. Little, Oak
Ridge National Laboratory, Health and Safety
Research Division, Oak Ridge, TN

CHAPTER 5. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

Quality Assurance Program Plan for the Radiological Survey Activities Program - Uranium Mill Tailings Remedial Action Project

ORNL/TM-9684/R1; 55 pp. (1986, August)

The Radiological Survey Activities (RSA) program at Oak Ridge National Laboratory (ORNL) is responsible for surveying designated sites in the vicinity of 24 inactive mill sites involved in the Department of Energy's (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP). The purpose of these surveys is to provide a recommendation to DOE whether to include or exclude the site from UMTRAP based on whether the onsite residual radioactive material (if any) originated from the former mill sites, and radiation levels onsite are in excess of appropriate Environmental Protection Agency (EPA) criteria. This report describes the quality assurance program plan for the RSA program in conducting all activities related to the UMTRA project. All quality assurance provisions given by the DOE, DOE/UMTRA, and ORNL organizations are integrated into this plan. Specifically, this report identifies the policies and procedures followed in accomplishing the RSA/UMTRAP QA program, identifies those organizational units involved in the implementation of these procedures, and outlines the respective responsibilities of those groups. (Auth)(SET)

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Thiers, G.R. , and T.R. Wathen, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Uranium Tailings Reclamation - Regulations, Design and Construction

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ. March 2-6, 1986, 645 pp.; (pp. 429-432) (1986)

The design and construction of systems to clean up or stabilize designated tailings sites are governed by numerous environmental regulations and technical guidelines. Design criteria have been established to fulfill these regulations and guidelines. A compacted soil cover, a radon barrier, will inhibit radon emanation and will prevent groundwater contamination in conformance with the regulations. To provide environmental protection during

the construction of the isolation system requires a variety of federal, state and local permits, approvals and notifications. Temporary features that provide the necessary environmental protection during construction include flood control berms, intercept ditches, sediment control facilities, and evaporation ponds or wastewater treatment facilities. The remedial action recently completed at the Uranium Mill Tailings Remedial Action (UMTRA) site at Canonsburg, Pennsylvania has shown that the design for the isolation of tailings may need to be adjusted in response to unforeseen site conditions that develop during construction. However, this experience also demonstrates that the construction of a waste isolation project can proceed to a successful conclusion and satisfy basic regulatory requirements.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Project Schedule and Cost Estimate Report

UMTRA-DOE/AL-166; UMTRA-DOE/AL-400127.0166 (1987, February)

This report contains a project schedule and cost estimates for the Uranium Mill Tailings Remedial Action (UMTRA) Project. All cost tables represent obligation dollars, at both a constant FY 1986 level and an estimated escalation level, and are based on the FY 1988 Department of Energy Budget submittal of December 1986. These tables display the total UMTRA Project estimated costs which include both Federal and state funding. Both the schedules and cost estimates are planning estimates only and are based on several assumptions which are outlined in the foreword. The report also contains site-specific demographic data, conceptual design assumptions, and a general project overview. (CAC)

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Zaslowsky, M., S.F. Allen, and D. Summers, Morrison-Knudsen Engineers, Inc., San Francisco, CA

QA/QC Applied to the Design Portion of the Uranium Mill Tailings Remedial Action Project - Low-Level Nuclear Waste

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of

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the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 541-544) (1986)

The Uranium Mill Tailings Radiation Control Act of 1978 (PL 95-604) requires the U.S. Department of Energy (DOE) to perform remedial action at 24 abandoned uranium processing sites. The Uranium Mill Tailings Remedial Action (UMTRA) project was initiated to accomplish this. The project involves the stabilization, disposal, and control of mill tailings to prevent or minimize radon diffusion into the environment. Remedial actions implemented at UMTRA sites must meet standards set by the U.S. Environmental Protection Agency (EPA). Each remedial action site must be licensed by the Nuclear Regulatory Commission (NRC)

as having been designed and constructed to meet EPA standards. In addition, remedial actions must also comply with Quality Assurance (QA) requirements as stipulated in ANSI/ASME NQA-1-1979 (NQA-1), DOE Order 5700.6A and DOE Order AI 5700.6A. This paper describes the implementation of a QA program responsive to NQA-1 for management of low-level nuclear waste from uranium mill tailings. Aspects of QA implementation such as development of project procedures, training, and audits are discussed and potential problem areas are identified. It is shown that an efficient and cost effective QA program can be implemented in compliance with QA requirements.

CHAPTER 5. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

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Baker, K.R., D.J. Lechel, and D.R. Phoenix, Weston (Roy F.), Inc., Albuquerque, NM

The Environmental Assessment Process in Project Planning

CONF-850314; Waste Management '85: Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Waste Policies and Programs, General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 24-28, 1985, 573 pp.; (pp. 51-54) (1985)

The planning activities associated with remedial actions at 24 inactive uranium mill sites are discussed in relation to the preparation of the environmental assessments required by the National Environmental Policy Act (NEPA). The standards for the project include long-term stability, protection of water quality, radon control, and cleanup of land and structures. Design considerations, data and analyses requirements, alternatives selection procedures, and how these activities are fully integrated into the NEPA documents are discussed. (Auth)

403

Caldwell, J.A., N.B. Larson, and R. Rager, Jacobs Engineering Group, Inc., Albuquerque, NM; Sergeant, Hauskins & Beckwith Geotechnical Engineers Inc., Albuquerque, NM

Assessment of the Effects of Potential Ground Subsidence on a Reclaimed Tailings Pile

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 101-114) (1987)

As part of the UMTRA Project, remedial work is being done at the Ambrosia Lake pile in New Mexico where there are mine workings at about 174 to 180 meters below the southwest part of the pile. Potential subsidence, if it occurs, could impact the integrity of the remedial work. This paper describes the evaluations and analyses done to assess the potential for and nature of subsidence of

strata beneath the pile. The paper also describes the work done to assess the impacts, if any, of subsidence on the pile and, in particular, on the radon barrier (a cover of compacted silty clay placed over the pile). The analyses show that even if the maximum theoretically predicted subsidence were to occur, there will be no significant effect on the integrity of remedial works at the pile. The final conclusion is that it is unnecessary to relocate the tailings. (Auth)(CAC)

404

Caldwell, J.A., J.W. Thackston, and R. Portillo, Jacobs Engineering Group, Inc., Albuquerque, NM

Geotechnical and Water Resource Aspects of Uranium Mill Tailings Pile Reclamation Projects

CONF-860695; HazMat '86, Hazardous Materials Management, Proceedings of the Fourth Annual Conference, Atlantic City, New Jersey, June 2-4, 1986; (pp. 497-507) (1986)

Design and construction work is currently in progress at more than twenty sites associated with the UMTRA Project. This work involves final reclamation of the uranium mill tailings piles so that they are stable for at least 200 years and for up to 1000 years. Remedial action construction plans for the tailings piles involve detailed consideration of the present and possible future groundwater and surface water impacts of the pile. Since the stabilized pile is ultimately a major geotechnical structure, detailed consideration of the long-term resistance to erosion and containment of radioactive material is also required. A case history illustrates how the critical design criteria governing the remedial action activities at the various piles are applied to the pile at the Lakeview site to provide for long-term protection of the water resource and public health and safety. (Auth)(DCM)

405

Deutsch, W.J., and J.W. Thackston, Jacobs Engineering Group, Inc., Albuquerque, NM

Aquifer Restoration Considerations at Inactive Uranium Mill Tailings Sites

CONF-860695; HazMat '86, Hazardous Materials Management, Proceedings of the Fourth Annual

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Conference, Atlantic City, New Jersey, June 2-4, 1986; (pp. 20-30) (1986)

Environmental hazards associated with inactive uranium mill tailings are being evaluated as part of the Uranium Mill Tailings Remedial Action (UMTRA) Project. Twenty-four sites in ten states are covered in this \$900M project. One of the primary potential health hazards identified at these sites has been the contamination of groundwater by seepage of tailings solution from the pile into the underlying aquifers. Remedial action measures at these sites must minimize future contamination of groundwater resources and consider the feasibility of aquifer restoration. The tailings constituents that have been found in groundwater at contaminant levels according to the EPA drinking water standards are cadmium, molybdenum, nitrate, selenium, sulfate, and uranium. The design of an aquifer restoration method to eliminate these relatively mobile contaminants from the groundwater must consider the chemistry of the elements, local hydrogeologic conditions, size of the contaminant plume, level of contamination, and the available treatment technology. The decision to implement aquifer restoration must be based on the current and predicted value of the water resource, the overall effect of restoration on the aquifer system, an evaluation of the uncertainty inherent in the restoration method, and the cost of restoration. At several sites it has been found that the restoration of the groundwater may not be feasible because of the volume of water that must be treated and/or the lack of data to show that available treatment methods will be effective. This paper describes existing groundwater contamination; at several sites, explores the options available for restoration, and discusses the decision-making process used to evaluate the restoration alternative. (Auth)

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Espegren, M.L., T.E. Carter, C.A. Little, and S.J. Ramos, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Inclusion Survey Contractor Implementation Plan for Fiscal Years 1986-1988

ORNL/TM-10116; 130 pp. (1987, March)

The Radiological Surveys Activities Group (RASA) of Oak Ridge National Laboratory acts as the Inclusion Survey Contractor (ISC) to the Uranium Mill Tailings Remedial Action (UMTRA) Project of the U.S. Depart-

ment of Energy (DOE). The ISC investigates properties to determine whether the properties qualify for remedial action according to the standards set forth for the UMTRA Project by the U.S. Environmental Protection Agency. The major work elements making up the ISC's activities are: consent form acquisition, land survey/drawing, inclusion survey, post-survey activities, survey report, file transmittal, and recommendation for a vicinity property to be included into or excluded from UMTRAP. The ISC will produce 2960 recommendations in FY 1988 for \$3.98M. (Auth)

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Little, C.A., B.A. Berven, T.E. Carter, M.L. Espegren, F.R. O'Donnell, S.J. Ramos, C.D. Retolaza, A.S. Rood, F.A. Santos, D.A. Witt, and K.M. Woynowski, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Radiological Survey Activities - Uranium Mill Tailings Remedial Action Project Procedures Manual

ORNL/TM-9902 (1986, July)

The purpose of this Procedures Manual is to provide a standardized set of procedures that document in an auditable manner the activities performed by the Radiological Survey Activities (RASA) group in the Dosimetry and Biophysical Transport Section of the Health and Safety Research Division at the Oak Ridge National Laboratory, in its role as the Inclusion Survey Contractor (ISC). The Procedures Manual ensures that the organizational, administrative, and technical activities of the RASA/UMTRA group conform properly to those of the ISC. This manual also ensures that the techniques and procedures used by the RASA/UMTRA group and contractor personnel meet the requirements of applicable governmental, scientific, and industrial standards. The Procedures Manual provides formal procedures for conducting inclusion radiological surveys and includes program planning, equipment operation, and quality assurance elements. (Auth)(SET)

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Narasimhan, T.N., A.F. White, and T. Tokunaga, Lawrence Berkeley Laboratory, Berkeley, CA

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Groundwater Contamination from an Inactive Uranium Mill Tailings Pile: 2 - Application of a Dynamic Mixing Model

Water Resources Research 22(13):1820-1834 (1986, December)

This paper is the second in a series of two papers on the subject of infiltration and contamination of a shallow water table aquifer by low pH process waters from an abandoned uranium mill tailings pile at Riverton, Wyoming. The contamination process has been governed by transient infiltration rates, saturated-unsaturated flow, as well as transient chemical reactions between the many chemical species present in the mixing waters and the sediments. In the first paper, field data and an interpretation of the process based on a static mixing model were presented. The second paper presents the results of a numerical investigation of the dynamic mixing process. The model, DYNAMIX (DYNAMIC MIXing), couples a chemical speciation algorithm, PHREEQE, with a modified form of the transport algorithm, TRUMP, specifically designed to handle the simultaneous migration of several chemical constituents. The overall problem of simulating the evolution and migration of the contaminant plume was divided into three sub problems that were solved in sequential stages. These were the infiltration problem, the reactive mixing problem, and the plume-migration problem. The results of the application agree reasonably with the detailed field data. The methodology developed in the second study demonstrates the feasibility of analyzing the evolution of natural hydrogeochemical systems through a coupled analysis of transient fluid flow as well as chemical reactions. (Auth)(DCM)

409

Nelson, R.A., R.P. Schoenfelder, and K.R. Baker, Jacobs Engineering Group, Inc., Albuquerque, NM; Weston (Roy F.), Inc., Albuquerque, NM

An Evaluation of the Suitability of Teradex Track-Etch Detectors for Environmental Rn-222 Measurement

Health Physics 49(1):157 (1985, July)

Track-etch detectors have been widely used for Rn-222 measurement and are generally considered accurate for concentrations significantly higher than normal back-

ground. However, exposure/response data for concentrations at or near ambient background concentrations (approximately 0.5 pCi/l) are not commonly available. A monitoring network was established in Durango, Colorado, using Track-etch detectors to measure radon-222 concentrations in the community as well as near the mill tailings pile. The technique to measure radon concentrations is described, and data from four quarters of monitoring are reported and evaluated. Statistical methods for evaluating track-etch data, and assessing the validity of individual measurements are discussed. (Auth)

410

Provencher, R., G. Smith, T.B. Borak, and P. Kearney, Colorado State University, Fort Collins, CO

Comparison of the Response of a NaI Scintillation Crystal with a Pressurized Ionization Chamber as a Function of Altitude, Radiation Level, and Ra-226 Concentration

CONF-860203; Health Physics Considerations in Decontamination and Decommissioning, Proceedings of the Health Physics Society 19th Midyear Topical Symposium, Knoxville, TN, February 2-6, 1986, 594 pp.; (pp. 339-346) (1986, February)

The Grand Junction Uranium Mill Tailings Remedial Action-Radiological Survey Activities Group (UMTRA-RASA) program employs a screening method in which external exposure rates are used to determine if a property contaminated with uranium mill tailings is eligible for remedial action. Portable NaI detectors are used by survey technicians to locate contaminated areas and determine exposure rates. The exposure rate is calculated using a regression equation derived from paired measurements made with a pressurized ionization chamber (PIC) and a NaI detector. During July of 1985 extensive measurements were taken using a PIC and a NaI scintillator with both analogue and digital readout for a wide range of exposure rates and at a variety of elevations. The surface soil was sampled at most of these locations and analyzed for radium-226 (Ra-226). The response of the NaI detectors was shown to be highly correlated to radiation level but not to Ra-226 concentration or elevation.

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Rogers, V.C.

Radiological Criteria for the Phase 2 Inactive Mill Tailings Programs

Transactions of the American Nuclear Society 27:153-154; CONF-771109; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 27-December 2, 1977; (pp. 153-154) (1977)

Ford, Bacon and Davis has been performing an engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at 22 mill sites in eight Western states. A preliminary survey (Phase I) was carried out by ERDA in cooperation with the EPA and the affected states. Based on the findings of this survey, Phase II work began which included the preparation of topographic maps, performance of core drillings and radiometric measurements, evaluation of radiation exposures, investigation of site hydrology and meteorology, and evaluation and costing of alternative corrective actions. On beginning Phase II, radiological criteria were established which are applicable to sites and buildings in which the materials have been used. This article discusses these assessment criteria. (Auth)(CAC)

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Rogers, V.C., R. Baird, G.M. Gantner, K.E. Hatfield, L.W. Weyand, and G.M. Sandquist, Ford, Bacon & Davis Utah, Inc., Salt Lake City, UT; University of Utah, Salt Lake City, UT

Engineering Assessment of the Inactive Vitro Uranium Mill Tailings at Salt Lake City, Utah

Transactions of the American Nuclear Society 24:244-246; CONF-761103; World Nuclear Energy - A Status Report, Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 14-19, 1976; (pp. 244-246) (1976)

Ford, Bacon & Davis Utah Inc. has recently completed a detailed engineering assessment which provides technical basis for appropriate remedial actions on the inactive Vitro Uranium Mill Tailings in Salt Lake City, Utah. The evaluation included the following considerations: on-site

and off-site direct radiation; land contamination from windblown tailings; hydrology and contamination by water pathways; continuous exhalation of radon gas from tailings; and consequences of the potential health hazards. The inhalation of radon daughters from diffusion is the largest contributor to human exposure. Ten viable remedial action alternatives were evaluated. Costs, descriptions, benefits, and adverse effects of these alternatives, which range from \$0.5 million for minimal action to \$30 million for complete decontamination and removal to an isolated location are included. (Auth) (SET)

413

Skinner, D.J., H.R. Meyer, J.H. Coffman, and E. Couch, Chem-Nuclear Systems, Inc., Albuquerque, NM

Outdoor Radon Concentration During Remedial Action at the Shiprock, New Mexico Site

Health Physics 49(1):180 (1985, July)

Shiprock, NM is one of 24 inactive Uranium Mill Tailings Remedial Action (UMTRA) locations. As part of the environmental monitoring program, radon concentrations are measured with a real time radon gas monitor. Remedial action construction activities may create short term fluctuations of radon concentrations; however, annual average radon concentrations are not affected. Pre-operational values are compared with values measured during construction activities. The philosophy for monitor station selection is also presented. (Auth)

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Smithwick, G.A., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Publication of Finding of No Significant Impact, Remedial Action at the Ambrosia Lake Uranium Mill Tailings Site, Ambrosia Lake, New Mexico

(FONSI - Ambrosia Lake Uranium Mill Tailings Site) (1987, June 17)

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The U.S. Department of Energy (DOE) has prepared an environmental assessment (EA) (DOE/EA-0322) on the proposed remedial action at the inactive uranium milling site located in Ambrosia Lake, New Mexico. Based on the analyses in the EA, the DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.). Therefore, the preparation of an Environmental Impact Statement (EIS) is not required. (Auth)(DCM)

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Smithwick, G.A., U.S. Department of Energy, Office of the Assistant Secretary for Environment, Safety, and Health, Washington, DC

Publication of Finding of No Significant Impact, Remedial Action at the Tuba City Uranium Mill Tailings Site, Tuba City, AZ

Federal Register 52(33):5173-5175 (1987, February 19)

The Department of Energy (DOE) has prepared an environmental assessment on the proposed remedial action at the inactive uranium milling site located in Tuba City, Arizona. Based on the analyses of the assessment, the DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment. Thus, the preparation of an Environmental Impact Statement is not required. The proposed action is to stabilize the Tuba City tailings pile at its present location. All contaminated materials from around the pile would be covered with compacted earth to inhibit radon emanation and water infiltration. A rock erosion barrier would be placed over the pile to inhibit wind and water erosion and discourage animal and human intrusion. These actions will result in compliance with the EPA standards. Details concerning the site history, project description, and findings of this action are given. (Auth)(CAC)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming - Text

DOE/EA-0254 (1987, June)

This document assesses and compares the environmental impacts of various alternatives for remedial action at the inactive Riverton uranium mill tailings site 2 miles southwest of Riverton, Wyoming. The site covers 173 acres and contains 70 acres of tailings and some of the original mill structures. Title I of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), Public Law 95-604, authorized the U.S. Department of Energy to clean up the inactive site to reduce the potential health impacts associated with the residual radioactive materials remaining at the site and at associated properties off of the site. Title II of the UMTRCA authorized the U.S. Nuclear Regulatory Commission (NRC) or agreement state to regulate the operations of active uranium mill sites and the eventual reclamation of these active sites. The U.S. Environmental Protection Agency promulgated standards for the remedial actions (Title 40, Code of Federal Regulations, Part 192, Subparts A through E). Remedial actions at the inactive and active mill sites must be performed in accordance with these standards and with concurrence of the NRC. The proposed action is to relocate the Riverton tailings and contaminated materials to Gas Hills, an area 45 to 60 road miles east of the Riverton site that contains several active (Title II) uranium mill tailings sites. The Riverton (Title I) tailings and contaminated materials would be consolidated with the tailings at a selected active site and then stabilized in accordance with the active site's remedial action plan to be approved by the NRC. (Auth)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Environmental Assessment of Remedial Action at the Lakeview Uranium Mill Tailings Site, Lakeview, Oregon, Volume 1 - Text

DOE/EA-0271 (Vol. 1); UMTRA-DOE/EA-0271 (Vol. 1) (1985, April)

An assessment and comparison of the environmental impacts of various alternatives for remedial action at the

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Lakeview uranium mill tailings site located one mile north of Lakeview, Oregon, is given. The site covers 256 acres and contains 30 acres of tailings, 69 acres of evaporation ponds, and 25 acres of windblown materials. 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 vicinity properties off the site. The U.S. Environmental Protection Agency (EPA) 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. Three alternatives have been addressed in this document. The first alternative (the proposed action) is relocation of all contaminated materials to the Collins Ranch site. The contaminated materials would be consolidated into an embankment constructed partially below grade and covered with radon protection and erosion protection covers. A second alternative would relocate the tailings to the Flynn Ranch site and dispose of the contaminated materials in a slightly below grade embankment. A radon protection and erosion protection cover system would also be installed. The no-action alternative is also assessed. Stabilization in place is not considered due to potential seismic and geothermal hazards associated with the current tailings site, and the inability to meet EPA standards. (Auth)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Environmental Assessment of Remedial Action at the Lakeview Uranium Mill Tailings Site, Lakeview, Oregon, Volume 2 - Appendices

DOE/EA-0271 (Vol. 2); UMTRA-DOE/EA-0271 (Vol. 2); 161 pp. (1985, April)

An assessment and comparison of the environmental impacts of various alternatives for remedial action at the Lakeview uranium mill tailings site located one mile north of Lakeview, Oregon, is given. The site covers 256 acres and contains 30 acres of tailings, 69 acres of evaporation ponds, and 25 acres of windblown materials. 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 vicinity properties off the site. The U.S. Environmental Protection Agency (EPA) 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. Three alternatives have been addressed in this document. The first alternative (the proposed action) is relocation of all contaminated materials to the Collins Ranch site. The contaminated materials would be consolidated into an embankment constructed partially below grade and covered with radon protection and erosion protection covers. A second alternative would relocate the tailings to the Flynn Ranch site and dispose of the contaminated materials in a slightly below grade embankment. A radon protection and erosion protection cover system would also be installed. The no-action alternative is also assessed. Stabilization in place is not considered due to potential seismic and geothermal hazards associated with the current tailings site, and the inability to meet EPA standards. (Auth)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Action at the Tuba City Uranium Mill Tailings Site, Tuba City, Arizona - Environmental Assessment

DOE/EA-0317; 289 pp. (1986, November)

This document assesses and compares the environmental impacts of various alternatives for remedial action at the Tuba City uranium mill tailings site located approximately six miles east of Tuba City, Arizona. The site covers 105 acres and contains 25 acres of tailings and some of the original mill structures. 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

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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 associated contaminated materials into a recontoured pile. A radon barrier would be constructed over the pile and various erosion control measures would be taken to assure the long-term stability of the pile. Another alternative which would involve moving the tailings to a new location is also assessed in this document. This alternative would generally involve greater short-term impacts and costs but would result in stabilization of the tailings at a more remote location. The no action alternative is also assessed in this document. (Auth)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Action at the Ambrosia Lake Uranium Mill Tailings Site, Ambrosia Lake, New Mexico - Environmental Assessment

DOE/EA-0322 (1987, June)

An assessment and comparison is given of the environmental impacts of various alternatives for remedial action at the Ambrosia Lake uranium mill tailings site located near Ambrosia Lake, New Mexico. The designated site covers 196 acres and contains 111 acres of tailings and some of the original mill structures. The Uranium Mill Tailings Radiation Control Act (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 action (40 CFR Part 192). Remedial action must be performed in accordance with these standards and with the concurrence of the U.S. Nuclear Regulatory Commission. The proposed action is to stabilize the tailings at their present location by consolidating the tailings and associated contaminated materials into a recontoured pile. A radon barrier would be constructed over the pile and various erosion protection measures would be taken to assure the long-term stability of the pile. Another

alternative which would involve moving the tailings to a new location is also assessed in this document. This alternative would generally involve greater short-term impacts and costs but would result in stabilization of the tailings at an undeveloped location. The no action alternative is also assessed in this document. (Auth)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado, Volume 2 - Appendices (Draft Environmental Impact Statement)

DOE/EIS-0126D (Vol. 2) (1986, March)

This appendix provides the information needed to understand the conceptual designs for the remedial action alternatives addressed in this draft Environmental Impact Statement (DEIS). It is intended to provide sufficient detail for the reader to evaluate the feasibility and assess the impacts of each remedial action alternative. It is not intended to provide the detailed engineering necessary to implement the alternatives. Details of the proposed remedial action will be presented in the Draft Remedial Action Plan. The purpose of the remedial action is to stabilize and control the uranium mill tailings (residual radioactive wastes) and other contaminated materials in a manner which complies with U.S. Environmental Protection (EPA) standards (40 CFR Part 192). Consistent with this purpose and the EPA standards, the following major design objectives have been established: (1) Reduce the average radon flux from the site to levels consistent with the EPA standards; (2) design controls to be effective for up to 1000 years to the extent reasonably achievable, and, in any case, for at least 200 years; (3) ensure that existing or anticipated beneficial uses of surface and groundwaters are not adversely affected; (4) reduce contaminant levels (radium-226) in areas released for unrestricted use to levels consistent with the EPA standards; (5) minimize the land area to be occupied by the stabilized tailings; (6) provide flood protection, runoff and sediment control, and treatment of waste water as required; (7) prevent inadvertent human intrusion into the stabilized tailings; (8) minimize plant root penetration and animal burrow-

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ing into the stabilized tailings; (9) protect against releases of contaminants from the sites during construction; and (10) minimize the areas disturbed during construction and human exposure to contaminated materials. (Auth)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado, Volume 1 - Text (Final Environmental Impact Statement)

DOE/EIS-0126F (Vol. 1); 419 pp. (1986, December)

This statement evaluates and compares the environmental impacts associated with various remedial action alternatives for the residual radioactive materials remaining at the inactive uranium processing site and associated vicinity properties at Grand Junction, Mesa County, Colorado. This statement is also intended to aid the Bureau of Land Management (BLM) in amending their management framework plans and final resource management plan, as well as assisting in compliance with the withdrawal application as appropriate. The site is a 114-acre tract of private and state owned land which contains approximately 3.1 million cubic yards of tailings and associated contaminated soils. The vicinity properties are homes, businesses, public buildings, and vacant lots which may have been contaminated during construction by the use of tailings as building materials. An estimated 3465 vicinity properties would be cleaned up during remedial action of the tailings pile. The tailings were produced by the former Climax Uranium Company which processed uranium ore, which it sold to the U.S. Atomic Energy Commission from 1951 to 1966 and to private sources from 1966 to 1970. This statement evaluates six alternatives for stabilization and disposal of the tailings and other contaminated materials: (1) no action; (2) stabilization at the Grand Junction site; (3) disposal at the Cheney Reservoir site with truck transport; (4) disposal at the Cheney Reservoir site with train and truck transport; (5) disposal at the Two Road site with truck transport; and (6) disposal at the Two Road site with train and truck transport. DOE's preferred alternative is disposal at the Cheney Reservoir site with truck transportation (Alternative 3) (Auth)(SET)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado, Volume 2 - Appendices (Final Environmental Impact Statement)

DOE/EIS-0126F (Vol. 2); 341 pp. (1986, December)

Remedial Actions conducted at the Former Climax Uranium Company Uranium Mill Site, in Grand Junction, Colorado, included the areas of Surface Water, Ground Water, and Potentially Affected Hydrogeologic Environment including the Processing Site, Cheney Reservoir Site, and the Two Road Site. Areas covered in this Final Environmental Impact Statement include: surface water features; flood analysis; environmental characteristics; waste and contaminant transport; climatic effects on contaminant migration; existing usage and value of water resources; alternate water supplies; future usage and value of water resources; and impacts in affected hydrogeologic environment.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado, Volume 1 - Text (Draft Environmental Impact Statement)

DOE/EIS-0132D (Vol. 1); 266 pp. (1987, May)

The Rifle Uranium Mill Tailings Remedial Action (UMTRA) Project sites consist of two separate tailings sites adjacent to the city of Rifle in Garfield County, Colorado. The eastern site, known as Old Rifle, is about 0.3 mile from the center of Rifle. The western site, known as New Rifle, is about two miles from the center of Rifle. The Colorado River is immediately south of both sites. Both sites are the sites of uranium mills that processed uranium ores for the production of uranium. The 22-acre Old Rifle tailings site consists of the 13-acre tailings pile

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and nine-acre mill area. The only structures remaining at the mill site are the assay building and the foundations of other mill facilities. Fifty-three acres adjacent to the tailings site are contaminated with windblown tailings and debris. The total amount of contaminated materials at the Old Rifle site, including contaminated soils beneath the tailings, is estimated to be about 580,000 cubic yards. Seepage from the tailings pile has contaminated groundwater in the alluvium beneath the pile. The New Rifle tailings site occupies 142 acres. The tailings pile covers 33 acres, and the mill area covers 59 acres. The entire New Rifle site is contaminated, and a 63-acre area adjacent to the tailings site has been contaminated with windblown tailings. The total amount of contaminated materials at the New Rifle site, including contaminated soils beneath the tailings, is estimated to be about 2,930,000 cubic yards. Seepage from the tailings pile has contaminated groundwater in the alluvium and Wasatch Formation beneath the pile. Both the Old and New Rifle tailings piles have been partially stabilized. The Old Rifle pile was recontoured, covered with six inches of soil, and revegetated. The New Rifle pile was covered with fertilizer and mulch and revegetated. Approximately 102 potential vicinity properties have been found in the Rifle area. These vicinity properties are residences, businesses, or open lands that may have been contaminated by the use of tailings as a sand substitute in building materials or as fill material before the hazards associated with the tailings were known. The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), Public Law 95-604, authorizes the U.S. Department of Energy to perform remedial action at the Rifle tailings sites (as well as at many other sites) to reduce the potential public health impacts from the residual radioactivity remaining in the tailings. The U.S. Environmental Protection Agency promulgated standards (40 CFR Part 192) for this remedial action. The U.S. Nuclear Regulatory Commission will concur in the selection of a remedial action alternative and will issue a license for the long-term surveillance and maintenance of the final disposal site. The alternatives addressed in this environmental impact statement (EIS) include taking no action toward remedial action, stabilizing the Old and New Rifle tailings at the New Rifle site, and relocating the Old and New Rifle tailings to one of two alternate disposal sites (Estes Gulch or Lucas Mesa) away from Rifle. All of the alternatives except no action include remedial action at the vicinity properties. (Auth)(DCM)

tions Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado, Volume 2 - Appendices (Draft Environmental Impact Statement)

DOE/EIS-0132D (Vol. 2) (1987, May)

This appendix provides the information needed to understand the conceptual designs for the remedial action alternatives addressed in this environmental impact statement (EIS) for the Old and New Rifle Uranium Mill Sites. It is intended to provide sufficient details for the reader to evaluate the feasibility and assess the impacts of each remedial action alternative. It is not intended to provide the detailed engineering necessary to implement the alternatives. Details of the preferred remedial action will be presented in the remedial action plan. The remedial action alternatives addressed in this EIS include no action, stabilization at the New Rifle site, disposal at the Estes Gulch site, and disposal at the Lucas Mesa site. The purpose of the remedial action is to stabilize and control the uranium mill tailings and other contaminated materials in a manner which complies with the U.S. Environmental Protection Agency (EPA) standards (40 CFR Part 192). Consistent with this purpose and the EPA standards, the following major design objectives have been established: (1) Reduce the average radon flux from the site to levels consistent with the EPA standards; (2) design controls to be effective for up to 1000 years to the extent reasonably achievable, and, in any case, for at least 100 years; (3) ensure that existing or anticipated beneficial uses of surface and groundwaters are not adversely affected; (4) reduce contaminant levels (radium-226) in areas released for unrestricted use to levels consistent with the EPA standards; (5) minimize the land area to be occupied by the stabilized tailings; (6) provide flood protection, runoff and sediment control, and treatment of waste water as required; (7) prevent inadvertent human intrusion into the stabilized tailings; (8) minimize plant root penetration and animal burrowing into the stabilized tailings; (9) protect against releases of contaminants from the sites during construction, and (10) minimize the areas disturbed during construction and exposure to contaminated materials. (Auth)(DCM)

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U.S. Department of Energy, Office of the Assistant Secretary for Environment, Safety, and Health, Washington, DC

Finding of No Significant Impact, Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming

(FONSI - Riverton Uranium Mill Tailings Site) (1987, June 15)

The U.S. Department of Energy (DOE) has prepared an environmental assessment (DOE/EA-0254) on the proposed remedial action at the inactive uranium milling site near Riverton, Wyoming. Based on the analyses in the EA, the DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321, and those that follow). Therefore, the preparation of an environmental impact statement (EIS) is not required. (Auth)(DCM)

427

Voigt, W.R., U.S. Department of Energy, Office of Remedial Action and Waste Technology, Washington, DC

Availability of Environmental Assessment and Finding of No Significant Impact: Remedial Action at the Inactive Tuba City Uranium Mill Tailings Site, Tuba City, AZ

Federal Register 52(14):2437 (1987, January 22)

The Department of Energy (DOE) has published an Environmental Assessment (EA) of Remedial Action at the Tuba City Uranium Mill Tailings Site, Tuba City, Arizona. The assessment specifically relates to the proposed remedial action on residual radioactive materials at the inactive Rare Metals uranium mill site near Tuba City. On the basis of the analyses in the EA, the DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment. This article discusses the background of the site, the scope and availability of the EA report, and the availability of the Finding of No Significant Impact report. (Auth)(CA)(DCM)

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Walker, M.L., U.S. Department of Energy, Office of the Assistant Secretary for Environment, Safety, and Health, Washington, DC

Announcement of Availability of Final Environmental Impact Statement: Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, CO

Federal Register 52(48):7651-7652 (1987, March 12)

The Uranium Mill Tailings Radiation Control Act (UMTRCA), Pub. L. 95-604, was enacted for the purpose of addressing a Congressional finding that uranium mill tailings located at inactive processing sites may pose a potential health hazard to the public. Under Title I of UMTRCA, the U.S. Department of Energy (DOE) designated 24 inactive processing sites for remedial action. The former Climax Uranium Company uranium mill site at Grand Junction, Mesa County, Colorado, is one of these inactive sites. The U.S. Environmental Protection Agency (EPA) is charged by UMTRCA with the responsibility for promulgating remedial action standards for inactive uranium mill sites. The purpose of these standards are to protect the public health and safety and the environment from radiological and nonradiological hazards associated with residual radioactive materials at the sites. The DOE has proposed a plan of remedial action that will satisfy the EPA standards. Under UMTRCA, the DOE and the State of Colorado entered into a cooperative agreement for remedial action at the Grand Junction site and eight other sites. The DOE has prepared a final Environmental Impact Statement (EIS) on the proposed remedial action at the Grand Junction site. The EIS, which is available to the public, indicates that the preferred remedial action (Alternative 3) is to dispose of the wastes from the milling site at the Cheney Reservoir site using truck transportation. The Cheney Reservoir site is located 18 miles southeast of the Grand Junction site. Five remedial action alternatives are analyzed in the EIS. These are: (1) No action; (2) stabilization at the Grand Junction site; (3) disposal at the Cheney Reservoir site with train and truck transport; (4) disposal at the Two Road site with truck transport; and (5) disposal at the Two Road site with train and truck transport. (DCM)

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Walker, M.L., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Publication of Finding of No Significant Impact, Remedial Action at the Tuba City Uranium Mill Tailings Site. Tuba City, Arizona

Report; 7 pp. (1986)

The Department of Energy (DOE) has prepared an environmental assessment (DOE/EA-0317) on the proposed remedial action at the inactive uranium milling site located in Tuba City, Arizona. Based on the analyses in the EA, the DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C 4321 et seq.). Therefore, the preparation of an Environmental Impact Statement (EIS) is not required.

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Walters, W.H., R.L. Skaggs, M.G. Foley, and P.A. Beedlow, Pacific Northwest Laboratory, Richland, WA

Erosion Protection of Uranium Tailings Impoundments

NUREG/CR-4480; PNL-5724; 105 pp. (1986, September)

Pacific Northwest Laboratory (PNL) prepared this report to assist in the design and review of erosion protection works for decommissioned uranium tailings impoundments. The major causes of erosion over the long-term decommissioning period are from rainfall-runoff (overland flow) and stream channel flooding. The method of protection recommended for the impoundment side slopes and site drainage channels is rock riprap. Combinations of vegetation and rock mulch are

recommended for the top surface. The design methods were developed from currently available procedures supplemented by field, laboratory, and mathematical model studies performed by PNL. Guidelines for the placement of riprap, inspection, and maintenance are presented. Other subjects discussed are rock selection and testing, slope stability, and overland erosion modeling. (Auth)

431

Yusko, J.G., Pennsylvania Department of Environmental Resources, Bureau of Radiation Protection, Pittsburgh, PA

The Impact of an UMTRA Project on Local School Systems

Health Physics 49(1):157-158 (1985, July)

Within one-half mile of the Canonsburg, Pa., Uranium Mill Tailings Remedial Action Project Site are located three elementary schools, one junior high school and one senior high school. One elementary school is a parochial school; the other schools are part of the local public school system. Because of perceived fears that the remedial action project would subject school children to increased hazards, the parochial elementary school has been closed for the past two school years; a temporary school site has been established approximately 10 miles away. Long-term ambient radon monitoring on this school property has shown the average radon concentration to be less than 0.3 pCi/l, well below the 3.0 pCi/l standard. The school is scheduled to be reopened for the 1985-86 school year. The effects on the public school system have not been as drastic. Radiological surveys have disclosed only naturally-occurring materials, but indoor radon monitoring levels have evoked concern when these values are compared to the (outdoor annual average) standard. The responses to these concerns by the school officials and the federal and state agencies leading the cleanup effort are detailed, including the expanded school monitoring program, educational presentations made by project participants to the school district and the public, and the expansion of the public school curriculum to include elementary, junior- and senior-high school level courses in radiation, radioactivity and the connections with physics, chemistry, biology, and environmental science. (Auth)(SET)

CHAPTER 5. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

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Cleanup of Vicinity Properties

Pamphlet; 13 pp.

During the first 15 years of uranium production, uranium tailings were considered to be excellent material for use in private and public construction in communities where uranium mills were located. Little information was known about the potential long-term health effects of the low-level radioactivity present in the tailings. Radon, a colorless, odorless, tasteless radioactive gas, decays into nongaseous daughter products which can attach themselves to smoke and dust particles and lodge themselves in the lungs. By aerial surveys, mobile van surveys, on-site inspections, and records from the uranium processing plants, the DOE has designated over 8,000 potential vicinity properties which may require clean-up operations. Before cleanup can be undertaken, a property owner must sign a Property Owner Consent form. The consent form allows DOE legal access to the property so that surveys can be made to determine if tailings are present. If tailings are present, a work plan for remedial action is prepared, and all the data are compiled in a Remedial Action Agreement (RAA). The RAA explains exactly what portion of the property will be cleaned up, what method will be used, and that the property will be returned to as near as the original condition as possible. The remedial action will be performed at no cost to the property owner. After the cleanup is finished, the property owner will be asked to sign the Owner Acceptance Form, thereby acknowledging that the remedial action work has been performed to his satisfaction. (SET) (DCM)

433

Metry, A.A., and J. Newell

Control of Radionuclide Releases from an Inactive Radioactive Site

Transactions of the American Nuclear Society 46:58-60; CONF-840614; Proceedings of an American Nuclear Society Annual Meeting, New Orleans, LA, June 3-7, 1984; (pp. 58-60) (1984)

This paper is based on a feasibility study conducted by Roy F. Weston, Inc., for Sandia National Laboratories for the U.S. Department of Energy's (DOE) UMTRAP Project Office. The U.S. DOE is considering several methods for carrying out remedial actions in Canonsburg, Pennsylvania, at the site of an inactive uranium-processing mill. The main objective of this study is to determine the feasibility of in situ stabilization as the remedial action and control of the release of radionuclides into the environment. In situ stabilization is an alternative to site decontamination and off-site disposal. The problems associated with off-site 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 off-site 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. (Auth)

CHAPTER 5. URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM WASTE DISPOSAL

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Gregory, P.O., and G.A. Jones, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Risk Assessment and Reliability for Low-Level Radioactive Waste Disposal

CONF-860317; Waste Management '86, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986; (pp. 139-146) (1986)

The reliability of critical design features at low-level radioactive waste disposal facilities is a major concern in the licensing of these structures. To date, no systematic methodology has been adopted to evaluate the geotechnical reliability of Uranium Mill Tailings Remedial Action (UMTRA) disposal facilities currently being designed and/or constructed. This paper discusses and critiques the deterministic methods currently used to evaluate UMTRA reliability. Because deterministic methods may not be applicable in some cases because of the unusually long design life of UMTRA facilities, it is proposed that a probabilistic risk assessment-based methodology be used as a secondary method to aid in the evaluating of geotechnical reliability of critical items. Similar methodologies have proven successful in evaluating the reliability of a variety of conventional earth structures. In this paper, an "acceptable" level of risk for UMTRA facilities is developed, an evaluation method is presented, and two example applications of the proposed methodology are provided for a generic UMTRA disposal facility. The proposed technique is shown to be a simple method which might be used to aid in reliability evaluations on a selective basis. Finally, other possible applications and the limitations of the proposed methodology are discussed.

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McCormick, J.

Volunteer for the Atomic Age

Newsweek (841224) 104:12 (1984, December 24)

A mill near Edgemont, South Dakota, which produced "yellowcake" from uranium ore from 1956 to 1974 still has a number of open tailings piles. There are also dozens of "hot spots" near homes and gardens where the mostly spent ore was hauled for fill. The largest industry in

Edgemont is an ongoing \$25 million burial of the mill and tailings in a pit outside the town. Residents of Edgemont feel that their years of experience with handling uranium mill tailings could qualify their area for a low-level nuclear waste repository. While the Edgemont residents do not want the waste stored in their basements, they feel good about storing it at Igloo, a ghost town eight miles south of Edgemont. (SET)(DCM)

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U.S. Department of Energy, Albuquerque Operations Office, Office of Public Affairs, Albuquerque, NM

DOE Schedules Three Public Hearings in Salt Lake City Area on Draft Environmental Impact Statement on Mill Tailings Site

DOE News (March 1983):1-4 (1983, March)

The U.S. Department of Energy (DOE) has scheduled three public hearings to receive comments on the draft environmental impact statement (DEIS) concerning the cleanup of slightly radioactive mill tailings and other materials from the Vitro mill tailings site in South Salt Lake City, Utah on March 22 and March 23, 1983. The DEIS examines three remedial action alternatives: (1) no action; (2) stabilization of all material at the Vitro site; and (3) decontamination of the Vitro site and transfer of all contaminated material to a new disposal site located two miles south of Clive, Tooele County, Utah. Radiation exposure, transportation impact, land uses, and costs are evaluated in comparing alternatives 2 and 3. The Environmental Protection Agency (EPA) standards for cleanup of inactive tailings sites cannot be met under the "no action" option. Residential population doses can be reduced to normal background under alternatives 2 and 3, although the previously uncontaminated site at the South Clive will receive some increases in radiation exposure during construction under alternative 3. The final course of action by DOE, with respect to these alternatives, will be based on analyses to be reported in the final EIS. This activity is being carried out under the Uranium Mill Tailings Remedial Action Program, managed for DOE by the Uranium Mill Tailings Remedial Action Project Office, Albuquerque Operations Office, Albuquerque, New Mexico. (Auth)(SET)(DCM)

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Denham, D.H., F.T. Cross, W.E. Kennedy, Jr., S. Marks, J.K. Soldat, and R.D. Stenner, Pacific Northwest Laboratory, Richland, WA

Technical Assistance to Department of Energy/Office of Operational Safety Assurance Program for Remedial Action

PNL-5750 (Part 5); Pacific Northwest Laboratory Annual Report for 1985 to the DOE Office of the Assistant Secretary for Environment, Safety and Health, Part 5 - Overview and Assessment; (pp. 31-33) (1986, February)

This project was initiated in FY 1984 to provide technical assistance to the Department of Energy (DOE), Office of Operational Safety (OOS) in developing and implementing its Assurance Program for Remedial Action (APRA), i.e., overview of the DOE remedial action programs. Technical assistance for this second year of the project included report and procedure reviews, and assistance

with conducting the Uranium Mill Tailings Remedial Action Program (UMTRAP) Office (DOE/AL) appraisal. This included participation in preappraisal visits to UMTRAP sites in Canonsburg, Pennsylvania; Grand Junction, Colorado; and Salt Lake City, Utah. Pacific Northwest Laboratory (PNL) also transferred the PNL-developed document review software to the Oak Ridge Associated Universities (ORAU) staff in Grand Junction, Colorado, in anticipation of future document reviews by the ORAU staff. Other accomplishments have included publication of two formal documents and three project reports, preparation and presentation of five topical reports at national and international meetings, two foreign trip reports, and comments on proposed draft standards of the Environmental Protection Agency (40 CFR 193). The project manager has also participated on National Council on Radiation Protection and Measurements (NCRP) and American Society for Testing and Materials (ASTM) subcommittees developing decommissioning standards, as well as International Atomic Energy Agency (IAEA) advisory groups developing environmental monitoring guidelines.

Chapter 6

URANIUM MILL TAILINGS MANAGEMENT

- **Design, Planning, and Regulations**
- **Environmental Studies and Site Surveys**
- **Health, Safety, and Biomedical Studies**
- **Decontamination Studies**
- **Site Stabilization and Reclamation**
- **Waste Disposal**
- **General Studies**

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CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

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Need Tailings Surveillance, Research Council Finds

Nuclear News 30(5):48 (1987, April)

This article briefly summarizes the National Research Council's report calling for an ongoing surveillance program to control hazards posed by uranium mill tailings which are placed under cover to contain radon releases. The report, entitled "Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings," states that such measures should be established as federal regulations currently do not provide for such monitoring. The address to which one can write for copies of the report is also included. (CAC)

439

Annual Report of the Office of the Supervising Scientist, 1985-1986

Report; 147 pp. (1986)

The Office of the Supervising Scientist was established to implement laws, develop procedures and undertake research related to environmental protection of the uranium mining areas of the Alligator Rivers Region in the Northern Territory. Information on administration, environmental protection arrangements, supervisory and assessment activities, and research activities is presented for the period 1 July 1985 to 30 June 1986. The research projects described are concerned with ecological systems in the region and the investigation of the probable short-term impact on these systems of the release of contaminants resulting from uranium mining operations. Appendices on legislation, agreements, authorizations and approvals, environmental requirements for the Ranger and Nabarlek projects, and environmental infringements and incidents are included.

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Browning, R.E., U.S. Nuclear Regulatory Commission, Washington, DC

NRC Activities in the Waste Management Area

CONF-850419; Proceedings of the National Council on Radiation Protection and Measurements 21st Annual Meeting, Washington, DC, April 3, 1985, 285 pp.; (pp. 251-258) (1986)

The NRC's nuclear waste management activities are managed and coordinated by the Office of Nuclear Material Safety and Safeguards (NMSS). These activities cover the regulation for disposal of all NRC licensed source, byproduct and special nuclear material waste, including uranium mill tailings. The functions of NMSS include developing the criteria and framework for high-level waste regulation, including the technical bases for the licensing of high-level waste repositories; licensing and regulating low-level waste disposal facilities and providing the technical support for such regulation; providing national program management for licensing and resulting uranium recovery facilities and associated mill tailings; (these operations include uranium mills, heap-leach facilities, ore buying stations, solution mining, and byproduct uranium recovery); and reviewing and concurring in significant DOE decisions relating to inactive uranium mill tailings, remedial action program sites, and licensing of long-term monitoring and maintenance programs for stabilized tailings piles.

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Chilk, S.J., U.S. Nuclear Regulatory Commission, Washington, DC

Reassertion of Certain Regulatory Authority in the State of New Mexico

(1986, May 29)

By letter dated March 18, 1986 Governor Toney Anaya of New Mexico, requested that the NRC reassert its authority over uranium milling and mill tailings in New Mexico. The Governor stated that because of severe budget constraints, as well as other compelling reasons, the State can no longer assume regulatory responsibility for uranium mill tailings. The NRC granted the governor's request and reasserted licensing and regulatory authority over these activities and materials. This article discusses the details of this action and includes an address to which one can write for further information. (Auth)(CAC)

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Chilk, S.J., U.S. Nuclear Regulatory Commission, Washington, DC

Uranium Mill Tailings Regulations: Extension of Comment Period for Groundwater Protection and Other Issues (10 CFR Part 40)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

Federal Register 51(175):32217 (1986, September 10)

On July 8, 1986, the Nuclear Regulatory Commission (NRC) published for public comment a proposed rule to amend its regulations governing the disposal of uranium mill tailings. The proposed changes were intended to incorporate into existing NRC regulations the groundwater protection regulations published by the Environmental Protection Agency for these wastes. The comment period for this proposed rule was to have expired on September 8, 1986. The American Mining Congress requested a 60-day extension of the comment period to allow the results of its workshop held on August 26 and 27 to be factored into its comments. In view of the complexity and importance of the proposed rule and the desire of the Commission to allow all parties to fully express their views, the NRC decided to extend the comment period as requested. The extended comment period expired on Friday, November 7, 1986 (Auth)(DCM)

443

Dragonette, K.S., U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Uranium Mill Tailings Regulations: Groundwater Protection and Other Issues

Federal Register 51(207):39268 (1986, October 27)

The advance notice of proposed rulemaking seeks comment on NRC's tentative approach to making further amendments to its uranium mill tailings regulations. The contemplated rulemaking proceeding is intended to incorporate groundwater provisions and other requirements established by the Environmental Protection Agency for similar hazardous wastes into NRC regulations. This action is necessary to make NRC regulations consistent with EPA standards as required by the Uranium Mill Tailings Radiation Control Act. Alternatives to this action involve timing and scope. Comments on the ANPRM will help define the nature and scope of the action. EPA has estimated that compliance with their groundwater standards and with the stability, radon release, and other requirements recently promulgated will cost the industry from about \$310 million to \$540 million for all tailings generated by the year 2000. The range depends on the eventual cost of groundwater protection for future tailings. The EPA regulations are binding on NRC licensees in the interim. Estimates of NRC resources are still being developed. (Auth)

444

Dragonette, K.S., U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, DC

Uranium Mill Tailings Regulations: Conforming Nuclear Regulatory Commission (NRC) Requirements to Environmental Protection Agency (EPA) Standards

Federal Register 51(76):14912 (1986, April 21)

The final rule revises the Nuclear Regulatory Commission's regulations governing the disposal of uranium mill tailings to conform them to regulations recently published by the Environmental Protection Agency that set standards for protecting the environment from these wastes. The final rule would remove inconsistencies between NRC and EPA requirements and incorporate in NRC regulations the stability, radon release, and other provisions of the EPA standard not related to groundwater. This action is necessary to comply with provisions of the Uranium Mill Tailings Radiation Control Act and the NRC Authorization Act for FY 1983; therefore no alternatives to this action need to be considered. EPA has estimated that compliance with their recently published regulations would cost the uranium milling industry from about \$310 million to \$540 million to dispose of all existing tailings and tailings to be generated by the year 2000. This includes the costs of the groundwater protection provisions which are to be addressed in future NRC rule changes. The EPA regulations are binding on NRC licensees in the interim. (Auth)

445

Hoyle, J.C., U.S. Nuclear Regulatory Commission, Washington, DC

Criteria for Guidance of States and NRC in Discontinuance of NRC Regulatory Authority and Assumption Thereof by States Through Agreement

Federal Register 46(15):7540-7546 (1981, January 23)

The Nuclear Regulatory Commission has revised its statement of policy regarding criteria for guidance of States and NRC in discontinuance of NRC regulatory

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authority and assumption of regulatory authority by States through agreement. This action is necessary to make editorial changes to update the policy statement, to allow States to enter into agreements for low-level waste only, and to incorporate the provisions and requirements of the Uranium Mill Tailings Radiation Control Act of 1978. Adoption of this policy will allow interested States to enter into agreements with the NRC and regulate low-level waste sites only. Additionally, those States that meet the criteria for the regulation of uranium mills and tailings may exercise regulatory authority over these sources as provided by the Uranium Mill Tailings Radiation Control Act of 1978, as amended. The revised statement of policy reflects the following principal changes: (1) modification of Criterion 27 to allow a State to seek an agreement for the regulation of low-level waste as a separate category; (2) inclusion of additional criteria for States wishing to continue regulating uranium and thorium processors and mill tailings after November 8, 1981; and (3) editorial and clarifying changes to make the statement current. (CAC)

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Martin, J.B., U.S. Nuclear Regulatory Commission, Washington, DC

Overview of NRC Mill Licensing Activities

GJO-108(77); CONF-7710121; Uranium Industry Seminar, *Proceedings of a Seminar, Grand Junction, CO, October 26-27, 1977*; (pp. 227-232) (1977)

Actions during the year by NRC to alleviate problems associated with tailings management are reviewed. Information is included on licensing activities and review times, regulatory guides, generic environmental impact statements, and fuel cycle standards.

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Martz, M.K., SRA Technologies, Inc., Arlington, VA

Current Environmental Regulations

CONF-850314; Waste Management '85: Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Waste Policies and Programs, General Interest, R.G. Post (ed.), *Proceedings of the Symposium on Waste Management, Tucson, AZ, March 24-28, 1985*, 573 pp.; (pp. 45-49) (1985)

An overview of the federal environmental statutes and implementing regulations is provided, including the National Environmental Policy Act, the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, and the Endangered Species Act. Recent developments which may have a direct impact on waste repository siting and management activities include: final promulgation of National Emission Standards for Hazardous Air Pollutants for radionuclides, the DOE-EPA memorandum of understanding which brings mixed radioactive and chemical waste under the requirements of RCRA, and the proposed designation of additional sole source aquifers. (Auth)

448

Ratliff, R.A., B. Dornsife, V. Autry, L. Gronemyer, J. Vaden, and T. Cashman, *Conference of Radiation Control Program Directors, Inc., Frankfort, KY*

Suggested State Requirements and Criteria for a Low-Level Radioactive Waste Disposal Site Regulatory Program

NUREG/CR-4352; 40 pp. (1986, September)

The purpose of this study was to develop criteria and procedures for a state to follow in the development of a program to regulate a low-level waste (LLW) disposal site. The task included: (1) identifying those portions of the U.S. Nuclear Regulatory Commission's (NRC's) regulations that should be matters of compatibility; (2) identifying the various expertise and disciplines that will be necessary to effectively regulate a disposal site; (3) identifying the resources necessary for conducting a confirmatory monitoring program; and (4) providing suggestions in other areas which, based on experience, would result in a more effective regulatory program. To be able to regulate a low-level radioactive waste site, a state must first assume regulatory authority from the NRC in accordance with Section 274 of the Atomic Energy Act of 1954, as amended. This category of transfer of regulatory authority is commonly called a "limited agreement," and is criterion 27.e in the NRC Statement of Policy entitled "Criteria for Guidance of States and NRC in Discontinuance of NRC Regulatory Authority

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and Assumption Thereof by States Through Agreement" (Appendix A of this report). There are 36 criteria which are included in the NRC policy statement, which has been revised to incorporate the provisions and requirements of the Uranium Mill Tailings Radiation Control Act of 1978. Those States that are interested in entering into agreements with the NRC and that meet the criteria for the regulation of uranium mills and tailings may exercise regulatory authority over these sources as provided by the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604), as amended. (SET)(DCM)

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Shepherd, T.A.

A Methodology for Evaluating Uranium Tailings Management Alternatives

Dissertation Abstracts International, Section B:
40(3):1822 (1979, September)

The future potential for uranium mining and milling in the U.S. is evaluated, and the problems related to the disposal of mill tailings are discussed. Radioactive and non-radioactive contaminants contained in uranium mill tailings are identified and evaluated. Alternative tailings management options are analyzed with respect to containment of potential contaminants and protection of the natural and human environment from exposure to radioactive materials. The author points to the need for a formalized decision methodology which can be applied to the selection of acceptable tailings management alternatives based on specific site conditions. The author's proposed methodology incorporates the following elements: the analysis of the likelihood of failure; the potential magnitude of release of radioactive material; the negative utility of failure; and the consequence of failure to produce two decision parameters - the severity of failure and risk of failure. The application of the methodology requires that a complete set of potential failure modes and modes of radioactive release be considered for both the operating and the post-operating long-term phases of the disposal plan. The post-operating long-term phase is subdivided into three periods: a short long-term period of several hundred years after abandonment; a medium long-term period of several thousand years; and a long-term period which extends up to 100,000 years into the future. An extensive list of potential failure modes is presented and evaluated in terms of likelihood of failure and potential magnitude of release as related to site and design specifics of a disposal plan. This serves

as a basis for demonstrating the methodology by applying it to a hypothetical tailings management plan in two different settings. The author concludes with some general observations about important failure mechanisms, modes of release and design, and site construction of a tailing management plan for all periods. These conclusions can serve as a useful guide for design. The author also shows that the methodology provides a functional framework for organization and analysis of information pertinent to the evaluation and comparison of tailings management plans. It can be used in the evaluation of specific tailings management plans to help the decision maker identify site and decision elements and potential failure modes which are most critical to the safe containment of potential contaminants. (Auth)(CAC)

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Smith, D.S., U.S. Environmental Protection
Agency, Washington, DC

EPA Activities in Radioactive Waste Management

Transactions of the American Nuclear Society
27:145; CONF-771109; Proceedings of an American
Nuclear Society Winter Meeting, San Francisco,
CA, November 27-December 2, 1977; (p. 145)
(1977)

The U.S. Environmental Protection Agency (EPA) is concerned with the proper management of all types of radioactive wastes. Their goal is to assure that no unwarranted risks are imposed on present or future generations. To achieve this goal, EPA is undertaking an active program to develop the necessary environmental criteria, guidance, and standards for waste management. This article briefly describes a three-step waste management program of the EPA to develop such criteria and standards. The cooperative work with ERDA and NRC to assess the environmental impact of uranium mill tailings is also mentioned in relation to EPA activities in radioactive waste management. (Auth)(CAC)

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

Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings - Back-

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

ground Information Document (40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants)

EPA-520/1-86-009 (1986, August)

This Background Information Document supports the agency's final rule on radon-222 emissions from licensed uranium milling activities. It is an integrated risk assessment that provides the scientific basis for this action. Although the U.S. Environmental Protection Agency (EPA) has considered radon-222 in several regulatory actions, no specific emission standard for this radionuclide has yet been promulgated for operating licensed uranium mills. The health effects of radon-222 and the risk assessment procedure are summarized in Chapter 2. The incidence of lung cancer and resulting deaths among miners exposed to radon-222 are described, and the range of risk factors is presented. The sources of radon-222 in uranium milling and the factors affecting the rate of radon-222 emissions are described in Chapter 3. This chapter also includes a general description of EPA's risk-estimating procedure, along with the methods of measuring radon-222. A description of each licensed mill, its associated tailings impoundments, and its estimated milling production rates are contained in Chapter 4. Estimates of radon-222 emissions from the existing tailings impoundments are presented in Chapter 5. The baseline industry risk assessment for individuals and regional and national populations and the control techniques and work practices that can be used to reduce radon-222 emissions are described in Chapters 6 and 7, respectively. The resulting emissions after application of these control methods are estimated. A comparison of work practices, costs, and effectiveness is presented in Chapter 8. Information for this study was compiled from the technical literature, previous studies by EPA and the Nuclear Regulatory Commission, comments resulting from rulemaking notices, and discussions with industry representatives. Comments received during the public comment period were incorporated into this final document as appropriate. No significant change in the technical information was made except for the agency's revision of the risk factors associated with radon-222 exposure. These risk factors were increased from a range of 250-1000 deaths per million person working level months to a range of 380-1520 deaths per million person working level months. In addition, mill site-specific information was corrected and the discussion of interim cover was revised. (Auth)(JMR)

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

Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings - Economic Analysis (40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants)

EPA-520/1-86-010; 235 pp. (1986, August)

On October 31, 1984, U.S. EPA announced in the Federal Register an Advance Notice of Proposed Rulemaking to inform interested parties that the agency is considering standards for radon-222 emissions for licensed uranium ore processing facilities (uranium mills) under the Clean Air Act. Subsequently, EPA entered into an agreement with the Sierra Club to promulgate these standards by May 1, 1986. By agreement of these parties this date was changed to August 15, 1986. This was formalized by a court stipulation from the United States District Court for the Northern District of California. This document presents the findings of an economic analysis of alternative proposed work practices for controlling radon-222 emissions during the operation of licensed uranium mills. The report contains separate chapters which discuss the: current status of the domestic uranium milling industry; current radon-222 emissions and risk estimates; baseline forecasts of production, emissions, and health effects in the absence of the proposed rules; descriptions of proposed alternative work practices for controlling radon-222 emissions from tailings impoundments; estimates of the benefits and costs of these alternative work practices; the probable economic impacts of the proposed rules; and consideration of the financial impacts of the proposed rule on the owners of existing and future mills, and the consumers of nuclear-generated electricity. A draft of this document and of the Background Information Document (BID) were distributed to the public in early 1986. Public hearings were conducted in March 1986 and several comments on the assumptions utilized in this report were presented. The principal areas of concern referred to the interim cover option and the length of time it was assumed that a facility would remain idle prior to final stabilization. In addition, comments stressed the poor economic conditions in the uranium mining and milling industries. This document has been revised to address these concerns raised by the public. First, the interim cover option has been revised to account for technical difficulties in covering the evaporation ponds and sides of tailings piles. Second, the report now includes two

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alternate assumptions about the length of time a pile may remain idle prior to final stabilization. In addition to the 40-year assumption contained in the primary analysis, a complete set of costs and benefits for each regulatory alternative has been developed for a much shorter idle period of 20 years. Finally, the economic condition of the uranium industry and market is reaching an all-time low. All facility owners are continuously evaluating their investments and considering future costs and market uncertainties, and some have chosen to permanently close their plants in 1986. For the purpose of this analysis, industry data is current through February 1, 1986. (Auth)(JMR)

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

Final Rule for Radon-222 Emissions from Licensed Uranium Mill Tailings - Response to Comments (40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants)

EPA-520/1-86-011 (1986, August)

In this document EPA responds to comments received on the proposed rulemaking "National Emission Standards for Hazardous Air Pollutants; Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings," published in the Federal Register on February 21, 1986 (51 FR 6382-6387). Subsequent to the announcement of the proposed rule, a public hearing was held on March 25, 1986 in Denver, Colorado (51 FR 8205). The comment period was held open until April 28, 1986. In addition to requesting comments on the proposed alternative work practices, the agency specifically asked for comments pertaining to the following questions: (1) Is it feasible to dewater tailings, as would be required under a continuous disposal alternative? (2) What is the maximum period for design licensing and construction? (3) Is the size limit of 20 acres for phased disposal reasonable? (4) Are current or potential ground water problems severe enough to warrant termination of pumping tailings into unlined impoundments? (5) Are there any unidentified public health or environmental problems associated with evaporation ponds? (6) Are interim controls for tailings piles a practical alternative? (7) Is it reasonable to assume for a reference case, a 40-year lag before compliance with UMTRCA? (8) To what extent should the

timing of UMTRCA requirements be factored into the choice of a control option? Major concerns and issues arising from written and oral comments on the proposed rulemaking are summarized. Each commenter is identified by a letter and number after the comment. EPA's response to the comment then follows. In the interest of clarity and economy, some comments are paraphrased, and some closely related comments are combined. A list of the commenters and their identification numbers is given in Appendix A. (Auth)(JMR)

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U.S. Environmental Protection Agency, Washington, DC

National Emission Standards for Hazardous Air Pollutants (NESHAPs): Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings (40 CFR Part 61)

Federal Register 51(185):34056-34067; AO-FR-3060-7 (1986, September 24)

This final rule establishes work practices that apply to tailings at licensed uranium mill sites. Radon-222 is emitted from these tailings in amounts sufficient to produce a risk to public health. The work practices established here will limit the emissions of radon-222 in accordance with Section 112 of the Clean Air Act. (Auth)

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U.S. Senate, Ninety-Ninth Congress, Washington, DC

Uranium Revitalization and Tailings Reclamation Act of 1986

Calendar No. 948; U.S. Senate, Ninety-Ninth Congress, Second Session, September 20, 1986; 41 pp. (1986)

S. 1004 authorizes and directs the Energy Secretary to establish a program to provide for reclamation and other remedial actions with respect to mill tailings at active uranium and thorium processing sites. The committee recommends passage with an amendment to both the text and the title. The purpose of the bill is to ensure an adequate long-term supply of domestic uranium and

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enrichment capacity, to establish a viable industry, and to expedite the financing for reclamation. The report summarizes the legislative background, gives a section-

by-section analysis, presents additional and minority views, and outlines necessary changes in existing law.

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Ahmed, J.U., and H.T. Daw, International Atomic Energy Agency, Division of Nuclear Safety and Environmental Protection, Vienna, Austria

Environmental Impacts of the Production and Use of Nuclear Energy - A Summary of the United Nations Environment Program Study

IAEA Bulletin 22(2):23-29 (1980, April)

In order to assess the environmental impacts of nuclear energy, the document considers the various operations involved in the nuclear power industry. These operations are the mining and milling of uranium, enrichment, fabrication of fuel elements, reactor operation, reprocessing of irradiated fuels (in the case of the recycle option), the management of radioactive wastes produced in all steps of the nuclear fuel cycle, decommissioning of nuclear facilities, and transport of radioactive materials. The environmental impacts of the various operations have been normalized to the net production of one gigawatt-year (GWY).

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Cassaday, V.J., D.B. Chambers, and L.M. Lowe, SENES Consultants Limited, Willowdale, Ontario, Canada

Critical Receptor Radiological Dose Pathways Calculations for Use in the 'ALARA' Optimization of Design Alternatives for the Decommissioning of Beaverlodge Mine, Mill and Tailings Areas

Health Physics 49(2):371 (1985, August)

Doses to various potential critical receptors were estimated for the decommissioning alternatives being considered for the Beaverlodge Mine. Calculations were also done for the operational and shutdown situations to provide a basis for ALARA (as low as reasonably achievable) optimization. Pathways considered included direct exposure, inhalation and ingestion of water, fish, caribou, wild fowl, berries and some types of garden produce. Site specific measurements were incorporated into the calculations as available and appropriate. Potential critical receptors chosen reflected the lifestyles of the

population likely to remain in the area after completion of the decommissioning activities. The paper discusses some of the more unusual aspects of these calculations. These include consideration of the local consumption patterns and the investigation of various modeling parameters necessary for the evaluation of the lichen-caribou-man pathway. Dose predictions are presented and discussed. (Auth)(SET)

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Cloutier, N.R., F.V. Clulow, T.P. Lim, and N.K. Dave, Laurentian University, Department of Biology, Sudbury, Ontario, Canada; Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Elliot Lake Laboratory, Elliot Lake, Ontario, Canada

Transfer Coefficient of Radium-226 from Vegetation to Meadow Voles, MICROTUS PENNSYLVANICUS, on Uranium Mill Tailings

Health Physics 50(6):775-780 (1986, June)

The Ra-226 level in vegetation growing on U mine tailings in Elliot Lake, Ontario, Canada, was 211 ± 22 mBq/g (dry weight) compared to less than 7 mBq/g (dry weight) in material from a control site. Skeletons of meadow voles (*MICROTUS PENNSYLVANICUS*) established on the tailings had concentrations of Ra-226 of about 6,083 mBq per animal in winter; about 7,163 mBq per animal in spring; about 1,506 mBq per animal in summer; and about 703 mBq per animal in fall, compared to less than 7 mBq per animal in the controls. The Ra-226 transfer coefficient from vegetation to voles (defined as total mBq of Ra-226 in adult vole per total millibecquerels of Ra-226 consumed by the vole in its lifetime) was calculated to be approximately 0.046 in summer and about 0.028 in fall. (Auth)(SET)(DCM)

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Dam, W.L., U.S. Nuclear Regulatory Commission, Division of Waste Management, Washington, DC

Geochemical Controls on Groundwater Quality at Uranium Recovery Sites

Site Selection, Characterization, and Design Exploration, Proceedings of the Association of

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Engineering Geologists 28th Annual Meeting, Winston-Salem, NC, October 7-11, 1985; (p. 85) (1985)

The production of contaminated wastes from uranium recovery operations and the subsequent migration and restoration techniques are examined. Wastes produced are acidic (pH 2), high in total dissolved solids, heavy metals (such as arsenic, selenium, molybdenum, and vanadium), and organics. The extent of groundwater contamination depends on several site-specific characteristics of the geology hydrology and chemistry which influence rock-water interactions. The most important geo-chemical processes which determine the extent of contamination include pH, redox potential, sorption and kinetics. For example, calcite in the soil neutralizes the acid mine waters by increasing the solution pH which results in decreasing mobility of some contaminants. However, the amounts of calcite available for acid neutralization are finite and may only be present for a short time period. Further, uranium mobility increases above pH 6 due to carbonate complexation. Ferric hydroxide produced from oxidized pyrite sorb and remove contaminants, including As, Se, and Mo, from solution. Restoration of contaminated groundwater can be greatly facilitated by implementing the controlling geochemical processes. Reducing agents like sodium sulfide have been effective in removing contaminants from solution in laboratory experiments. (Auth)(DCM)

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Davy, D.R., D.M. Levins, E.W. Vogt, and G.A. Ludgate

Management of Mine and Mine Tailings

CONF-830934; Proceedings of the Fourth Pacific Basin Nuclear Conference, Vancouver, Canada, September 11-15, 1983; (pp. 183-199) (1983)

This paper describes the main wastes produced in the mining and milling of uranium ores. Waste management practice in Australia, Canada and the United States is reviewed, with an emphasis on recent trends that could reduce the overall environmental impact. Site-specific factors are shown to have more influence on waste management decisions than generalizations based on generic assessment.

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Dubrovsky, N.M., K.A. Morin, J.A. Cherry, and D.J.A. Smyth, University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada; Morwijk Enterprises, Kitchener, Ontario, Canada; Golder Associates, Mississauga, Ontario, Canada

Uranium Tailings Acidification and Subsurface Contaminant Migration in a Sand Aquifer

Water Pollution Research Journal of Canada (Special Issue) 19(2):55-89 (1984)

Investigations of the geochemistry of inactive pyritic uranium tailings in the Elliot Lake Mining district of Ontario have focused on the Nordic tailings management area, where two impoundments are located in natural bedrock basins. The tailings are 8-12 m thick and overlie a localized deposit of glaciofluvial sands. Analyses of the solid, liquid, and gas phases in the vadose zone of the tailings show that gas-phase oxygen levels drop rapidly within 0.7 to 1.5 m of the surface, indicating rapid oxygen consumption during pyrite oxidation. Oxidation during the past 15 to 20 years has caused a marked depletion of near-surface pyrite. The oxidation of pyrite in the vadose zone imparts to infiltrating precipitation high concentrations of iron, sulfate, various heavy metals, and a pH generally between 1.5 and 4. The acidic infiltration moves downward at a rate of 0.2 to 2.0 m/yr, displacing high-pH groundwater that originated as process water discharged from the mill. It now occupies the entire tailings thickness over a small area of the tailings. At one location a well-defined plume of high-Fe(++) tailings-derived groundwater has developed in the sand aquifer adjacent to the tailings. The plume consists of three zones: an inner core characterized by greater than 5000 mg/L iron, pH less than 4.8, and elevated concentrations of several heavy metals and radionuclides; an outer zone with less than 2500 mg/L iron, pH greater than 5.5, and relatively low concentrations of heavy metals and radionuclides; and a transition zone separating the two. Although the average linear groundwater velocity is about 440 m/yr near the dam, reactions such as mineral dissolution, precipitation and coprecipitation retard the migration of the front of the inner core, producing an observed frontal migration rate of approximately 1 m/yr. Groundwater from the outer zone of the plume flows laterally towards a small stream, where a portion of it is now discharging into the stream bed. The discharge results in the precipitation of amorphous ferric hydroxide on the

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stream bed. Most of the H^+ produced by Fe precipitation is buffered, and only a moderate decrease in stream pH is observed. Inner zone conditions will not reach the stream unless input of low-pH is observed. Inner zone conditions will not reach the stream unless input of low-pH groundwater from the tailings continues for several hundred years. The rate of pyrite oxidation in the Nordic Mine tailings has been decreasing; however, there is sufficient pyrite in the tailings to generate high-Fe groundwater for several decades or more. Calculated groundwater migration rates indicate that in the next few decades acidic, low-pH groundwater will occupy the entire tailings thickness over most of the tailings area, causing an increase in the total flux of contaminated groundwater into the underlying aquifer. The outer zone of the plume has already arrived at a small stream, and acidification of the surface waters may increase if the Fe concentration in the groundwater seepage increases. (Auth)(SET)

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Fenzi, A., Verona University, Facolta de Medicina e Chirurgia, Verona, Italy

Pre-operational Survey of a Uranium Mine near Val Vedello, Italy

Health Physics 51(2):197-205 (1986, August)

Results obtained from radiometric research carried out from 1980-81 in the region of uranium mines in the Val Vedello are provided. Data are presented on Rn-222, Ra-226, and natural uranium concentrations in spring and surface waters. Concentrations were found to be relatively low. There is some increase in the vicinity of the exploratory uranium mine but this is, at least up to the present, only of a local character. Data are presented on external gamma exposure, Pb-210 and Po-210 in food-stuffs and in the urine of normal and exposed populations as well as Ra-226 in milk and vegetable samples. The aim of this study is to outline a preliminary map of natural radioactivity on the site before starting the mining activity. This will enable the author later to detect changes caused by the uranium mining, milling and mill tailings disposal operations.

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Hans, J.M., Jr., G.G. Eadie, J. Tirral, and B. Peterson, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Above Ground Gamma Ray Logging for Locating Structures and Areas Containing Elevated Levels of Uranium Decay Chain Radionuclides - Final Technical Note

ORP/LV-78-2; PB-282-392; 46 pp. (1978, April)

This report describes the construction and operation of a mobile gamma ray logging system used to locate areas and structures containing elevated levels of natural uranium decay chain radionuclides. The detector system consists of a sodium iodide crystal coupled to four photomultiplier tubes and associated electronic system which permits both an audible indication and a strip chart recording of gamma ray photon count rates. Under normal operations, the detector assembly is mounted in a van at about two meters above the ground surface and gamma ray logs are obtained while traveling at about 16 kilometers per hour (10 mph). This system has been used extensively in the Pocatello and Soda Springs, Idaho areas and identified about 1900 locations where phosphate slag has been used for various construction purposes. The system has also been used in several other communities to identify locations where uranium mill tailings or pumice, containing slightly elevated concentrations of natural radioactivity, was used for construction purposes.

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Harrison, W.C., B.E. Halbert, and D.B. Chambers, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, National Uranium Tailings Program, Ottawa, Ontario, Canada

Modeling and Pathways Analysis for Uranium Mill Tailings: The National Uranium Tailings Program

CONF-850609; Proceedings of the Canadian Nuclear Association 25th Annual International Conference and the Canadian Nuclear Society Sixth Annual Conference, Ottawa, Ontario, Canada, June 2-5, 1985; (pp. 19.6-19.10) (1985)

In 1982 Energy, Mines and Resources Canada established a National Uranium Tailings Program (NUTP) attached to the CANMET Branch. The NUTP is a research program intended to pull together previous

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work on Canadian uranium mill tailings, to fund additional work where significant gaps are found and to develop the capability to predict the long-term effects of tailings while incorporating natural variability in data and uncertainty in future events. Mathematical modeling plays a major role in this program since quantitative predictions of future behavior can only be made with a model. The NUTP is, therefore, sponsoring modeling work on two technical levels. One deals with the various components such as source chemistry, surface water transport or biological uptake; the other provides a framework within which simplified component models can be linked together to model the overall system.

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Hart, D.R., P.M. McKee, A.J. Burt, and M.J. Goffin, Beak Consultants Limited, Mississauga, Ontario, Canada; Environment Canada, Environmental Protection Service, Toronto, Ontario, Canada

Benthic Community and Sediment Quality Assessment of Port Hope Harbour, Lake Ontario

Journal of Great Lakes Research 12(3):206-220 (1986)

Sediments in Port Harbour, Lake Ontario, have been heavily contaminated by radionuclides and heavy metals from a radium recovery plant, a uranium refinery, and other industrial activities. Spatial patterns in surficial sediment contamination, benthic community structure, and bioaccumulation of contaminants were assessed to determine possible relationships and potential environmental hazards in the event of dredging. Benthic community differences in species composition and density between inner and outer harbor areas corresponded with both habitat and sediment quality differences. Sediment loss-on-ignition, nitrogen, iron, copper, lead, chromium, zinc, and nickel concentrations in the inner harbor exceeded provincial guidelines for open water disposal of dredged spoils. Only iron exceeded those guidelines in the outer harbor. Tissue levels of radionuclides and heavy metals in benthic invertebrates were greatest at the most heavily contaminated stations in the inner harbor. Reduced benthic densities and maximum sediment contamination occurred near a refinery cooling water discharge. (Auth)

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International Atomic Energy Agency, Vienna, Austria

Environmental Migration of Radium and Other Contaminants Present in Liquid and Solid Wastes from the Mining and Milling of Uranium - Final Report of a Coordinated Research Programme Sponsored by the IAEA, 1981-1985

IAEA-TECDOC-370; 38 pp. (1986, April)

This coordinated research program has been directed at studying the migration of radium and other contaminants from tailings. It is therefore particularly concerned with the migration and transfer processes caused by ingress of water into tailings piles. Some of the studies in the program have been concerned with the behavior of radium after transfer into aquatic systems while others were concerned with the basic processes which occur in tailings piles. Studies of the latter type are essential if the long-term behavior of radium and other contaminants is to be predicted with confidence and the effects of various treatment schemes are to be understood. The migration behavior of radium-226, as a precursor to radon-222, will also have an effect on the long-term emission of this gas. The appendices of this report contain the guidance on analysis and measurement procedures and the summaries of research carried out by individual contractors.

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Kvasnicka, J., Department of Mines and Energy, Darwin, Northern Territory, Australia

Radiation Data Input for the Design of Dry or Semi-Dry Uranium Tailings Disposal

Health Physics 51(3):329-336 (1986, September)

This article presents the experimental results of assessing radium and specific alpha-activity distribution with respect to particle size of the Ranger (RUM) and Nabarlek (QML) uranium mines dry tailings samples. The variation of radon emanation coefficient versus particle size of dry tailings has also been measured. The nuclear-track detection technique, gamma spectrometry and alpha counting were used for the above measurements. Surface Rn flux from the hypothetical Nabarlek semi-infinite dry tailings pile is 32 Bq/sq meter/s and the Rn

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flux for Ranger is 10 Bq/sq meter/s. The theoretical exposure rates for 1 meter above these hypothetical tailings piles are 0.95 microcoulomb per kilogram per hour and 0.28 microcoulomb per kilogram per hour, respectively. The derived air alpha-contamination limits (DAAC) for the tailings dust were calculated to be 1.2 Bq/cu m for workers and 0.034 Bq/cu m for a member of the public. The limit for workers corresponds to the air tailings dust concentration of 0.79 mg/cu m for QML tailings and 2.2 mg/cu m for RUM tailings. The DAAC limit for the public corresponds to the air tailings dust concentration of 0.022 mg/cu m for QML tailings and 0.064 mg/cu m for RUM tailings. (Auth)(SET)(DCM)

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Longmire, P.A., University of New Mexico, Albuquerque, NM

Geochemistry, Diagenesis, and Contaminant Transport of Uranium Tailings, Grants Mineral Belt, New Mexico

Thesis (Masters): 194 pp. (1983, December)

Mine-stope backfilling is one method of disposal of uranium tailings in the Grants Mineral Belt, New Mexico. It is accomplished by hydraulically emplacing a slurry of tailings and treated-surface discharge water in abandoned mine stopes. The drainage fluids mix with ground water (Morrison Formation) and are pumped to the surface, treated, and discharged. This regional aquifer contains an alkaline pH, moderately low ionic strength (0.02 M), and is sodium-bicarbonate rich. Uranium tailings consist of unrecovered ore and gangue, and contain large amounts of sulfate salts. Pore fluid is characterized by a low pH (2), high Eh (+0.78 V) and high ionic strength (0.37 M), and contains moderately high activities of metal-sulfate and chloride complexes. Upon initial burial, pore fluid is supersaturated with respect to gypsum, goethite, hematite, barite, quartz, gibbsite, and kaolinite in oxidizing groundwater. Gypsum is the most abundant salt. Sorption of metals by silt and clay-sized material has been shown. Further diagenetic processes will occur as pore fluid equilibrates with native groundwater: (1) Gypsum will dissolve, releasing calcium, sulfate, and sorbed ions. Calcite may partially replace gypsum. (2) Detrital and authigenic phases, including barite, kaolinite, albite, microcline, and montmorillonite, will undergo incongruent surface-controlled dissolution followed by limited release of radium, strontium, barium, sodium, potassium, aluminum, silica, and sorbed ions. (3)

Uranium is stable as uranyl carbonate and hydroxide complexes and becomes concentrated on detrital and authigenic phases, followed by precipitation of coffinite, in the presence of high Si(OH)_4 activity, and uraninite. Short temporal degradation of groundwater quality, in areas adjacent to backfill, will result, due to gypsum and pyrite dissolution. Based on observed and predicted geochemical transformations, backfill disposal of uranium tailings is safe and effective. (Auth)

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Mann, H., F.G. Ferris, T.J. Beveridge, W.S. Fyfe, R. Humphrey, and K. Tazaki, University of Western Ontario, London, Ontario, Canada

Metal Uptake by Microorganisms: Retardation of Toxic Heavy Metal Dispersion from Tailing Environments, Elliot Lake, Timmins, and Sudbury (Grant 265)

Ontario Geological Survey Miscellaneous Paper 130; (pp. 190-209) (1986)

The contribution of microorganisms to the retardation of heavy metal dispersion from mine tailing environments at Elliot Lake, Timmins, and Onaping has been examined. Algae samples from tailing drainage at Elliot Lake typically contained about 20 ppm U, and up to a maximum of 0.13% U by weight. Other metals, which include Al, Ti, Pb, Zn, Ba, Cu, Ni, Mo, Th, Be, and Zr, were also concentrated by algae. In sediment cores taken from the Stanrock tailing impoundment at Elliot Lake, there was a high degree of coincidence between metal abundance and organic-rich layers. Examination of the organic material by analytical electron microscopy revealed heavily mineralized remains of bacteria and algae. Filamentous algae from Gilles Lake near Timmins were also analyzed for metal content. These algae, like their counterparts at Elliot Lake, contained significant quantities of metals with concentrations $10(E+4)$ to $10(E+6)$ times that of the lake water.

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McKee, P.M., W.J. Snodgrass, D.R. Hart, H.C. Duthie, J.H. McAndrews, and W. Keller, Beak Consultants Limited, Mississauga, Ontario, Canada; University of Waterloo, Department of Biology, Waterloo, Ontario, Canada; Royal Ontario Museum, Department of Botany, Toronto,

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Ontario, Canada; Ontario Ministry of the Environment, Sudbury, Ontario, Canada

Sedimentation Rates and Sediment Core Profiles of U-238 and Th-232 Decay Chain Radionuclides in a Lake Affected by Uranium Mining and Milling

Canadian Journal of Fisheries and Aquatic Sciences 44(2):390-398 (1987)

Radionuclide concentration profiles in sediment cores from three deep basins of Quirke Lake, Ontario, showed enrichment in the surficial layers corresponding to the period of uranium mining in the watershed and a milling-related pH decline, which was determined by a sedimentation rate technique based on analysis of fossil diatoms. Recent sedimentation rates are approximately 96 to 185 grams per square meter per year. Profiles of uranium-238 and thorium-232 decay chain radionuclides showed an enrichment of 1-3 orders of magnitude in surficial sediments relative to background in deeper sediments. Radionuclide levels in surficial sediments exceeded those reported in lake sediments in uncontaminated systems and, for some radionuclides, approached or equaled levels in sediments contaminated with uranium and radium refining residues. Radionuclide activity ratios in the surficial layers of the Quirke Lake cores and downstream sediments demonstrated the relative mobilities of the elements in the watershed. Net sediment loading rates for radionuclides in the three basins were 130-230 mg per square meter per year for uranium, 340-4000 Bq per square meter per year for other members of the U-238 decay chain, and 210-530 Bq per square meter per year for Th-232 and Th-228. (Auth)(DCM)

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Morris, R.C., and L. Fraley, Jr., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Environmental Effects on Rn-222 Fluence Rate from Reclaimed Uranium Tailings

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S50 (1987)

Radon-222 fluence rates from covered uranium mill tailings were measured. The measurements were made with and without a clay cap, and with and without vegetation over the tailings. Several environmental variables were measured as well. Fluence rates ranged from 0.0017 to 2.0 Bq per square meter per second. Fluence rate was inversely related to topsoil moisture, but the strongest effect was that of an interaction between vegetation and the clay cap which enhanced fluence rate at least one order of magnitude over vegetated plots without a clay cap and bare plots with a clay cap. Vegetated, clay-capped plots commonly produced fluence rates over the EPA maximum of 740 mBq per square meter per second. (Auth)(DCM)

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Nielson, K.K., and V.C. Rogers, Rogers & Associates Engineering Corporation, Salt Lake City, UT

A Mathematical Model of Radon Emanation from Geological Materials

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S57 (1987)

Radon source terms for indoor radon, atmospheric releases, mine exposures, or environmental assessments are usually estimated from parent radium concentrations multiplied by the radon emanation fraction. Emanation fractions have been measured over the 0.001 to 0.98 range, with typical values being in the 0.1-0.5 range. Previous theory of emanation identifies emanation mechanisms, but does not quantitatively explain observed emanation fractions or related moisture effects. This paper describes a mathematical model of radon emanation and its moisture dependence in uranium ores, tailings, and other geological materials. The model assumes cylindrical pore geometry, with concentric radium source distributions, and computes the fractions of recoil radon atoms emanated into the pore space. Emanation is computed to occur with proper recoil trajectory, proximity to pore surfaces, and energy distributions that terminate the recoil path in the pore space. Moisture films of varying thicknesses on the pore surfaces serve to absorb recoil energy, thereby increasing the emanation by both direct and indirect recoil mechanisms. Calculated emanation-moisture curves compared favorably with laboratory measurements. Emanation

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coefficients increase with moisture up to 10-20 percent of saturation in sandstone ores with large pores, and up to 60-70 percent of saturation in ores with small pores. No moisture dependence was observed or predicted above these ranges. The model suggests that about 78 percent of the ore mass is non-porous and radium-free, and that the radium-bearing minerals are confined to a layer about 0.025 micrometer thick around the pores. Moisture increased emanation coefficients by factors of 1.4 to 4.2, depending on the pore distribution of the ore. (Auth)

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Pai, H.L., G.G. Case, and E.W. Edwardson, R.A.D. Service and Instruments Limited, Scarborough, Ontario, Canada; SENES Consultants Limited, Willowdale, Ontario, Canada; Canadian Institute for Radiation Safety, Elliot Lake, Ontario, Canada

Annual Variation of Radon Levels in the Vicinity of Five Uranium Tailings Areas near Elliot Lake, Ontario

Health Physics 49(1):180 (1985, July)

Monthly radon level measurements were made over a 12-month period to provide a data base for the atmospheric dispersion modeling of radon from uranium mine tailings piles at Elliot Lake, Ontario. The study was carried out as part of the National Uranium Tailings Program sponsored by Energy, Mines and Resources Canada. An array of sixty-five specially designed electrostatically enhanced solid state track detectors were used to make the measurements in the vicinity of 5 tailings areas and at several background sites. The detectors feature an automatic capacity charging device powered with conventional 9 volt dry cell batteries. The electrostatic enhancement system provided the sensitivity and reliability required to measure low ambient radon levels during the monthly periods. Radon levels were also measured at 4 heights (1 m, 2 m, 4 m, 8 m) above the surface of tailings at two sites. Instrumentation and survey results are presented. (Auth)(SET)

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Perez, J., A.E. Torma, D.E. Caldwell, J.A. Brierley, and C.L. Brierley, New Mexico Institute of Mining and Technology, Socorro, NM; Saskatchewan University, Saskatoon, Saskatchewan, Canada; Advanced Mineral Technologies, Inc., Socorro, NM

Influence of Microorganisms in the Weathering Stability of (Ba, Ra)SO₄ in Uranium Mining and Milling Wastes

CONF-8310249; Planetary Ecology, Proceedings of the Sixth International Symposium on Environmental Biogeochemistry, Santa Fe, NM, October 10, 1983. Van Nostrand Reinhold Company Inc., New York; (pp. 273-282) (1985)

It is well known that seasonal changes affect the solubility of barium-radium sulfate ((Ba, Ra)SO₄). In early spring higher Ra-226 concentrations are in solution than by the end of the fall season. The present study has developed an intensified leach technique for the assessment of the influence of microorganisms on the stability of (Ba, Ra)SO₄ contained in synthetic and actual uranium mill tailings. In this process, a period of 10.5 simulated weathering years is equivalent to three weeks of wet and two weeks of dry treatment of tailings. The results obtained indicate that in the presence of microorganisms, *THIOBACILLUS FERROOXIDANS*, the Ra-226 concentration was decreased as a function of time compared to that concentration obtained in the sterile experiments. The decrease in the Ra-226 concentration was found to be the consequence of sulfuric acid and ferric sulfate production from pyrite by bacterial action. The excess of sulfate in solution resulted in a decrease in the solubility of (Ba, Ra)SO₄. In the sterile experiments, the pyrite oxidation was considerably slower, as indicated by pH measurements, and fewer sulfates were produced. Therefore, the solubility of (Ba, Ra)SO₄ could proceed towards the dissociation resulting in higher Ra-226 concentrations in solutions.

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Peterson, S.R., R.J. Serne, and W.J. Martin, Pacific Northwest Laboratory, Richland, WA

Predictive Geochemical Modeling of Contaminant Concentrations in Plumes Migrating from Uranium Mill Tailings Waste Impoundments

EOS, Transactions of the American Geophysical Union 66(18):274; Proceedings of an American Geophysical Union Spring Meeting, Baltimore, MD, May 27-29, 1985; (p. 274) (1985, April 30)

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The compositions of effluents from column experiments in which uranium mill tailings solution percolated through sediments were determined and used to validate a chemical model of the tailings solution/sediment interactions. The chemical model was then applied to a field site to predict the contaminant concentrations migrating from a U-mill tailings waste impoundment. A documented plume has migrated up to 1000 meters from the disposal site. Seventeen wells exist at varying distances from the waste disposal pond and have been sampled quarterly over a period of several years to monitor the migration of leachate. The chemical model of the leachate/sediment system consisted of minerals and solid phases, known or suspected to be present, coupled with a surface complexation model. The following processes were considered: advection, dissolution/precipitation of minerals and amorphous compounds, surface adsorption, soluble complex formation and redox reactions. Thermodynamic constraints determined the number of iron surface sites available for adsorption and predicted that finite masses of iron and aluminum oxyhydroxides, basaluminite, rhodochrosite, gypsum, celestite, and magnesian calcites were precipitating and/or dissolving rapidly enough to control the concentrations of their dissolved components in this chemical system. The predicted concentrations of many of the trace metals followed the analytical values obtained in the laboratory and field quite closely. Many trace metal concentrations appeared to be controlled by adsorption onto the iron oxyhydroxide that precipitated. (Auth)

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Rogers, V.C.

The Environmental Impact of Uranium Mill Tailings Generated Between 1975 and 2030

Transactions of the American Nuclear Society 30:91-92; CONF-7811109; CONF-781105; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 12-16, 1978; (pp. 91-92) (1978)

This paper focuses on the environmental impact resulting from mill tailings generated during uranium production to meet projected light-water reactor demands to the year 2030. The dominant exposure mechanism from the tailings is inhalation of radon gas and radon daughters produced by radioactive decay of Ra-

226 in the tailings. For the purposes of estimating the environmental impact of the tailings, six piles were distributed in six development centers, each with a 1975 population of about 55,000 people. Radiation exposure to radon gas and radon daughters constituted over 98% of the environmental impact. Population exposures, radon concentration distributions, and resulting health effects are estimated by using the Gaussian Plume Model with annual meteorology typical of uranium milling regions. By 2030 the total annual population dose rate from the tailings is estimated to be $5.6 \times 10(E+5)$ man-rem/yr. (Auth)(SET)(DCM)

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Rogers, V.C., R.F. Overmyer, C.M. Jensen, and G.M. Sandquist, Ford, Bacon & Davis Utah, Inc., Salt Lake City, UT; University of Utah, Salt Lake City, UT

Moisture Effects on Radon Diffusion

Transactions of the American Nuclear Society 33:174-175; CONF-791103; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 11-15, 1979; (pp. 174-175) (1979)

The key parameter defining the migration of the radon through the porous medium is the effective diffusion coefficient, which can vary over three orders of magnitude, greatly affecting the radon emission rate from a tailings pile. Moisture can affect the diffusion coefficient in two ways: first, by blocking the pores of the medium and decreasing the porosity; and second, by absorbing radon. Measurements have been made of the value of the diffusion coefficient for two Wyoming and New Mexico cover materials as a function of moisture content. The surface radon flux was measured using activated charcoal canisters. The canisters were gamma counted after being exposed to the radon flux at the surface of the material. The resulting diffusion coefficients for several soils and for several moistures show values which vary by several orders of magnitude. (Auth)(SET)

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Silker, W.B., N.A. Wogman, C.W. Thomas, D.B. Carr, and P.C. Heasler, Battelle Pacific Northwest Laboratories, Richland, WA

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Measurement of Radon Diffusion from Uranium Mill Tailing Piles

NUREG/CR-1109; PNL-3187; 16 pp. (1979, October)

The concentrations of Ra-226 and Rn-222 were measured as a function of depth within a uranium mill tailings pile by in situ gamma-ray spectrometry. Radon diffusion and exhalation rates were determined from the concentration gradients by employing an integral solution of the diffusion equation that accommodates a nonuniform depth distribution of the parent radium. Radon diffusion coefficients of 0.0002 and 0.0017 sq cm per second, and exhalation rates of 60 and 275 atoms per sq cm per second were determined for two locations with differing soil moisture content.

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Staub, W.P., Oak Ridge National Laboratory, Oak Ridge, TN

Excursion Control at In Situ Uranium Mines

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (8 pp.) (1987)

This paper summarizes excursions (uncontrolled movement of lixiviant beyond the ore zone) based on case histories of 8 in situ uranium mines (7 in Wyoming and 1 in Texas). These case histories were compiled from data provided by the U.S. Nuclear Regulatory Commission, the Wyoming Department of Environmental Quality, and the Texas Department of Water Resources. Most of these data were provided to the above agencies by mining companies in response to regulatory requirements pertaining to licensing actions.

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U.S. Nuclear Regulatory Commission, Washington, DC

Draft Environmental Statement Related to the Union Carbide Corporation, Gas Hills Uranium Project, Natrona County, Wyoming

NUREG-0441 (Draft); 161 pp. (1979, January)

The proposed action is the renewal of source material license SUA-648 issued for the operation of the Gas Hills Uranium Project in Wyoming, near Moneta. The project is an acid leach, ion-exchange, and solvent-extraction uranium ore processing mill at an increased capacity of 500,000 tons per year and the construction of two heap leach facilities in Natrona and Fremont counties for initial processing of low-grade ore. After analysis of environmental impacts and adverse effects, it is the proposed position of NRC that the license be renewed subject to conditions relating to stabilization of the tailings, reclamation, environmental monitoring, evaluation of any future activity not evaluated by NRC, archaeological survey, analysis of unexpected harmful effects, and decommissioning.

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Warwick, W.F., J. Fitchko, P.M. McKee, D.R. Hart, and A.J. Burt, National Hydrology Research Institute, Department of the Environment, Saskatoon, Saskatchewan, Canada; Beak Consultants Limited, Mississauga, Ontario, Canada

The Incidence of Deformities in CHIRONOMUS spp. from Port Hope Harbour, Lake Ontario

Journal of Great Lakes Research 13(1):88-92 (1987)

CHIRONOMUS spp. larvae collected from sediments in the harbor at Port Hope, Ontario, had a greater incidence of mouth part deformities in the more heavily polluted inner harbor area (83 percent, 33 of 40 individuals) than in the outer harbor (14 percent, 1 of 7 individuals). Port Hope Harbour, the site of radium and uranium refining operations since 1933, is contaminated by uranium-238 and, to a lesser extent, thorium-232 decay chain radionuclides and several trace metals. This difference suggests that deformities are related to the areal extent of contamination. An estimated dose rate of 1 mGy/day in chironomids suggests that radiation may be a significant factor in the induction of deformities; however, heavy metals and elevated water temperatures may also be involved. (Auth)

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Williams, R.E.

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A Guide to the Prevention of Groundwater Contamination by Uranium Mill Wastes

A Guide to the Prevention of Ground Water Contamination by Uranium Mill Wastes, 185 pp. (1982, June)

This document is intended to assemble two types of information pertinent to the problem of the control of seepage from uranium mill tailings ponds. These two categories of information, in general terms, consist of site selection and analysis procedures and techniques that can be used to engineer seepage control for sites that are not necessarily ideal from a hydrogeological viewpoint. (Auth)(SET)

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Wren, C.D., N.R. Cloutier, T.P. Lim, and N.K. Dave, University of Toronto, Toronto, Ontario, Canada

Ra-226 Concentrations in Otter, LUTRA CANADENSIS, Trapped near Uranium Tailings at Elliot Lake, Ontario

Bulletin of Environmental Contamination and Toxicology 38(2):209-212 (1987, February)

The Elliot Lake area of Ontario is currently the major uranium producing region of Canada. It is estimated there are 120 million tonnes of uranium tailings spread over 600 ha in the vicinity of Elliot Lake. The transfer and fate of uranium-series radionuclides from tailing sites remain primary ecological concerns in these areas.

The transfer potential of Ra-226 to predatory species has not been examined in detail. The objective of this study was to measure Ra-226 levels in otters (LUTRA CANADENSIS), captured near tailing sites, to provide further information on the fate of radionuclides in the environment.

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Zelle, P.W., N.D. Kretz, D.R. Rayno, and W.E. Kisleleki, Argonne National Laboratory, Environmental Impact Studies Division, Argonne, IL

A Gamma-Ray System for Field Analysis of Tailings and Soil

CONF-811049; Uranium Mill Tailings Management, Proceedings of the Fourth Symposium, Fort Collins, CO, October 26-27, 1981, 737 pp.; (pp. 181-192) (1981)

The EPA-recommended standard for the average Ra-226 concentration in soil subsequent to remedial action of inactive uranium mill sites is 5 pCi/g. In order to direct a tailings remedial action program, it is necessary to identify areas where soil contamination exceeds this soil limit. A method has been developed to perform gamma-ray analysis of soil samples for Ra-226 contamination. Samples taken from tailings areas are sealed in cans with a commercially available system. A counting system composed of a low-background shield and high-volume NaI detectors demonstrated an overall detection limit of 5 + or - 0.4 pCi/g Ra-226 in a 100-second counting interval. System design, calibration, and the procedure to determine Ra-226 concentration are described. (Auth)

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Inhalation of Radon Products May Cause 9,000 Cancer Deaths

Occupational Health and Safety Letter (840722)
:6-7 (1984, July 22)

This article discusses a report issued by the National Council on Radiation Protection and Measurements (NCRP) which asserts that inhalation of the airborne radioactive daughters of radon resulting from the release of radon gas, primarily from the soil, may account for as many as 9,000 deaths from lung cancer in Americans each year. This is 9 percent of the over 100,000 deaths occurring annually from lung cancer in the U.S. This estimate is a mathematical extrapolation based on the health effects from the higher levels of exposure experienced by underground miners of uranium and certain other ores. "Elevated radon daughter exposures are now reported in association with ordinary living conditions as well as unusual geological or occupational settings," said the NCRP report. These settings include areas adjacent to or homes built upon uranium mill tailings. The report also discusses the physical and biological basis of estimating radiation dose to the lung from inhalation of radon and its daughters. The radon daughters that contribute the major radiation dose are two solid, short-lived radioactive isotopes of polonium. The radiation involved is alpha radiation, which has a health effect only if the radioactive isotopes concerned are ingested or inhaled as is radon and its daughters. The unit of exposure to radon and its daughters is the Working Level Month (WLM) which accounts for the concentration radon and its daughters in the air and the duration of exposure. The current occupational exposure limit for miners is 4 WLM per year. Although higher levels were reported in the past, the average exposure to uranium miners in recent years has seldom exceeded 1 to 2 WLM, reflecting better ventilation in the mines. By contrast, the average national exposure to Americans from radon and its daughters is estimated by NCRP to be about 0.2 WLM per year. (Auth)(CAC)

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Chakravatti, J.L., K.B. Culver, A.W. Ashbrock, and S.E. Frost, Denison Mines Limited, Elliot Lake, Ontario, Canada; Rio Algom Limited, Toronto, Ontario, Canada; Eldorado Resources Limited, Ottawa, Ontario, Canada

Application of the Principle of Optimization in Radiation Protection in Uranium Mining and Milling

CONF-860315; Optimization of Radiation Protection, Proceedings of an International Symposium, Vienna, Austria, March 10-14, 1986. International Atomic Energy Agency, Vienna, Austria; (pp. 299-308) (1986)

Uranium is mined in deep underground low grade deposits in eastern Canada and in shallow high grade deposits in western Canada. The working conditions and resultant radiation exposures in the two areas are quite different. Three examples of cost-benefit analysis applied to uranium mining are discussed: (1) ventilation of an underground mine; (2) shielding of trucks for a high grade open pit mine; and (3) decommissioning of a major mine-mill complex.

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Horton, T.R., U.S. Environmental Protection Agency, Washington, DC

Estimation of Radon-222 Daughter Doses from Large-Area Sources

Transactions of the American Nuclear Society 27:132-133; CONF-771109; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 27-December 2, 1977; (pp. 132-133) (1977)

Potentially significant doses to the bronchial epithelium portion of the lungs have been detected in persons inside structures located near uranium mill tailings piles and several unlikely sources of radon. These dose estimates, however, are not absolutes because more representative meteorological data is needed for each site and real receptors should be identified. This article identifies the potential radiological problems of large area sources that release radon into the environment. The relative magnitude of each source is also demonstrated by comparing dose estimates, normalizing certain parameters to facilitate this comparison. (Auth)(CAC)

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Morgan, M.G., Carnegie Mellon University, Pittsburgh, PA

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National Research Council Panel Report - Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 7-13) (1987)

Uranium mill tailings are the finely ground sand-like material that is left after uranium is extracted from ore. As of early 1983, approximately 200 million metric tons of uranium mill tailings covering 1300 ha at 51 sites had accumulated in the United States. Most of these sites are in the arid Southwest. Uranium mill tailings present health and environmental concerns because of the residual radioactivity that they contain and because of a variety of other potential pollutants, such as chlorides, sulfates, and heavy metals. The milling process makes the radioactive and nonradioactive materials contained in the ore when it was mined much more mobile and also adds several potential contaminants to the tailings material during the milling process. Exposure routes of concern are release of the gas radon-222, airborne dust, and surface and groundwater contamination. In addition, the use of tailings as construction material or fill can lead to dangerously high levels of radon in associated buildings. At the request of the Department of Energy, a National Research Council study panel, convened by the Board on Radioactive Waste Management, has examined the scientific basis for risk assessment and management of uranium mill tailings and issued this final report containing a number of recommendations. Several major themes recur throughout the report: (1) To ensure the effectiveness of control measures over the long term, it will be necessary to maintain a low level but ongoing program of surveillance of uranium mill tailings piles with provisions for any necessary corrective actions; (2) because of the variability of physical, chemical, radiological, and demographic factors at each site, risk management strategies must be site specific; (3) the health risks posed by exposure to radon from uranium mill tailings piles are trivial for the average U.S. citizen, range from small to modest for most persons who live close to piles, but in special circumstances could be significant for a few individuals who live in close proximity to certain uncontrolled piles. (Auth)(JMR)

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National Research Council, Uranium Mill Tailings Study Panel, Washington, DC

Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings

DOE/DP-93032-T1; 260 pp. (1986)

Uranium mill tailings are the finely ground sand-like material that is left after uranium is extracted from ore. As of early 1983, approximately 200 million metric tons of uranium mill tailings covering 1300 ha at 51 sites had accumulated in the United States. Most of these sites are in the arid Southwest. Uranium mill tailings present health and environmental concerns because of the residual radioactivity that they contain and because of a variety of other potential pollutants, such as chlorides, sulfates, and heavy metals. The milling process makes the radioactive and nonradioactive materials contained in the ore when it was mined much more mobile and also adds several potential contaminants to the tailings material during the milling process. Exposure routes of concern are release of the gas, Rn-222, airborne dust, and surface and groundwater contamination. In addition, the use of tailings as construction material or fill can lead to dangerously high levels of radon in associated buildings. At the request of the Department of Energy, a National Research Council study panel, convened by the Board on Radioactive Waste Management, has examined the scientific basis for risk assessment and management of uranium mill tailings and issued this final report containing a number of recommendations. Chapter 1 provides a brief introduction to the problem. Chapter 2 examines the processes of uranium extraction and the mechanisms by which radionuclides and toxic chemicals contained in the ore can enter the environment. Chapter 3 is largely devoted to a review of the evidence on health risks associated with radon and its decay products. Chapter 4 provides a consideration of conventional and possible new technical alternatives for tailings management. Chapter 5 explores a number of issues of comparative risk, provides a brief history of uranium mill tailings regulation, and concludes with a discussion of choices that must be made in mill tailing risk management.

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Rogers, V.C., and R. Baird

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Radiation Pathways and Potential Health Impacts from Inactive Uranium Mill Tailings

Transactions of the American Nuclear Society 30:92-94; CONF-7811109; CONF-781105; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 12-16, 1978; (pp. 92-94) (1978)

The purpose of this paper is to describe in detail the methodology used for pathway analysis and health effects estimations. Specific parameters are presented for each of the 21 uranium mill sites that were evaluated, and the computer program RADAD, which was developed as part of this task, is described. The principal radioisotopes associated with uranium mill tailings are the decay products of U-238, primarily, Th-230, Ra-226, Rn-222, and Rn-222 daughters. The major routes of exposure to man are: (1) inhalation of the Rn-222 daughters; (2) external whole-body gamma exposure; (3) inhalation of windblown tailings; and (4) ingestion by man of ground or surface water contaminated with radioactivity. To calculate the potential exposure a population would receive from the radon pathway, the radon transport is tracked from its generation in the radium bearing mill tailings, through the tailings and any cover material present, and into the air where it is transported by wind and diffusion. The radon transport through the atmosphere is calculated with the Gaussian Plume solution to the diffusion equation. Key site-specific input parameters to the calculations are the cylindrical equivalence of the tailings pile dimensions, average radium concentrations in the tailings, meteorological data and population information. Key results of the analysis include the radon flux at the tailings pile surface, radon concentration as a function of position, and population exposures. The final step in estimating potential health effects from radon and radon daughters was to convert the measured radon concentrations to working levels (WL) and working level months (WLM), and then to apply a risk estimator that related a given population-WLM value to the potential number of lung cancers that could statistically be attributed to the excess exposures. (Auth)(SET)(DCM)

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Silhanek, J.S., U.S. Environmental Protection Agency, Washington, DC

Radon-222 Emissions from Licensed Uranium Mill Tailings

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S13 (1987)

The U.S. Environmental Protection Agency established a rule on September 24, 1986 which requires work practices for tailings at licensed uranium mill sites. In developing that rule, an analysis was performed to determine the environmental effects due to radon-222 emissions from these sites. This paper presents the results of that analysis and compares it to actual radon measurements made at these sites. Lung cancer, which is caused by the short-lived decay products of radon, is the dominant health hazard from uranium mill tailings. It was found that individuals living near an uncontrolled tailings pile are subject to high risks due to radon emitted from uranium mill tailings. The EPA estimated that at present some persons may be exposed to risks that are as high as one in one hundred. Based on models for the risk to all exposed populations, about one to five fatal cancers per year were estimated from emission of radon from the tailings at 20 active mill sites if no controls are present. If the tailings at all sites were to dry out, it is estimated that the risk could rise to about two to nine fatal cancers per year. Approximately one half of these deaths are estimated to occur within 80 kilometers of the tailings piles. (Auth)(DCM)

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Travis, C.C., A.P. Watson, and L.M. McDowell-Boyer

Potential Population Dose from Radon-222 Released by Uranium Tailings Piles

Transactions of the American Nuclear Society 30:90-91; CONF-7811109; CONF-781105; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 12-16, 1978; (pp. 90-91) (1978)

The purpose of this study is to provide estimates of inhalation dose from Rn-222, Pb-210, and Po-210 to the population resulting from releases of Rn-222 from tailings piles in the Western United States. Distinguishing features of this study include four generic release sites, an advanced atmospheric dispersion model, updated dose conversion factors, detailed demographic data, and considerations for inhalation dose from primary and resuspended Pb-210 and daughters. (Auth)(SET)(DCM)

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Whittington, D., and W. Drummond

Examination of EPA's Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings

Environmental Impact Assessment Review 6(3)
:233-251 (1986, September)

The article presents an in-depth analysis of EPA's Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings. This RIA is concerned with a familiar problem in environmental policy: how much money to spend today to reduce deaths and illness from long-term exposure to low levels of hazardous substances. Four types of analytical weaknesses are identified in the RIA and a reevaluation that provides a more useful basis for decision making is presented. However, the reevaluation illustrates the sensitivity of the analysis to such ethical issues as who is granted standing in the benefit calculations. This examination suggests that cost-benefit analysis should highlight such fundamental ethical choices rather than obscure them.

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Woods, D.A., Office of the Supervising Scientist for the Alligator Rivers Region, Sydney, Australia

Variation of Annual Limits on Intake and Derived Air Concentrations with Activity Median Aerodynamic Diameter for Uranium Mine and Mill Dusts

CONF-850844; Proceedings of the Australian Radiation Protection Society Tenth Annual Conference, Melbourne, Australia, August 19, 1985; (pp. 17-22); Radiation Protection in Australia 4(1):17-22 (1986, January)

Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) of uranium mill and mine dust of 1 micrometer and 10 micrometer Activity Median Aerodynamic Diameter (AMAD) are calculated based on ICRP 30 data and assumptions on the radionuclide composi-

tion of these dusts. It is suggested that a single ALI value and the corresponding DAC value may be used for both ore and tailings dust, irrespective of dust AMAD. Also, the ALI and DAC for fresh product dust is more restrictive than the ALI and DAC for old product dust.

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Yuan, Y.C., C.J. Roberts, and M.H. Momeni

Radiological Assessment Methodology for Uranium Mills

Transactions of the American Nuclear Society 30:94; CONF-7811109; CONF-781105; Proceedings of an American Nuclear Society Winter Meeting, Washington, DC, November 12-16, 1978; (p. 94) (1978)

Assessment of the radiological impact of uranium milling operations requires careful consideration of the exposure pathways associated with transport of radon gas and particulate material containing uranium and its decay products. The Uranium Dispersion and Dosimetry (UDAD) computer code has been developed for estimating potential radiation exposure to individuals and the general population within an 80-km radius of a reference mill site. This report considers only transport of radioactive material through the air. Exposure may occur from inhalation, external irradiation from airborne and ground-deposited activity, and ingestion of foodstuffs. Calculation of the inhalation dose to an individual is based on the ICRP Task Group Lung Model (TGLM). Following this model, the fraction of inhaled activity deposited in the lung compartments is determined by the aerodynamic properties of the particles. Terrestrial food pathways included in the model are vegetation, meat, milk, poultry, and eggs. Calculation of internal organ or tissue doses is based on ICRP recommendations with the option of using either a single or multiple exponential retention model. Radiological impact studies of uranium milling have indicated that it is necessary to treat resuspension explicitly, and to include the transport of large particles (greater than 10 μm). These large particles have been found to contribute significantly to the dose to the local population. The model predicts that essentially all of the environmental dose commitment will be delivered within two years after the radioactive material has been released. (Auth)(SET)(DCM)

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Evans, J.V., P.L. Brown, and G. Sinclair, Australian Atomic Energy Commission, Lucas Heights Research Laboratories, Lucas Heights, Sutherland, New South Wales, Australia

Geochemistry of Uranium and Daughters in Tailings from the Milling of Uranium Ores

CONF-860912; ICNR '86, Nuclear and Radiochemistry, Proceedings of an International Conference, Beijing, China, September 1-5, 1986, 325 pp. Chinese Nuclear Society, Beijing, China; (p. 290) (1986)

Selective chemical leaching is being used to investigate the phase distribution of uranium and its more important long-lived daughter products, thorium-230, radium-226, and lead-210, within solid tailings arising from the milling of Australian uranium ores. A knowledge of the solid state speciation and ponding of these radionuclides within the mineralogically and chemically heterogeneous tailings matrix is important to the prediction of the likely long-term behavior and environmental impact of the waste.

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Haque, K.E., and B.H. Lucas, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Mineral Sciences Laboratories, Ottawa, Ontario, Canada

Mini-Pilot-Scale Hydrochloric Acid Leaching of an Elliot Lake Uranium Ore

Uranium 2(4):327-342 (1986, April)

A hydrochloric acid leaching process has been found to provide high uranium recoveries and low residual radium content in the tailings. Several uranium extraction process flowsheets have been developed based on hydrochloric acid leaching of uranium ores, of pyrite-free tails from pyrite flotation minerals, and of magnetic concentrates from high intensity magnetic separation of radioactive minerals. Two-stage hydrochloric acid leaching of an Elliot Lake uranium ore with 4-hr-retention in each stage provided 98% overall recovery of uranium and tailings containing 30 pCi of Ra per gram of tailings. However, the economics of the acid chloride process com-

pare unfavorably both in capital and in operating costs with the conventional sulfuric acid process, unless such a process provides significant savings in environmental costs.

498

Hynes, T.P., T. Meadley, and N. Thompson, Amok Limited, Saskatoon, Saskatchewan, Canada

Effluent Treatment Experience at a High-Grade Uranium Mine

Canadian Journal of Civil Engineering 13(4):429-437 (1986, August)

Amok Ltd. is the operator of uranium mining and milling facilities at Cluff Lake in northwestern Saskatchewan. All contaminated liquid effluents from these facilities have been subject to treatment by chemical and physical methods before release to the environment. In particular, a secondary treatment system (STS) has been operated adjacent to the tailings management area to reduce the concentration of radium-226 to below the maximum levels allowable in the final effluent. The STS has operated for over 2 years at a nominal rate of 4000 cubic meters per day. During this time, the most stringent regulatory limit on radium-226 concentration (0.37 Bq/l or 1×10^{-11} g/l total, based on a monthly arithmetic mean) has been exceeded on only two occasions. The process regularly removes 99% of the radium from the effluent stream. Data is presented on chemical addition rates, efficiencies of system components, and the significance of each stage of the treatment process. In addition, several modifications have been made to the STS. Recently, a primary treatment system has been added to the effluent treatment process. Preliminary indications are that this system has increased the overall efficiency of the system. (Auth)

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Landa, E.R., C.L. Miller, and D.M. Updegraff, U.S. Geological Survey, Reston, VA; U.S. Geological Survey, Denver, CO; Colorado School of Mines, Department of Chemistry and Geochemistry, Golden, CO

Leaching of Ra-226 from Uranium Mill Tailings by Sulfate Reducing Bacteria

Health Physics 49(1):155 (1985, July)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT DECONTAMINATION STUDIES

Sparingly soluble sulfate precipitates appear to be a major host for radium in sulfuric acid-treated, uranium mill tailings. The dissolution of such precipitates by natural processes, such as metabolism by sulfate reducing bacteria (SRB), creates the potential for the release of radium to the contacting waters. Significant leaching of radium by SRB was observed in the laboratory during the anaerobic incubation (1 to 112 days) of uranium mill tailings with pure cultures of *DESULFOVIBRIO DESULFURICANS* and mixed cultures containing SRB isolated from the tailings, all grown on a lactate medium at room temperature. While the maximum Ra-226 concentration reached in a sterile media control was 0.44 Bq/L (12 pCi/L), that in the SRB systems was 61 Bq/L (1640 pCi/L) or about 20 percent of the total radium inventory in the original tailings sample. The leaching of radium in SRB systems was accompanied by a decrease in soluble sulfate concentration, an increase in total sulfide concentration, and an increase in the number of SRB. The observed leaching effect does not appear to be due to chelation of radium by microbial exudates. Implications of these findings to the management of uranium mill tailings and other radioactive waste are discussed. (Auth)

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Landa, E.R., C.L. Miller, and D.M. Updegraff

Leaching of Radium-226 from Uranium Mill Tailings by Sulfate-Reducing Bacteria

Health Physics 51(4):509-518 (1986, October)

Relatively insoluble sulfate precipitates appear to be a major host for Ra in sulfuric acid-treated, U mill tailings. The dissolution of such precipitates by natural processes, such as metabolism by sulfate-reducing bacteria (SRB), creates the potential for release of Ra to contacting waters. Significant leaching of Ra by SRB was achieved in the laboratory during the anaerobic incubation (1 to 119 days) of U mill tailings with pure cultures of *DESULFOVIBRIO DESULFURICANS* and mixed cultures containing SRB isolated from the tailings, all grown on a lactate medium at room temperature. While the maximum Ra-226 concentration reached in a sterile media control was 0.44 Bq/L (12 pCi/L), that in the SRB systems was 61 Bq/L (1640 pCi/L) or about 20% of the total Ra inventory in the original tailings sample. The leaching of Ra in SRB systems was accompanied by a decrease in soluble sulfate concentration, an increase in total sulfide concentration, and an increase in the number of SRB.

The observed leaching effect does not appear to be due to the action of microbial chelates or to binding to cell walls. Potential implications of these findings to the management of U mill tailings and other radioactive wastes are discussed. (Auth)

501

Nirdosh, I., M.H. Baird, and S.V. Muthuswami

Processes for Extracting Radium from Uranium Mill Tailings

U.S. Patent 4,654,200 (1987, March 31)

An improvement in a process for the extraction of Ra from uranium mill tailings solids including the steps of contacting the tailings with a liquid leaching agent, leaching the tailings therewith and subsequently separating the leachate liquid and the leached solids is claimed. The improvement involves use of a leaching agent which comprises: a complexing agent in an amount of from 2-10 times the stoichiometric amount needed to complex the metal ions to be removed thereby from the tailings; and a reducing agent reducing the hydrolyzable ions of the metal ions to be removed to their lower oxidation states, the reduction agent being present in an amount from 2-10 times the stoichiometric amount needed for reducing the hydrolyzable metals present in the tailings.

502

Reardon, E.J., and P.M. Moddle, University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada

Suitability of Peat as an Oxygen Interceptor Material for the Close-Out of Pyritic Uranium Tailings: Column Studies

Uranium 2(1985):83-110 (1985)

A series of column experiments were conducted to evaluate the impact of a peat layer placed over uranium mill tailing on the chemical composition of effluent water. Three columns were prepared with tailings at the base and overlain with varying thicknesses of peat. A layer of crushed quartz sand completed the stratigraphic configuration. Two control columns, one without peat and one with peat, but without tailings, were also prepared. The

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column experiments were conducted for a 57-day period under saturated-flow conditions, followed by a 50-day period of unsaturated flow. The total water influx over the course of the experiments corresponded hydrologically to approximately 6 years of infiltration. The results of the chemical analyses of the effluent waters show that the presence of peat, after 6 years of simulated infiltra-

tion, has no effect on the effluent concentration levels of Ca, Mg, Na, K, Si, Fe, Al, and pH. Uranium concentration levels of column effluent samples were found to be directly correlated with the amount of peat material in a particular column. (Auth)(SET)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

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Bragg, J.W., Exxon Minerals Company, Houston, TX

Mill Tailings: Reclamation Costs

Science 230(4731):1223 (1985, December 13)

Mark Crawford's article "Mill Tailings: A \$4-Billion Problem" (News and Comment, 9 August, p. 537) incorrectly states that "milling companies, many of which are owned by major corporations like...Exxon..., want to shift 55 percent of the reclamation costs to the electric utility industry and another 30 percent to the Federal Government." We are not a supporter of such legislation and have stated so when asked. I regret that we were not called to clarify our stance. The two uranium properties we are reclaiming are being done so at our expense and in compliance with applicable state and federal standards. (Auth)(DCM)

504

Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Study of Facilities Relative to Stabilization of Uranium Mill Tailings at Elliot Lake - Final Report

INIS-mf-10158; 61 pp. (1983, June)

The total project capital cost of facilities to stabilize uranium mill tailings at Elliot Lake while producing 350,000 short tons per year of sulfuric acid and 286,000 short tons per year of triple superphosphate is approximately 153 million dollars. This includes pyrite flotation, roasting, acid and phosphate production, site preparation, utilities and project overhead. A new operating credit of 20.43 dollars per short ton of acid is estimated, achieved from the sale of steam and fertilizer. Two alternatives to the above were also examined, as follows: (1) Production of 286,000 short tons per year of acid, and the mill's requirement. The capital cost of this scheme is approximately 89 million dollars, with a net operating credit of 14.97 dollars per short ton of acid. (2) Production of only 350,000 short tons per year of acid. This would entail disposal of the excess pyrite floated from the Rio Algom mills. The capital cost of this scheme is approximately 75 million dollars, with an operating cost of 10.47 dollars per short ton of acid.

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Miller, L.L., and L.A. Davis, Water, Waste & Land Inc., Fort Collins, CO

Hydrogeologic Aspects of Reclamation of the Ray Point Tailings Facility: A Case Study

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 299-310) (1987)

Recent concern over pollution of groundwater resources has resulted in regulations which require a uranium tailings reclamation plan to address potential impacts on groundwater as a result of seepage from the reclaimed tailings impoundment. This paper presents a case study of the hydrogeologic aspects of the reclamation of a tailings impoundment located in south Texas. The study indicates that some seepage from the impoundment has occurred in the past and minor amounts of seepage continue to occur. While contaminated water from the impoundment appears to have moved a substantial distance from the impoundment, recent evidence suggests that the upper zone of saturation is receding, particularly during periods when there is no ponded water on the northern end of the basin. Because construction of the final surface will prevent additional ponding, it is believed that the water which currently exists in the wells along the southern and western edges of the impoundment will continue to dissipate. Therefore, it is anticipated that the tailings impoundment will have no negative impacts on groundwater resources of south Texas. (Auth)(CAC)

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Singh, V., J.B. Berry, and D.F. Kapral, Acres American, Inc., Buffalo, NY; Union Carbide Corporation, Uravan, CO

Uranium Mill Tailings Geotechnical Investigations - A Case History

Proceedings of an International Conference on Case Histories in Geotechnical Engineering, S. Prakash (ed.), St. Louis, MO, May 6-11, 1984, Vol. 3; (pp. 1405-1413) (1984)

CHAPTER 6. URANIUM MILL TAILINGS MANAGEMENT SITE STABILIZATION AND RECLAMATION

Uranium mill tailings at Union Carbide Corporation's mining and mill complex in Uravan, Colorado, are deposited in two tailings piles along a steep hillside. The tailings are deposited in slurry form and allowed to decant. The decant liquid is then removed for recycling in the milling operation. The impoundment dikes are raised using the coarser portion of the tailings in an upstream method of construction. At the time of the study, the height of the tailings piles was in excess of 100 feet. Continued use of these piles necessitated a detailed geotechnical stability evaluation and design of stabilizing measures in order to maintain safety factors and meet regulatory requirements. Any failure of these slopes could have serious consequences. This paper discusses the geotechnical evaluation of the tailings piles, design and construction of the stabilizing measures, and the performance of the tailings pile slopes. The work was performed to meet the requirements set by the Colorado Department of Health, a State of Colorado agency, and the Nuclear Regulatory Commission of the United States, which acted as consultant and reviewer to the Department of Health. These regulatory agencies conducted a detailed review of the design and construction activities. Since the construction of the stabilizing berms, a regular monitoring program has been in effect. The data collected to date indicate that the performance of the slopes has been satisfactory. (Auth)(CAC)

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Staub, W.P., and S.R. Abt, Oak Ridge National Laboratory, Oak Ridge, TN

Methodology for Oversizing Marginal Quality Riprap for Erosion Control at Uranium Mill Tailings Sites

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (9 pp.) (1987)

Properly selected and oversized riprap from local sources may provide superior erosion protection compared with revegetation at a number of uranium mill tailings sites in arid regions of the United States. Whereas highly durable rock is appropriate for protecting diversion channels to the height of the 5-year flood, marginal quality rock may be adequate for protecting infrequently flooded side slopes of diversion channels, tailings embankments and caps. Marginal quality rock may require oversizing to guarantee that design size specifications are met at the end of the performance period (200 to 1000 years). This paper discusses a methodology for oversizing marginal quality rock. Results of cyclic freezing and thawing tests are used to determine oversizing requirements as functions of the performance period and environment. Test results show that marginal quality rock may be used in frequently saturated areas but in some cases oversizing will be substantial and in other cases marginal quality rock may be disqualified. Oversizing of marginal quality rock appears to be a practical reality in occasionally saturated areas (between the 5-year and 100-year floods). Furthermore, oversizing will not generally be required on slopes from the 100-year flood.

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Bell, M.J., U.S. Nuclear Regulatory Commission, Washington, DC

The Nuclear Regulatory Commission's Low-Level Waste Management Program

Transactions of the American Nuclear Society 27:143-144; CONF-771109; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 27-December 2, 1977; (pp. 143-144) (1977)

This article discusses the objectives and recent activities of the Nuclear Regulatory Commission's Low-Level Waste Management Program. The program is concerned with mill tailings, decommissioned facilities, and licensing of radioactive waste as well as low-level waste. The article briefly summarizes the environmental impact statements for LWRs as tabulated in NRC regulations and federal and state programs used by the NRC to regulate waste disposal. The structure of the waste management program is also outlined. (CAC)

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Blomeke, J.O., and C.W. Kee, Oak Ridge National Laboratory, Oak Ridge, TN

Projections of Wastes To Be Generated

CONF-760701; Management of Waste from the LWR Fuel Cycle, Proceedings of an International Symposium, Denver, CO, July 11-16, 1976; (pp. 96-117) (1976)

Projections of commercial fuel-cycle wastes are used on ERDA's "low growth" forecast of February 1975 (revised) for nuclear power in the United States. In this case, the installed nuclear electric capacity rises from 70 GW in 1980 to 625 GW in the year 2000. Most of the power is generated by LWRs through the end of this century. Commercial liquid-metal fast breeder reactors are introduced in 1993 and account for about 10% of the total installed capacity by 2000. Plutonium recycle as fuel in LWRs begins in 1981 and is used in about 75% of LWRs by 1983. Fuel reprocessing is assumed to begin in 1978, with reprocessing capability increasing at such a rate that the spent-fuel backlog is worked off by 1988. Eleven principal fuel-cycle wastes are identified, and

their rates of generation, shipment, and total accumulated inventories are calculated. These estimates assume the satisfactory completion of selected research and development programs that are under way on separation techniques, fixation processes, packaging and transportation systems, and repositories for long-term storage and terminal isolation of the wastes. Also counted in the fuel-cycle wastes inventory are the accumulation of ore tailings from uranium ore milling and processing. The quantity of tailings is estimated on the basis that 95% of the uranium is extracted from ores assaying 0.2% uranium. The unrecovered 5% and all radioactive daughters remain with the tailings, which average in volume 0.16 cubic yard per short ton (0.13 cubic meter per metric ton) of recovered U3O8. Results are presented on three bases: for 1 GW-yr of electricity generated; for a fuel fabrication and reprocessing throughput of 1500 metric tons per year; and for the total U.S. nuclear economy. (Auth) (DCM)

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Botsford, S.E., and J.G. Oldham, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Economics of Alternative Uranium Tailings Transport Methods

CONF-860317; Waste Management '86, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986, 645 pp.; (pp. 443-448) (1986)

The paper is directed at selecting an economic method for transporting tailings from existing locations to final disposal sites. The method of transportation chosen will depend on the quantity of tailings, the terrain and the distance to be transported. Procedures for transporting uranium tailings, as well as advantages and disadvantages, are discussed for each of the following transportation modes: (1) truck; (2) rail; (3) conveyor; (4) tram; and (5) slurry pipeline. Emphasis is placed on uranium tailings disposal. Economic data and recommendations that may be used for selection of a system for a particular situation are presented. Finally, general conclusions are reached relating the characteristics of a system with economic alternatives for transporting the material.

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Cobb, W.E., W.V. Bluck, and I.P.G. Hutchison, CH2M Hill, Denver, CO; Steffen, Robertson and Kirsten, Inc., Denver, CO

Management for Hazardous Waste Liability at Mining Sites

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 201-206) (1987)

Mining companies, as developers of natural resources, are being forced to deal with potential long-term liabilities of past, present, and future mining operations. These liabilities are very real, and take several forms: RCRA compliance and cleanup; Superfund; or Natural Resource Damage Claims (NRDC). This paper discusses management strategies for dealing with these various liabilities. The authors' observations and suggestions are based on corporate experience with approximately 15 mining-related Superfund, over 100 organic-contaminated Superfund, and 50 private-sector hazardous waste projects. The financial liabilities associated with mining-related Superfund sites and NRDC's are becoming evident; potential financial liabilities are demonstrated as follows: Union Carbide recently settled on a \$42 million cleanup program at Uravan, including moving processing wastes to centralized storage areas; and State of Colorado Department of Health has proposed a cleanup of \$120-200 million for the Eagle Mine, including tailings removal to a RCRA disposal facility and perpetual treatment of mine water. As evidenced by these numbers, the potential financial impacts of mining-related environmental liabilities can be extremely high. Settlements could severely impact the profitability of any company, whether it is large or small. Waste management problems can result in burdensome liabilities and legal entanglements. Extreme cases include the mine site being placed on the National Priorities List (NPL), (i.e., Superfund) and/or subjected to a NRDC. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) created a mechanism for investigating and cleaning up the top priority hazardous waste sites in the United States. The five-year, \$1.8 billion, program initiated studies and cleanup programs at numerous facilities. The Superfund Amendments and Reauthorization Act of 1986 (SARA) provides approximately \$9 billion for another five years of Superfund. In

conclusion, we can expect CERCLA activity with the approval of SARA. Superfund remediation and Natural Resource Damage Claims are very serious and potentially extremely costly liabilities. Mining companies should place significant emphasis on implementing comprehensive, scientifically based, waste management strategies for new, ongoing, and non-operating facilities. A sound waste management strategy should be based on the following components: (1) a sound technical understanding of site conditions and contaminant migration pathways; (2) a solid understanding of Risk Assessment techniques, identifying potential site problems that could impact public health, welfare, and the environment; (3) a sound grasp of regulations that may be applicable (both enforceable and non-enforceable) at a given site; (4) a superior technical understanding of the implementability of specific, cost-effective, remedial or corrective actions; (5) an aggressive negotiation approach that uses technical personnel rather than attorneys; (6) the willingness to implement negotiated remedies in a timely manner; and (7) a staged approach to the implementation of remedial actions. (Auth)(JMR)

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Daniel, D.E., University of Texas, Austin, TX

Hydraulic Conductivity Tests for Clay Liners

CONF-870211; Geotechnical and Geohydrological Aspects of Waste Management, D.J.A. van Zyl (ed.), Proceedings of the Ninth Annual Symposium, Fort Collins, CO, February 1-6, 1987; (pp. 15-34) (1987)

This paper discusses methods for measuring the hydraulic conductivity of clay liners in both the laboratory and the field. If a clay liner is to function properly, it must have a low hydraulic conductivity. The author shows that no testing method is without simplifying assumptions and limitations. For laboratory tests, the key consideration is to avoid excessive confining stress. In situ tests range from small, easy-to-use devices to much larger, less convenient apparatuses. No one type of in situ test will always be the best. However, one of the objectives of an in situ hydraulic conductivity test should be to permeate a representative volume of soil. The pan lysimeter and sealed double-ring infiltrometer are best able to test a large volume of soil. (Auth)(CAC)

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Folwell, K., Folwell (Keith) and Associates Pty Limited, Cherrybrook, Australia

Proposals for Water Disposal at the Ben Lomond Uranium Project

INIS-mf-10485; CONF-8509324; Proceedings of an Environmental Workshop, Townsville, Australia, September 16, 1985; 30 pp. (1985, September)

This paper briefly describes the Ben Lomond uranium project and explains the design philosophy, operating characteristics and inter-relationship between the various facilities utilized for the water management system. The quality of waters downstream of the project, after dilution of deep aquifer seepages with run-off water from outside the restricted release zones, is reviewed. The conclusions reached by State and Federal Governments and the author concerning such water quality are stated.

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Hancox, W.T., H.N. Isaac, and J. Howieson, Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, Canada; Ontario Hydro, Toronto, Ontario, Canada; Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Radioactive Waste Management in Canada

CONF-860314; Siting, Design and Construction of Underground Repositories for Radioactive Wastes, Proceedings of an International Symposium, Hannover, Federal Republic of Germany, March 3-7, 1986. International Atomic Energy Agency, Vienna, Austria; (pp. 19-34) (1986)

The overall objective of Canadian radioactive waste management is to ensure that there will be no adverse effects on man and the environment from such wastes. Canadian radioactive waste management programs encompass: (1) used fuel from nuclear electricity generating stations, (2) low and intermediate level radioactive wastes, and (3) uranium mine and mill tailings. Research and development pertaining to highly radioactive nuclear fuel waste is performed within the Canadian Nuclear Fuel Waste Management Program. The program covers interim stor-

age, transportation, immobilization and subsequent disposal. The term 'fuel waste' is defined as both used fuel discharged from CANDU reactors and high level radioactive liquid wastes that would result from recycling of used fuel, should recycling be implemented in the future. A number of low level radioactive waste management programs are being pursued. These are directed at siting and constructing disposal facilities for the various types of low level waste produced in Canada. The paper summarizes the achievements to date in both the Canadian Nuclear Fuel Waste and Low and Intermediate Level Radioactive Waste Management Programs.

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Knight, R.B., and J.P. Haile, Canadian Geotechnical Society, Montreal, Quebec, Canada

Sub-Aerial Tailings Deposition

INIS-mf-10155; CONF-8306275; Proceedings of the Panamerican Conference on Soil Mechanics and Foundation Engineering, Vancouver, Canada, June 1, 1983; (13 pp.) (1984)

The sub-aerial technique involves the systematic deposition of tailings in thin layers and allowing each layer to settle, drain and partially air dry prior to covering with a further layer. Underdrainage produces densities in excess of those achieved by sub-aqueous deposition and any air-drying serves to preconsolidate each layer with a resulting further increase in density. The low permeability of the tailings surface resulting from this deposition technique results in high runoff coefficients and, by decanting the runoff component of direct precipitation, a net evaporation condition can be achieved even in high rainfall areas. An underdrainage system prevents the build-up of excess pore-pressures within the tailings mass and at decommissioning the tailings are fully consolidated and drained thereby eliminating the possibility of any long term seepage. This paper presents a general description of these design concepts, and details of two projects where the concepts have been applied.

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Martin, J.B., U.S. Nuclear Regulatory Commission, Washington, DC

Update of NRC Uranium Mill Licensing Activities

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GJO-108(78); GJBX-22-79; CONF-7810106; Uranium Industry Seminar, Proceedings of a Seminar, Grand Junction, CO, October 17-18, 1978; (pp. 219-229) (1978)

Increased vigilance must be given to controlling emissions from active milling operations, particularly windblown tailings, to assure that the soon-to-be-effective EPA fuel cycle standard is met. Comprehensive environmental monitoring programs will have to be developed to confirm that, in fact, the limit is met. Just as was the case last year, tailings management and disposal is still the major item of concern relating to uranium milling operations. As stated earlier, the NRC feels that below-grade disposal is the preferred method of tailings disposal in that it provides the greatest assurances of long-term isolation. In any event, tailings must be disposed of in such a way that no active care is required of disposal sites, to avoid committing future generations to a significant, lingering obligation to care for wastes generated to produce benefits which they will only indirectly receive, if at all. While the primary means of providing long-term isolation of tailings must be by physical barriers, as a prudent, supplementary measure of control, we are concluding in the GEIS of uranium milling that ownership of disposal sites by a government agency is desirable. We expect a low level of continued surveillance at disposal sites with small expense involved. We are concluding that requiring operators to contribute on the order of \$100,000 per disposal site to cover ongoing expenses would be the most appropriate means of conforming to the principle that the waste generator should pay full cost of disposal. We feel such an arrangement would be fair, simple, and efficient, favoring it over complicated schemes involving such things as taxes on product or tailings generated and continued management of ear-marked funds. Legislation is now pending in the congress which would give NRC direct regulatory control over mill tailings and put into place the authorities needed to implement the long-term control and funding arrangements discussed above.

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Melis, L.A., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Development of the Disposal Technology Research Component of the National Uranium Tailings Program - Final Report

INIS-mf-10159; 119 pp. (1983, March)

The National Technical Planning Group on Uranium Tailings Research, organized by CANMET in 1980, recommended the establishment of a National Uranium Tailings Program to develop research on the long-term abandonment of uranium mine tailings. This report deals with the disposal technology component of this program and attempts to provide recommendations with respect to potential research avenues in this area. A description of uranium tailings in Canada is provided in order to identify the current situation with uranium tailings management. Uranium mining sites described include the Elliot Lake and Bancroft area of Ontario, the northern Saskatchewan properties and the two abandoned sites in the North West Territories. The description of the sites was facilitated by subdividing the tailings into inactive sites, active sites, new tailings sites and areas of tailings in a close-out situation. Methods identified as promising include subsurface disposal, in situ leaching, prevention of pyrite oxidation and reclamation studies at abandoned sites.

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Mitchell, D.H., and R. Cuello. Pacific Northwest Laboratory, Richland, WA

Geomembrane Selection Criteria for Uranium Tailings Ponds

NUREG/CR-3974; PNL-5224; 69 pp. (1986, September)

The selection criteria, particularly those involving chemical compatibility, of geomembranes to be used in ponds at uranium mill operations are discussed in this report. The principal functional criteria which a geomembrane must meet for this application are (1) a specified service life and (2) low permeability. Chemical compatibility with the waste is essential in meeting these functional criteria. In two different types of aging tests using simulated acidic uranium mill waste, degradation of chemical and physical properties were examined in sulfonated polyethylene. Compatibility tests according to the National Sanitation Foundation procedures are recommended to ascertain the stability of certain physical properties of the proposed geomembrane. Actual experience with a specific geomembrane in an identical application is probably the best method to assure compatibility; however, this experience is frequently not available. Experience with a geomembrane in similar

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applications is valuable in the selection process, however, small differences in either the geomembrane formulation or the waste composition may result in large differences in performance of the geomembrane. It is likely that many geomembranes have acceptable chemical stability for typical uranium mill applications, therefore, additional factors in the selection processes will include seaming characteristics, mechanical properties, site characteristics, and costs. (Auth)

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Reardon, E.J., and P.M. Moddle, University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada

Gas Diffusion Coefficient Measurements on Uranium Mill Tailings: Implications to Cover Layer Design

Uranium 2(1985):111-131 (1985)

The direct determination of how the physical properties of pyritic tailings affect the diffusion coefficient of oxygen is not possible because of the chemical and biochemical reactivity of oxygen gas within the tailings. However, reliable estimates of oxygen diffusion coefficients through the tailings can be calculated from diffusion coefficient measurements of another gas that does not react with the tailings constituents. Twenty-two separate determinations of the diffusion coefficient of carbon dioxide were made using a conductimetric technique on samples of uranium mill tailings obtained from the discharge spigot at the Quirke Mine disposal area near Elliot Lake, Ontario. The results of these measurements and the gas kinetic theory were used to derive a relationship which allows the prediction of the diffusion coefficient of oxygen through the uranium tailings. The calculated oxygen diffusion coefficient was used to evaluate the design characteristics of a uranium tailings close-out scheme which requires a two-component cover layer, consisting of a section of peat followed by depyritized tailings. A relationship was derived which relates the thickness of these components and the diffusion coefficient of oxygen of the cover layer material which would be required to exclude oxygen for a prescribed period of time. (Auth)(SET)(DCM)

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Schiager, K.J., University of Utah, Salt Lake City, UT

Disposal of Uranium Mill Tailings

CONF-850419; Proceedings of the National Council on Radiation Protection and Measurements 21st Annual Meeting, Washington, DC, April 3, 1985, 285 pp.; (pp. 149-162) (1986)

So much attention has been given to the criteria for disposal of uranium mill tailings during the past ten or more years that a review of most of that material would be necessarily superficial and most likely boring. Instead, this paper calls attention to aspects of this problem that have been avoided or ignored. In most respects, uranium mill tailings are very much like their non-radioactive counterparts, i.e., they present disposal concerns that are very similar to those for many of the waste products of the mineral extraction and energy production industries.

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Thiers, G.R., and E.S. Smith

Isolation of Abandoned Uranium Tailings

Soil Mechanics and Foundation Engineering, Proceedings of the 11th International Conference, San Francisco, August 1985, Vol. 3; (pp. 1307-1310) (1985)

Discusses the radiological and chemical aspects of tailings isolation, including: (1) reduction of the rate of radon exhalation (radon flux) by specifying a computed thickness of cover; (2) analysis and control of leaching and contaminant migration; (3) design of riprap for cover protection; and (4) certification of long-term durability of the cover protection material. (Auth)

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Thomson, B.M., P.A. Longmire, and D.G. Brookins, University of New Mexico, Department of Geology, Albuquerque, NM

Geochemical Constraints on Underground Disposal of Uranium Mill Tailings

Applied Geochemistry 1:335-343 (1986)

A three-phase investigation has been conducted on groundwater quality impacts of the underground dis-

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posal of tailings from acid-leach milling of uranium ores. These phases included field collection and analysis of samples obtained during backfilling of mill tailings in empty underground mine stopes, collection of soil samples from mill tailings piles and previously backfilled stopes, and evaluation of thermodynamic constraints on possible geochemical transformations. Contaminants of principal concern include As, Mo, Se, U, V, and Ra-226. The investigation has shown that short-term degradation of groundwater due to backfill disposal of the sand fraction of uranium tailings is negligible. Long-term effects,

defined as those occurring after mining operations cease and the mine fills with water, are predicted to also be very small. This is attributed to immobilization of pollutants through chemical reduction and precipitation, as well as adsorption onto aquifer materials. This conclusion is substantiated, in part, by observation of high concentrations of most of the contaminants on the silt and clay fraction of the soil samples collected, in contrast to the concentrations found on the sand fraction. (Auth)

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Acton, C.F., and L.A. Hofman, Lawrence Livermore National Laboratory, Livermore, CA

Potential Benefits of the Recovery of Strategic/Critical Materials from Mixed Wastes

Transactions of the American Nuclear Society 52:28; CONF-860610; Proceedings of an American Nuclear Society Annual Meeting, Reno, NV, June 15-19, 1986; (p. 28) (1986)

The United States is currently dependent on foreign suppliers for many of its strategic and critical materials. Chromium, platinum, and manganese are primarily supplied by South Africa and the Soviet Union. Zaire and Zambia are the major sources of cobalt. Budgetary cutbacks over the last 20 years have reduced the stockpiles maintained for defense use. Many are currently in deficit. Considering the tenuous relationships the United States maintains with many of the countries relied on for these strategic materials, an alternative source of materials would be welcomed. One potential source of some of these strategic and critical materials is uranium mill tailings. Substantial quantities of uranium, vanadium, molybdenum, and cobalt have been successfully recovered from uranium mill tailings. Other strategic materials currently in deficit (nickel, platinum, palladium, etc.) also may be recoverable from mill tailings. The U.S. Department of Energy (DOE) has responsibility for 17.9 million tonnes of uranium mill tailings. An additional 48.4 million tonnes of DOE tailings are comingled with private holdings in the four-state region. A program of consolidation and resource recovery from these tailings could yield many of the strategic and critical materials the United States currently imports from foreign sources.

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Airey, P.L., Australian Atomic Energy Commission, Lucas Heights Research Laboratories, Lucas Heights, Sutherland, New South Wales, Australia

Radionuclide Migration Around Uranium Ore Bodies: Analogue of Radioactive Waste Repositories - Annual Report, July 1982-June 1983

NUREG/CR-3941; AAEC/C40 (Vol. 1); 154 pp. (1984, October)

A number of uranium ore bodies in the Northern Territory of Australia have been evaluated as geochemical analogues of high-level radioactive waste repositories. The aim of the study is to contribute to the understanding of the scientific basis for the long-term prediction of the transport of radionuclides. Particular attention is being paid to investigations of (1) mechanisms of mobilization and subsequent retardation of uranium series nuclides following the weathering of metamorphic host rocks; (2) the role of iron minerals in the retardation of uranium and thorium; (3) the role of groundwater colloids in the transport of radionuclides; (4) experimental methods for studying the time dependence of adsorption coefficients; and (5) conceptual methods for studying the effect of transport of uranium series nuclides through crystalline host rocks over geological time. The possibility of incorporating certain transuranic and fission product elements into the analogue is discussed. (Auth) (SET)

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Bowser, R.Y., K.K. Nielson, and V.C. Rogers, Rogers & Associates Engineering Corporation, Salt Lake City, UT

Laboratory Measurement of Radon Diffusion Coefficients

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S56 (1987)

Diffusion barrier covers are commonly used to reduce radon releases into the atmosphere from uranium mill tailings piles, radioactive wastes, and other radium-contaminated materials. Since the covers may extend over hundreds of acres, it is important to minimize their thickness and resulting costs. Radon diffusion coefficients of the source and cover materials provide the basis for computing the thickness of cover needed to achieve a given level of radon flux reduction. A rapid transient diffusion method has been developed to accurately and precisely measure radon diffusion coefficients. Prepared sample columns are exposed at one end to a gaseous radon source, and the resulting alpha activity from radon diffusion is monitored at the opposite end as a function

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of time since exposure to the source. Radon diffusion coefficients are computed from fits to the radon breakthrough curve. The tests are conducted in a closed system to avoid atmospheric pressure effects. Tests require from 12 hours for dry porous materials to several days for nearly-saturated samples. Sample preparation protocols similar to those for ASTM geotechnical tests give good control of moistures and densities, and control the selection of test compactions and moistures. Measurements have been conducted on several hundred soil and uranium tailings samples, as well as on a variety of reference materials. Good agreement is obtained between laboratory and field sample compactions, and between this method and steady-state diffusion measurement methods. Sample compaction at above-optimum moistures appears to significantly reduce radon diffusion coefficients at subsequently low moisture saturations. (Auth)

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Clemence, S.P.

Use of In Situ Tests in Geotechnical Engineering

CONF-8606217; In Situ '86, Use of In Situ Tests in Geotechnical Engineering, Proceedings of an American Society of Civil Engineers Meeting, Blacksburg, VA, June 23, 1986, 1285 pp.; Geotechnical Special Publication No. 6 (1986)

This book presents the papers given at a conference on engineering geology. Topics considered at the conference included the liquefaction resistance of sandstones, a liquefaction study of coal refuse by nuclear gages, a probabilistic study of liquefaction, in-situ tests on a Florida peat, cone penetrometer use on uranium mill tailings, the in-situ testing and analysis of dams, and the in-place permeability measurement of slurry trench cutoff walls.

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Goldsmith, W.A., and W.E. Clements, Oak Ridge National Laboratory, Oak Ridge, TN; Los Alamos Scientific Laboratory, Los Alamos, NM

Radon from Radium-Bearing Residues: How Does It Get from Here to There?

Transactions of the American Nuclear Society 33:147-148; CONF-791103; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 11-15, 1979; (pp. 147-148) (1979)

This paper summarizes measurement and modeling techniques that may be used to estimate human exposures to residue-produced Rn-222 and its short-lived progeny. The migration of Rn-222 from granular residue to human exposure occurs in two phases: (a) escape of the Rn-222 atoms from their point of origin within the particles, and (b) subsequent migration through the capillary network between particles to the surface. Only those Rn-222 atoms formed by the decay of Ra-226 at or very near the surface of a particle of the residue are likely to escape from that particle. Radon within the interstitial pores migrates toward the residue surface as a result of molecular diffusion in the pore air or by transport of the pore air itself. Radon that diffuses to the surface of radium-bearing residues will be concentrated in structures, which might be built over those residues. Radon may also be transported off the site to nearby persons by atmospheric turbulence. The model used to estimate this offsite transport should be chosen carefully, and the meteorological data should be representative of the site. (Auth)(SET)

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Hart, K.P., D.M. Levins, and A.G. Fane, Australian Atomic Energy Commission, Lucas Heights Research Laboratories, Lucas Heights, Sutherland, New South Wales, Australia; University of New South Wales, Kensington, New South Wales, Australia

Steady-State Radon Diffusion Through Tailings and Multiple Layers of Covering Materials

Health Physics 50(3):369-379 (1986, March)

Uranium tailings piles are generally rehabilitated by covering them with a number of layers of earthen materials. This paper derives exact equations for the Rn concentration profile and flux attenuation through any number of covering layers. The equations take account of the distribution of Rn between interstitial air and water. Numerical examples are given to show that approximate methods give rise to significant errors in some circum-

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stances. The flux attenuation factor depends not only on the diffusion coefficient, porosity, moisture content and thickness of each layer but also upon the order of placement. To achieve maximum flux attenuation, the least permeable material should be uppermost. (Auth)

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Kennedy, R.H., L.J. Deal, F.F. Haywood, and W.A. Goldsmith. U.S. Energy Research and Development Administration, Division of Safety, Standards and Compliance, Washington, DC; Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN

Management and Control of Radioactive Waste from Uranium Milling Operations in the United States of America

IAEA-CN-36/479; STI/PUB-465; CONF-770505; Nuclear Power and Its Fuel Cycle, Volume 4 - Radioactivity Management, Proceedings of an International Conference, Salzburg, Austria, May 2-13, 1977. International Atomic Energy Agency, Vienna, 874 pp.; (pp. 545-560) (1977)

Of the 39 privately owned mills in the United States that produced and sold uranium to the U.S. Government during 1948 to 1971, 22 have closed down due either to exhaustion of reserves or lack of market. On the inactive mill sites there remain 24×10^6 tonnes of tailings containing 14,000 Ci of radium. Success in stabilization has been variable. In the past, theoretical models have had to be used in estimation of the environmental effects of uranium milling for lack of a sufficient factual base. The U.S. Energy Research and Development Agency (ERDA), in cooperation with the the Environmental Protection Agency and the States involved, is undertaking a comprehensive radiological assessment at each site. The results of this assessment should provide valuable basic information on the environmental impact of uranium ore processing. The current studies reveal that the inactive sites are a cause of small public exposure to radiation, primarily from Rn-222 from the tailings piles. This paper reviews radioactivity management in uranium ore processing to control the spread of radioactive materials, including methods used for stabilization to prevent wind and water erosion. Recent measurements of radioactivity levels in soils, ground and surface waters, and in air near tailings piles, are summarized and public health implications evaluated. Guidelines have been developed for land

decontamination, and procedures evaluated for long-term management of contaminated material to minimize future human exposure. Alternative methods for long-term tailings stabilization, their cost and benefits in terms of serious health effects avoided, are presented. (Auth)

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Landa, E.R., U.S. Geological Survey, Reston, VA

Radium-226 Contents and Rn Emanation Coefficients of Particle-Size Fractions of Alkaline, Acid and Mixed U Mill Tailings

Health Physics 52(3):303-310 (1987, March)

Alkaline circuit and mixed acid, and alkaline circuit uranium mill tailings sampled at an inactive mill site near Monticello, UT, and tailings from an active, acid-leach uranium mill were separated into particle-size fractions ranging from +10 mesh to -325 mesh by dry and wet separation techniques. The radium-226 contents and radon-222 emanation coefficients of these fractions were determined. Dry tailings show a high degree of aggregation that tends to mask the relation of properties, such as radium content and radon emanating power, to dispersed-particle size. Coarse-tailings fractions (+325 mesh) had emanation coefficients which were from 25 to 45% lower than those of their fine-fraction counterparts. Emanation coefficients measured for tailings derived from a salt roast/carbonate-leach process suggest that such ore roasting does not lead to reductions in radon emanation in the tailings derived therefrom. (Auth)

531

Larson, N.B., and B. Mitchell, Jacobs Engineering Group, Inc., Albuquerque, NM

Cone Penetrometer Use on Uranium Mill Tailings

CONF-860217; In Situ '86, Use of In Situ Tests in Geotechnical Engineering, Proceedings of an American Society of Civil Engineers Meeting, Blacksburg, VA, June 23, 1986, 1285 pp.; (pp. 700-713); Geotechnical Special Publication No. 6; (pp. 700-713) (1986)

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Piezocene data were found to be very reliable in the identification of uranium tailings according to the traditional categories of sands, sand-slime mixtures, and slimes by the use of charts based on the point stress and friction ratio. However, it was found that when an attempt is made to identify soils according to the Unified Soil Classification System (USCS), a rather large scatter is observed. Charts are presented in an attempt to quantify the data scatter in a probabilistic manner. The estimation of design parameters through piezocene data correlations with laboratory test results is briefly discussed.

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Lowson, R.T., and S.A. Short, Australian Atomic Energy Commission, Lucas Heights Research Laboratories, Lucas Heights, Sutherland, New South Wales, Australia

Analysis for the Radionuclides of the Natural Uranium and Thorium Decay Chains with Special Reference to Uranium Mine Tailings

AAEC/E-611; 42 pp. (1986, August)

A detailed review is made of the experimental techniques that are available, or are in the process of development, for the determination of uranium-238, uranium-235, uranium-234, protactinium-231, thorium-232, thorium-230, thorium-228, radium-228, radium-226, radium-223, polonium-210, and lead-210. These products of the uranium and thorium decay chains are found in uranium mine tailings. Reference is also made to a procedure for the selective phase extraction of mineral phases from uranium mine tailings.

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

Environmental Analysis of the Uranium Fuel Cycle: Part 4, Supplementary Analysis - 1976

EPA-520/4-76-017; PB-259-857; 145 pp. (1976, July)

The EPA recently completed a technical review of the uranium milling industry as part of an overall analysis of the uranium fuel cycle. This review included a description of the milling process, estimations of radioactive effluent releases, radiological impact, health effects impact, and the costs and effectiveness of control technologies for mills. An analysis of the tailings piles associated with mills was also included. This review was prepared in support of EPA's proposed standards for the nuclear fuel cycle. This report contains an extensive review of the costs and the effectiveness of various control technology systems for uranium mills and mill tailings piles.

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Wates, J.A., Jones & Wagener Inc., Johannesburg, South Africa

Filtration - An Application of a Statistical Approach to Filters and Filter Fabrics

Soil Mechanics and Foundation Engineering, M.D. Gidigas (ed.), Proceedings of the Seventh Regional Conference for Africa, Accra, Ghana, June 1980; (pp. 433-440) (1983)

This paper reviews statistical approaches to the evaluation of particulate filtration with particular reference to the construction and design of tailings dam filters. The statistical theories have been used to examine the distribution of voids expected of filter fabrics, and an evaluation is made of the effectiveness and efficiency of filter fabrics relative to conventional graded filters. The paper concludes that a statistical approach to the understanding of the behavior of filters can be most useful. More experimental performance records for filter fabrics are required before confidence can be had in the performance of fabrics. (Auth)(SET)

Chapter 7

TECHNICAL MEASUREMENTS CENTER

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George, J.L., and G.H. Langner, Jr., Bendix Field Engineering Corporation, Grand Junction, CO; U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

Field Study of Indoor Average Radon-Daughter Estimation Methods

GJ/TMC-26; 181 pp. (1986, August)

The purpose of this study was to evaluate and compare measurement methods and instruments used to estimate the annual average indoor radon-daughter concentration (RDC) in a structure under actual occupancy conditions. The basis for evaluation was whether a method using an instrument could provide reasonable assurance of compliance with RDC standards, and whether the precision represented by the coefficient of variation of the instrument was 15 percent or less. The instruments evaluated and commented on were: Kodak Pathe Alpha-Track Film; Terradex Type SF Detectors; Terradex Type SO Detectors; Technical Associates Passive Environmental Radon Monitor (PERM); EDA Instrument PERM; EML Radon Progeny Integrating Sampling Unit (RPISU); EDA Instruments PRISU; Eberline WLM-1. (Auth) (SET)

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George, J.L., and G.H. Langner, Jr., U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

Interim Results of the Prompt Alpha-Track Radon Detector Study

GJ/TMC-28; 32 pp. (1986, July)

The Technical Measurements Center is evaluating the reliability of using short-term exposures of alpha-track radon detectors to estimate annual average radon-daughter concentrations (RDC) in residences in the Grand Junction Colorado, area. This Prompt Alpha-Track Study was initiated in the summer of 1985 and will be completed in the summer of 1986. Two sets of data are being collected, each consisting of two-, three-, four-, five-, and six-month-long exposures of alpha-track radon detectors. October 2 was selected as the midpoint of the

Fall set of exposures and April 2 as the midpoint of the Spring set of exposures. These dates were selected after analyzing the RDC data collected by the Colorado Department of Health during the Grand Junction Remedial Action Program. This interim report on the Prompt Alpha-Track Study discusses the preliminary results of the Fall measurements. Terradex Type SF Track Etch detectors were exposed at 50 stations in 34 structures where previous annual average RDC and/or radon data have been collected. Two detectors were deployed at each station for each short-term exposure. Three additional annual detectors were deployed at each station concurrently with the six-month Fall detectors. The detectors were processed at a sensitivity level of 0.2 pCi-month/l. Preliminary results indicate that all of the short-term Fall measurements using October 2 as the midpoint of the exposure can reliably estimate the annual average indoor radon concentration in structures. The precision of both the short-term measurements and the methods is acceptable at 4 pCi/l. Results of a paired t-test indicate no difference in the measured radon concentration between a short-term measurement and an annual measurement, at the 0.01 level of significance. These conclusions are provisional since only the Fall data have been analyzed. (SET)(DCM)

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Karp, K.E., UNC Technical Services, Inc., Grand Junction, CO

Utilization of Radon-Flux and Radon in Soil-Gas Measurements as an Alternative to Surface Gamma Surveys for Locating Buried Radium Contamination

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S73 (1987)

Locating buried uranium mill tailings at properties in the vicinity of a tailings pile has depended almost exclusively on surface gamma surveys. Despite the effectiveness of the gamma surveys, a small but significant number of properties have structures with high indoor radon levels after remedial action. To search for the causative radon source using the same gamma-survey technique would be unavailing since it was not initially able to identify all of the source material. Therefore, the Technical Measurements Center employed an alternate approach using

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radon as a pathfinder to locate radium contamination. Radon-flux and radon in soil-gas measurements were compared with surface gamma measurements at a property known to have buried tailings and at a property where remedial action failed to decrease the indoor radon concentration. At the remediated property the radon measurements provided a useful means of characterizing the source of the high indoor radon concentration and delineated an additional low level radium source (2-3 pCi/g) which went undetected by the surface gamma survey. (Auth)

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Langner, G.H., Jr., and J.C. Pacer, U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

Protocol for the Estimation of Average Indoor Radon-Daughter Concentrations

GJ/TMC-09; 47 pp. (1986, June)

The Technical Measurements Center has developed a protocol which specifies the procedures to be used for determining indoor radon-daughter concentrations in support of Department of Energy remedial action programs. This document is the central part of the protocol and is to be used in conjunction with the individual procedure manuals. The manuals contain the information and procedures required to implement the proven methods for estimating average indoor radon-daughter concentration. Proven in this case means that these methods have been determined to provide reasonable assurance that the average radon-daughter concentration within a structure is either above, at, or below the standards established for remedial action programs. This document contains descriptions of the generic aspects of methods used for estimating radon-daughter concentration and provides guidance with respect to method selection for a given situation. It is expected that the latter section of this document will be revised whenever another estimation method is proven to be capable of satisfying the criteria of reasonable assurance and cost minimization. (Auth)(SET)

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Langner, G.H., Jr., UNC Geotech, Grand Junction, CO

Validation of the Abbreviated Radon Progeny Integrating Sampling Unit (RPISU) Method for Mesa County, Colorado

UNC/GJ-34(TMC); 78 pp. (1987, June)

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology established the Technical Measurements Center (TMC) at the DOE Grand Junction, Colorado, Projects Office to standardize, calibrate, and compare measurements made in support of DOE remedial action programs. Indoor radon-daughter concentration measurements are made to determine whether a structure is in need of remedial action. The TMC conducted this study to validate an abbreviated Radon Progeny Integrated Sampling Unit (RPISU) method of making indoor radon-daughter measurements to determine whether a structure has a radon-daughter concentration (RDC) below the levels specified in various program standards. The TMC established a criterion against which RDC measurements made using the RPISU sampling method are evaluated to determine if sampling can be terminated or whether further measurements are required. This abbreviated RPISU criterion was tested against 317 actual sets of RPISU data from measurements made over an eight-year period in Mesa County, Colorado. The data from each location were tested against a standard that was assumed to be the same as the actual annual average RDC from that location. At only two locations was the criterion found to fail. Using the abbreviated RPISU method, only 0.6 percent of locations sampled can be expected to be falsely indicated as having annual average RDC levels below a given standard. (Auth)

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Langner, G.H., Jr., and K.E. Karp, UNC Technical Services, Inc., Grand Junction, CO

Comparison of Radon and Radon-Daughter Grab Samples Obtained During the Winter and Summer

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S73 (1987)

The Technical Measurements Center (TMC), under the auspices of the U.S. Department of Energy (DOE), is

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investigating short-term methods for estimating annual average indoor radon-daughter concentrations (RDC). The short-term methods investigated as part of this study include ten-minute radon and radon-daughter grab sampling and hourly RDC measurements. Grab sampling was performed under controlled occupied conditions. Hourly RDC measurements were performed under three sets of conditions over a 72-hour period: uncontrolled occupied, controlled occupied, and controlled unoccupied. A field study at 40 sampling locations in 26 residential structures in Grand Junction, Colorado, was conducted once in the winter (during February and March 1985) and once in the summer (during July and August 1985). The results indicate that radon grab samples from basement locations are reproducible over different seasons during controlled sampling conditions. Nonbasement radon and RDC grab samples are highly variable even when the use of the structure by the occupant is controlled and the ventilation rate is restricted. These results confirm that a short-term radon or RDC measurement in a nonbasement location in a house is not a standardized measurement that can be used to infer an annual average radon concentration. On the other hand, the results suggest that it is not necessary to relocate the occupants during the time of grab sampling. (Auth)

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Marutzky, S.J., H.L. Fleischhauer, P.R. Engelder, and R.O. Gilbert, U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO; Pacific Northwest Laboratory, Richland, WA

Comparison of In Situ and Laboratory Measurement Methods for Radium-226 in Soils

GJ/TMC-24; 168 pp. (1986, October)

This study evaluates the equivalency of laboratory and in situ methods for determining radium-226 in soils by comparing means and regression relationships between one laboratory and five in situ methods. The in situ methods chosen for this study include spectrometer measurements and the "delta" measurement technique. The two objectives of this study are to evaluate the equivalency of mean concentrations, as observed with each of the six methods, in small homogeneous areas, and to evaluate the equivalency of the methods over a wide range of source strengths and inhomogeneous soil conditions. For the first objective, in situ data were collected

at 36 gridpoints in two areas having expected radium-226 concentrations of 5 pCi/g and 100 pCi/g. Each of the two areas were 100 square meters in size. After the in situ measurements were made, soil samples were collected for analysis. Results of the measurements in the high-concentration-area ranged from 95.2 to 123.6 pCi/g, with results from the laboratory method being the lowest. The in situ method results were all grouped above 107 pCi/g. The low-concentration area results ranged from 3.7 to 4.3 pCi/g. The paired comparison examines the difference between any two methods at each gridpoint. All but four of the 15 possible comparisons for both the low- and high-concentration areas were statistically different, indicating a small but consistent difference. For the second objective, two sets of 15 measurement points were chosen ranging in radium concentrations from 5 pCi/g to several hundred pCi/g. The planned-comparison tests indicated that both types of in situ methods produce equivalent mean radium concentrations for both areas. The regression analyses show that the in situ and laboratory methods are equivalent in one data set but not in the other. The regression equations differ significantly between the two data sets, indicating that the relationship could not be reproduced in an independent sampling. In view of the results of this study, in situ methods do not produce mean radium concentration values statistically equivalent to the laboratory analysis of soil samples. This conclusion must be qualified due to the relatively small differences in results from the high- and low-concentration-grid areas. (Auth)(SET)(DCM)

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Showalter, R., UNC Geotech, Grand Junction, CO

Investigation of the Hammer-Gamma Measurement Technique: A Feasibility Study

UNC/GJ-31(TMC) (1987, May)

The Technical Measurements Center (TMC), under the auspices of the U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology through the Grand Junction Projects Office (GJPO), investigated the feasibility of the "Hammer Gamma" as a reconnaissance tool for the determination of the approximate extent of shallow subsurface radium contamination. Initially, various detectors were evaluated to determine the most appropriate size for use in this task. Measurements were then taken in the calibration models maintained at the DOE/GJPO facility with existing instrumentation to determine sensitivities and calibration factors. Field

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measurements were taken to ensure subsurface contamination could be located with the instrumentation selected. Various methods of constructing a slim and shallow borehole were investigated to determine the easiest and quickest method of inserting the detector into the ground. Based on these investigations, a prototype "Hammer-Gamma" system was designed, built, and tested. (Auth)

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Steele, W.D., and D.C. George, Bendix Field Engineering Corporation, Grand Junction, CO; U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

Field Calibration Facilities for Environmental Measurement of Radium, Thorium, and Potassium - Second Edition

GJ/TMC-01 (Second Edition); 79 pp. (1986, August)

A key component of the Technical Measurements Center support is the development, identification, standardization, and maintenance of calibration facilities for environmental radioelement measurements. This report describes calibration facilities located at Grand Junction, Colorado, and at six secondary sites: Casper, Wyoming; Grants, New Mexico; George West, Texas; Reno, Nevada; Spokane, Washington; and Morgantown, West Virginia. These facilities are available to contractors for the calibration of radiometric field instrumentation for in situ measurements of radium, thorium, and potassium. The use of these facilities for the calibration of radiometric field instruments used in remedial action is made possible by the commonality of the radiometric measurement technique for uranium and for radium. (Auth)(SET)

Chapter 8

**GENERAL REMEDIAL ACTION
PROGRAM STUDIES**

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CHAPTER 8. GENERAL REMEDIAL ACTION PROGRAM STUDIES

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Berven, B.A., W.D. Cottrell, R.W. Leggett, C.A. Little, T.E. Myrick, W.A. Goldsmith, and F.F. Haywood, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Generic Radiological Characterization Protocol for Surveys Conducted for DOE Remedial Action Programs

ORNL/TM-7850; 76 pp. (1986, May)

This report describes goals and methodology that can be used by radiological survey contractors in surveys at properties associated with the Department of Energy's remedial action programs. The description includes (1) a general discussion of the history of the remedial action programs; (2) the types of surveys that may be employed by the Radiological Survey Activities (RSA) contractor; (3) generic survey methods that may be used during radiological surveys; and (4) a format for presenting information and data in a survey report. (Auth)

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Brazley, L., A. Wallo, and C. Young, U.S. Department of Energy, Germantown, MD; Aerospace Corporation, Washington, DC

Remedial Action Standards and Guidelines Applied to DOE Nuclear Energy Projects

CONF-870705; Proceedings of the Health Physics Society 32nd Annual Meeting, Salt Lake City, UT, July 5-9, 1987; Health Physics 52(Suppl. 1):S1 (1987)

A description is given of the primary remedial action standards and guidelines used by the U.S. Department of Energy (DOE), Office of Nuclear Energy in the conduct of remedial actions under the Formerly Utilized Sites Remedial Action Program (FUSRAP), the Uranium Mill Tailings Remedial Action Program (UMTRAP), and the Surplus Facilities Management Program (SFMP). Presentation of the philosophy of standards and guidelines implementation and the application of As Low As Reasonably Achievable (ALARA) principles for each of the remedial action programs highlights differences between program and site specific application. Remedial actions conducted under the

UMTRAP are guided by standards of general application and guidance for the application of supplemental standards promulgated by the U.S. Environmental Protection Agency (EPA) in March 1983, specifically for that program. Specific criteria and guidelines for a number of radionuclides encountered during preparations for remedial action under FUSRAP and SFMP for which standards and guidelines have not been established were developed by the DOE. The 100 mrem dose limit recommended by the International Commission on Radiological Protection (ICRP), standards of general application recommended by other regulatory agencies, and ALARA served to guide the process by which these standards were derived. (Auth)(DCM)

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Godlewski, N.Z.

Remedial Action Work

Nuclear News 30(3):73-76 (1987, March)

The Department of Energy's Office of Civilian Radioactive Waste Management is not the only DOE entity dealing with nuclear waste. The DOE Office of Defense Waste and Transportation Management is developing technology and facilities--most notably the Waste Isolation Pilot Plant, located in New Mexico--for the disposal of defense wastes. And the DOE's Office of Remedial Action and Waste Technology (ORAWT) covers such varied programs as mill tailings cleanup and the West Valley Demonstration Project. ORAWT reports to the DOE's Assistant Secretary for Nuclear Energy. Its three subdivisions cover uranium mill tailings projects, facility and site decommissioning projects, and waste treatment projects. (Auth)

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International Atomic Energy Agency, Vienna, Austria

Waste Management Research Abstracts No. 17

IAEA/WMRA/17 (1986)

Abstracts in this volume reflect research currently in progress in the field of radioactive waste management throughout the world. Topics covered include: low-

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intermediate-, and high-level wastes; alpha-bearing wastes; effluent discharges and their environmental impact; spent fuels, decontamination and decommissioning; disposal of nuclear wastes; and tailings. (Auth)(SET)

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Kaye, S.V., and R.O. Chester, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Dosimetry and Biophysical Transport Section: Radiological Survey Activities

ORNL-6246: Health and Safety Research Division Progress Report for the Period July 1, 1984-September 30, 1985; (pp. 16-18) (1986, January)

For this reporting period, the primary focus of work for the Radiological Survey Activities (RSA) program has been in the Department of Energy's (DOE's) Division of Facility and Site Decommissioning Projects. The RSA program has had major involvement in the Uranium Mill Tailings Remedial Action Project (UMTRAP) and the Formerly Utilized Sites Remedial Action Project (FUSRAP), and lesser involvement in the Surplus Facilities Management Project (SFMP). UMTRAP work included mobile gamma scans conducted in Edgemont, South Dakota; Salt Lake City, Utah; and Lander, Wyoming. During the past 18 months, approximately 3,000 inclusion surveys have been performed and reported to DOE/UMTRA. Recent work by the RSA/FUSRAP group has concentrated on identification and surveys to designate properties requiring remedial action in the vicinity of FUSRAP sites. Surveys have been conducted at vicinity properties at the following sites: Colonie, New York; Maywood, New Jersey; Niagara Falls Storage Site, New York; and the former Latty Avenue Storage Site, Hazelwood, Missouri. (Auth)(DCM)

549

Martz, M.K., K.H. Rea, R.W. Vocke, and R.W. Ferenbaugh, Los Alamos National Laboratory, Environmental Surveillance Group, Los Alamos, NM

Comprehensive Environmental Assessment and Response Program Confirmation and Evaluation Activities

LA-UR-86-2892; CONF-861227; Superfund '86, Proceedings of a Meeting, Washington, DC, December 1, 1986; 11 pp. (1986)

The U.S. Department of Energy Albuquerque Operations Office (DOE-AL) initiated the Comprehensive Environmental Assessment and Response Program (CEARP) to identify, evaluate, and conduct remedial actions at hazardous waste disposal and contamination sites on the eight nuclear weapons development and production installations under its jurisdiction. The CEARP is being implemented in five phases (Phase 1 - Installation Assessment; Phase 2 - Confirmation, Phase 3 - Technological Assessment; Phase 4 - Remedial Action; and Phase 5 - Compliance and Verification). During Phase 1, regulatory compliance was evaluated and disposal/contamination sites were identified. Phase 2 provides the field data for site characterization, risk assessment, determination of need for corrective action, and evaluation of possible remedial actions at hazardous waste sites. Phase 2 is being conducted in two stages (monitoring plan development/reconnaissance sampling and site characterization/remedial investigation). Problem sites across the DOE-AL complex were prioritized for site characterization, and CEARP Phase 2 activities have been initiated.

550

Oak Ridge National Laboratory, Oak Ridge, TN

Integrated Data Base for 1986: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics

DOE/RW-0006 (Rev. 2); 298 pp. (1986, September)

The information in this report summarizes the Department of Energy (DOE) data base for inventories, projections, and characteristics of domestic spent nuclear fuel and radioactive waste. This report is updated annually to keep abreast of continual changes. Baseline information is provided for planning purposes and to support program decisions. Although the primary purpose of this document is to provide background information for program planning with the DOE community, it has also been found useful by State and local Governments, the academic community, and a number of private citizens. (Auth)(DCM)

CHAPTER 8. GENERAL REMEDIAL ACTION PROGRAM STUDIES

551

Sharples, F.E., Oak Ridge National Laboratory, Oak Ridge, TN

Standards for Remedial Action: How Clean Is Clean?

CONF-870243; Proceedings of the Oak Ridge Model Conference, Oak Ridge, TN, February 3, 1987; (4 pp.) (1987, February)

The particular cleanup standards applied at a remedial action site will depend upon a variety of site-specific factors as well as which of the hazardous waste statutes is jurisdictionally applied. Parties who are currently participating in remedial action planning activities should be aware that applicable cleanup standards may be in large part open to negotiation with regulators.

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

Office of Remedial Action and Waste Technology: Program Summary

DOE/NE-0075 (1986, November)

The Office of Remedial Action and Waste Technology has two major programmatic responsibilities. The Remedial Action Program performs remedial actions to treat or stabilize radioactive wastes and to decontaminate and decommission contaminated DOE and selected nongovernment facilities as authorized by Congress. The function of the Nuclear Waste Technology Program is to conduct research and develop technologies for the treatment and immobilization of all types of civilian

radioactive wastes, to support the states and regions on low-level waste disposal issues, and to develop and transfer technology for the beneficial uses of nuclear byproducts. The programs of the Office of Remedial Action and Waste Technology are described in detail.

553

Yalcintas, M.G., B.A. Berven, M.S. Blair, and T.R. Barclay, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Automatic Recording of Joint Spatial and Radiological Data During Field Surveys: A Feasibility Study

Health Physics 49(1):125 (1985, July)

Radiological survey activities are being handled routinely by the Radiological Survey Activities Group (RSA) at Oak Ridge National Laboratory (ORNL) for the Uranium Mill Tailings Remedial Action Program (UMTRAP) and the Formerly Utilized Sites Remedial Action Program (FUSRAP). One of the major problems in conducting field surveys is the recording of the joint spatial and radiological data. A feasibility study is being performed to determine whether or not information on the location of the surveyor and the radiological information for that location can be transmitted by radio to a sensing unit located in a nearby vehicle. The vehicle unit would receive the transmitted data and store this information in digital format. The mobile unit positioning and surveying systems, as well as the software to handle the data and the method of interface will be described. Application of the system and the benefits for the radiological survey procedures are discussed. (Auth)

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APPENDIX

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Acronyms and Abbreviations

The following are acronyms and abbreviations commonly used in remedial action and radioactive waste management work.

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 Dechets 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 für Forschung und Technologie, Bonn, Federal Republic of Germany
BMI	Battelle Memorial Institute, Columbus, OH
RNF	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
BkP	Breeder Reactor Program
BFPNS	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 data base) Columbus, OH
CCE	Commission des Communautés Européennes, Brussels, Belgium
CCE	Commissione delle Comunità Europee, Ispra, Italy
CCR	Centro Comunità di Ricerca, Commissione delle Comunità Europee, Ispra, Italy
CDR	conceptual design report
CE	Combustion Engineering, Inc., Windsor, CT
CEA	Commissariat à l'Energie Atomique (France)
CEAN	Centre d'Etudes pour les Applications de l'Energie Nucleaire (Belgium)
CEC	Commission of the European Communities

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 Nazionale 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
CTPD	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 Hogskola, Institutionen for 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])
DAO	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	Délégation Générale 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
LOE-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	Eidgenossisches 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, Mcl, 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 Schifffahrt (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	Gunitite 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 Propulsion Laboratory, 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)
LMFB2	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 Research Center, U.S. National Aeronautics and Space Administration, Cleveland, OH
LSA	low specific activity
LT	long ton
LTFL	Low Temperature Fissionochemical 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 für die Lagerung Radioaktiver Abfälle, 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	Oskarshamnverkets 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 Elektrizitats-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)
SCNEOR	Societe Cooperative Nationale pour l'Entreposage de Dechets 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 pour 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 Kaernbraenslefoerserjning 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 Elektrizitätswerke 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
WNPD	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	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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563. James F. Graff, Jacobs Engineering Group, Inc.- UMTRA Program, Quality Assurance Division, 5301 Central Avenue NE, Suite 1700, Albuquerque, NM 87108
564. William C. Graham, UNC Geotech, Inc., Document Services Division, P.O. Box 14000, Grand Junction, CO 81502-5604
565. George R. Grandbouche, U.S. Department of Energy, Grand Junction Operations Office, P.O. Box 2567, Grand Junction, CO 81502

566. Robert J. Grandfield, U.S. Department of Energy, Dayton Area Office, P.O. Box 66, Miamisburg, OH 45342
567. Thomas J. Grant, EBASCO Services, Inc., Advanced Technology and Special Projects, 2 World Trade Center, 89th Floor, New York, NY 10048
568. Ken Greenwell, MK-Ferguson Company, P.O. Box 9136, 2309 Renard Place, SE #300, Albuquerque, NM 87119
569. Alan R. Gregory, Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, Gloucester, United Kingdom GL4 7RS
570. Mike Griffin, Chem-Nuclear Systems, Inc., P.O. Box 15606, 560 West Billinia, Salt Lake City, UT 84115-0606
571. Paul W. Griffin, Westinghouse Hanford Company, Decontamination and Decommissioning, P.O. Box 1970, Richland, WA 99362
572. William J. Griffing, U.S. Department of Energy, Chicago Operations, Operational and Environmental Safety Division, 9800 South Cass Avenue, Argonne, IL 60439
573. Dennis R. Haffner, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, MS F-22, Richland, WA 99362
574. Frank J. Hahne, Nuclear Assurance Corporation, 5720 Peachtree Parkway, Norcross, GA 30092
575. John B. Hall, U.S. Department of Energy, Nevada Operations Office, Health Physics and Environmental Division, P.O. Box 98618, Las Vegas, NV 89193-8618
576. Jack D. Hammond, M.K. Ferguson Company, Weldon Spring Site Remedial Action Project, Route 2, Highway 94 South, St. Charles, MO 63303
577. Nancy R. Hammond, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Mail Stop F22, Richland, WA 99362
578. David E. Harmer, IT Corporation, Nuclear Services Division, 312 Directors Drive, Knoxville, TN 37923
579. Johnny R. Harper, Los Alamos National Laboratory, Waste Management Group, P.O. Box 1663, Mail Stop E-516, Los Alamos, NM 87545
580. James M. Harris, Rockwell International, Rocketdyne Division, 6633 Canoga Avenue, T-009, Canoga Park, CA 91304
581. James W. Hartranft, Orange County Health Care Agency, Environmental Health, Radiological Health Section, P.O. Box 355, Santa Ana, CA 92702
582. Maurice I. Hawker, United Kingdom Atomic Energy Authority, Library, AEE Winfrith, Heath, Dorchester, Dorset, England, United Kingdom DT2 8DH
583. William M. Hayward, Westinghouse Hanford Company, Decontamination and Decommissioning, P.O. Box 1970, Richland, WA 99362
584. Fred F. Haywood, TMA/Eberline, Health Physics Division, P.O. Box 1040, Oak Ridge, TN 37831
585. Joseph D. Hegner, Virginia Power, Nuclear Operations Division, P.O. Box 26666, Richmond, VA 23261
586. William F. Heine, Rockwell Hanford Operations, Waste Management Program Office, P.O. Box 800, Richland, WA 99362
587. Marvin W. Henderson, Morrison-Knudsen Company, Inc., P.O. Box 9136, 2309 Renard Place, SE, #300, Albuquerque, NM 87119
588. Roy C. Hengerson, Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, MO 65102
589. Paul F. Highberger, Manager, Business Development for Government Programs, Chem-Nuclear Systems, Inc., 220 Stoneridge Drive, Suite 400, Columbia, SC 29210
590. Thomas E. Hill, Georgia Department of Human Resources, Radiological Health Section, 878 Peachtree Street, NE, Suite 600, Atlanta, GA 30309
591. Keith E. Hinds, Jacobs Engineering Group, Inc., 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
592. Kenneth B. Hinerman, Source Analysis and Evaluation Corporation, P.O. Box 5609, Rockville, MD 20855
593. Charles S. Hinson, U.S. Nuclear Regulatory Commission, NPR/DREP/RPB, Room EW/W 359, Washington, DC 20566
594. David Hoffman, Missouri Department of Natural Resources, Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401

595. Douglas W. Homer, Afftrex, Limited, Engineering Division, P.O. Box 21, Aber Road, Route 4, Finleyville, PA 15332
596. Jack Hoopes, Jacobs Engineering Group, Inc., UMTRA Project Office, 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
597. Leonard Homyak, NASA Lewis Research Center, Construction Management Branch, 21000 Brookpark Road, Cleveland, OH 44135
598. Gale K. Hovey, Bechtel National, Inc., P.O. Box 350, Oak Ridge, TN 37831
599. J. Howieson, Uranium and Nuclear Energy Branch, Energy and Mines Resources, 580 Booth Street, Ottawa, Ontario, Canada K1A 0E4
600. Fan-Yu Hsueh, Institute of Nuclear Energy Research, Library, P.O. Box 3-15, Lung-Tan, Taiwan 32500
601. Benno Huber, Commission of the European Communities, Directorate-General, Science, Research and Development, Decommissioning Program, Rue de La Loi 200, Brussels, B-1049 Belgium
602. Michael C. Hughes, Westinghouse Hanford Company, Surplus Facilities Management Division, P.O. Box 1970, Richland, WA 99352
603. Cheryl A. Hutchinson, NUMATEC, Inc., 2550 M Street, NW, Suite 400, Washington, DC 20037
604. S. Huwyler, Swiss Federal Institute for Reactor Research, Library, Wuerenlingen, CH-5303 Switzerland
605. John P. Hynes, Minnesota Environmental Quality Board, 100 Capitol Square Building, St. Paul, MN 55101
606. Thomas P. Hynes, AMOK, Limited, Environmental Section, 3125 Dieppe Street, Saskatoon, Saskatchewan, Canada S7M 3S3
607. T.E. Ingels, General Electric Company, Morris Operations Office, Nuclear Plant Services Department, 7555 East Collins Road, Morris, IL 60450
608. Clarence E. Ingersoll, Washington Department of Social and Health Services, Office of Radiation Protection, MS LE-13, Olympia, WA 98504
609. Kaoru Ito, Genjiryoku Daiko Company, Limited, Hiroshima Office, 4-19 Takara-Machi Nakaku, Hiroshima, Japan 730
610. Brent H. Ives, Lawrence Livermore National Laboratory, Plutonium Facility, P.O. Box 5808, Livermore, CA 94550
611. Mark A. Jackson, Jacobs Engineering Group, Inc., 5301 Central Avenue NE, Suite 1700, Albuquerque, NM 87108
612. Peter O. Jackson, Pacific Northwest Laboratory, Chemical Sciences Department, P.O. Box 999, Richland, WA 99352
613. Nihal D. Jayawardene, Ontario Hydro, Design and Development Division, Nuclear Materials Management, 700 University Avenue, Toronto, Ontario, Canada M5G 1X6
614. W.E. Jenkins, Canonic Environmental, 6551 South Revere Parkway, Suite 155, Englewood, CO 80111
615. Edward A. Jennrich, EG&G Idaho, Inc., National Low-Level Waste Management Program, P.O. Box 1625, Idaho Falls, ID 83415
616. Larry W. Jensen, U.S. Environmental Protection Agency, Air and Radiation Division, 230 South Dearborn, 5AR-26, Chicago, IL 60604
617. Cynthia L. Johnson, U.S. Department of Energy, Office of Remedial Action and Waste Technology, NE-20, Washington, DC 20545
618. Nels R. Johnson, TMA/Eberline, 5635 Kircher Boulevard NE, Albuquerque, NM 87109
619. Ruth H. Johnson, Babcock and Wilcox, NPD Library, P.O. Box 10935, Lynchburg, VA 24506
620. Stephen A. Johnston, Research Triangle Institute, Center for Economic Research, P.O. Box 12194, Research Triangle Park, NC 27709
621. John Jones, MK-Ferguson Company, P.O. Box 1030, Highway 396 North, Lakeview, OR 97630
622. Mark G. Jones, Bechtel National, Inc., P.O. Box 350, Oak Ridge, TN 37831-0350
623. Julie M. Jordan, NUS Corporation, Environmental Services Division, 910 Clopper Road, Gaithersburg, MD 20878
624. Michael D. Jordan, Director of Ship Refitting, United Kingdom Ministry of Defense, Foxhill, Bath, United Kingdom BA1 5AB
625. Drew G. Kachele, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 490, Richland, WA 99352

626. Myron M. Kaczmarzsky, WasteChem Corporation, Marketing Division, One Kalisa Way, Paramus, NJ 07652
627. Nancy E. Kaiser, Southern States Energy Board, Information Center, 2300 Peachford Road, Suite 1230, Atlanta, GA 30338
628. M. Kalin, Boojun Research, Limited, 139 Amelia Street, Toronto, Ontario, Canada M4X 1E6
629. Charles H. Kana, Manager, Radiological Engineering, General Electric Company, Knolls Atomic Power Laboratory, P.O. Box 1072, Building GI-101, Schenectady, NY 12301-1072
630. Joseph D. Kane, U.S. Nuclear Regulatory Commission, Low Level Waste Management and Decommissioning Division, MS 623-SS, 7915 Eastern Avenue, Silver Spring, MD 20012
631. Jeanne X. Kaspersor, Clark University, Center for Technology, Environment and Development, 950 Main Street, Worcester, MA 01610
632. Erminia U. Kauer, E.I. DuPont de Nemours and Company, Savannah River Laboratory, Budget/Library Departments, SRL Building 773A, Library, Aiken, SC 29808-0001
633. Robert F. Kaufmann, The Mark Group, Engineers and Geologists, Inc., 2300 Paseo Del Prado, D-103, Las Vegas, NV 89102
634. Vincent J. Kavlick, Fluor Daniel, Government Sales, 1627 K Street, NW, Washington, DC 20006
635. Philip D. Kearney, Colorado State University, Physics Department, Fort Collins, CO 80523
636. Harlan W. Keaton, Florida Department of Health and Rehabilitative Services, Environmental Radiation Control, P.O. Box 15490, Orlando, FL 32858
637. William N. Kellett, Central Electricity Generating Board, Operations' Engineering Division(North), Europa House, Bird Hall Lane, Cheadle Heath, Stockport, Cheshire, United Kingdom SK3 0XA
638. Larry G. Kellogg, Rockwell International, Rocketdyne Division, (LB-01) 6633 Canoga Avenue, Canoga Park, CA 91303
639. Janet L. Kelly, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Federal Building 379, Richland, WA 99352
640. Gary S. Kephart, Westinghouse Hanford Company, P.O. Box 1970, Richland, WA 99352
641. Berg Keshian, Inc., Roy F. Weston, Inc., 5301 Central Avenue NE, Suite 1000, Albuquerque, NM 87109
642. Susan B. Kintner, Chem-Nuclear Systems, Inc., Document Control Division, 220 Stoneridge Drive, Columbia, SC 29210
643. John E. Kirkpatrick, Nuclear Fuel Services, Limited, Decommissioning Department, Banner Hill Road, Erwin, TN 37650-9718
644. George E. Kirsch, Battelle, Columbus Division, Nuclear Services Section, 506 King Avenue, Building JN-2, West Jefferson, Columbus, OH 43201
645. Anthony F. Kluk, U.S. Department of Energy, Office of Defense Waste and Transportation Management, DP-124, Washington, DC 20545
646. Dale W. Koch, Babcock and Wilcox, Nuclear Power Division, SPIS, P.O. Box 10935, Lynchburg, VA 24506-0935
647. Donald L. Koch, Iowa Department of Natural Resources, Geological Survey Bureau, 123 North Capitol Street, Iowa City, IA 52242
648. Takaai Konna, Japan Atomic Energy Research Institute, Reactor Decommissioning Operation Division-1, JPDR, Tokai-mura, Naka-gun, Ibaraki-ken, 319-11, Japan
649. George J. Konzek, Sr., Pacific Northwest Laboratory, Waste Systems Department, P.O. Box 999, Sigma-2 Building, Richland, WA 99352
650. Kenneth D. Kok, Battelle, Columbus Division, Safeguards and Security Program Office, 506 King Avenue, Columbus, OH 43201
651. Kosta S. Kotti, E.I. DuPont de Nemours and Company, Inc., AED Savannah River Plant, Planning Division, 703A, E231N, Aiken, SC 29808-0001
652. Robert F. Krauel, Environment Canada, Environmental Contaminants Division, 25 St. Clair Avenue E., 7th Floor, Toronto, Ontario, Canada M4T 1M2
653. Adrian H. Krieg, A. Krieg Consulting and Trading, Inc., 119 Maplevale Drive, Woodbridge, CT 06525
654. Lloyd E. Kusler, Westinghouse Hanford Company, Chemical Processing Division, P.O. Box 1970, Richland, WA 99352
655. Akira Kutsamizu, Ohbayashi Corporation, Engineering Department, Nuclear Facilities Division, Ryumeikan Building 4, 3, 2-Chome, Kanda Surugadai, Chiyoda-ku, Tokyo, Japan

666. David K. Lacker, Texas Department of Health, Bureau of Radiation Control, 1100 West 49th Street, Austin, TX 78756
667. Thomas S. LaGuardia, TLG Engineering, Inc., Route 67, Box 237, Bridgewater, CT 06752
668. Gerard J. LaHaye, Ontario Ministry of Environment, Abatement West, 445 Albert Street East, Sault Sainte Marie, Ontario, Canada P6A 2J9
669. L.T. Lakey, Pacific Northwest Laboratory, Waste Technology Center, P.O. Box 999, Federal Building, Room 326, Richland, WA 99352
660. Roger R. Land, Bechtel National, Inc., P.O. Box 350, Oak Ridge, TN 37831-0350
661. E.R. Landa, U.S. Geological Survey-WRD, MS 432 National Center, Reston, VA 22092
662. Arthur W. Larson, Westinghouse Hanford Company, Surplus Facilities Management Division, P.O. Box 1970, Richland, WA 99352
663. Ned B. Larson, Jacobs Engineering Group, Inc., 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
664. Richard J. Laux, Missouri Department of Natural Resources, Environmental Quality Division, Water Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102
665. Susan M. Law, Jacobs Engineering Group, Inc., 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
666. Kenneth D. Lawver, U.S. Department of Energy, Weldon Spring Site Remedial Action Program, Route 2, Highway 94 South, St. Charles, MO 63303
667. J. Eric LeSurf, LN Technologies Corporation, 1925 Pine Avenue, Niagara Falls, NY 14301-2398
668. Tammy M. LeBeau, Natural Resource Analyst-Radon Program, Department of Water and Natural Resources, Joe Foss Building, Room 217, Pierre, SD 57501
669. David Lechel, Roy F. Weston, Inc., Environmental Services, 5301 Central Avenue NE, Suite 1000, Albuquerque, NM 87108
670. Sheldon Lefkowitz, Pentek, Inc., 1026 Fourth Avenue, Coraopolis, PA 15108
671. Ronald J. Lenart, Federal Energy Regulatory Commission, Office of Chief Accountant, 400 First Street, NW, Washington, DC 20426
672. Milton Levenson, Bechtel Power Corporation, 50 Beale Street, San Francisco, CA 94105
673. Leon Leventhal, TMA/Norcal, 2030 Wright Avenue, Richmond, CA 94804-0040
674. Ron Lewis, Office of Technical Services, 20251 Century Boulevard, 4th Floor, Germantown, MD 20674
675. Lawrence H. Levy, Northeast Utilities, Nuclear Engineering and Operations, P.O. Box 270, Hartford, CT 06141-0270
676. Darl R. Lewis, Jacobs Engineering Group, Inc., Engineering Division, Route 2, Highway 94 South, St. Charles, MO 63303
677. Stanley Lichtman, U.S. Environmental Protection Agency, Office of Radiation Programs, ANR-460, 401 M Street, SW, Washington, DC 20460
678. Richard C. Liebentritt, Omaha Public Power District, Engineering Division, 1623 Harney Street, Omaha, NE 68102
679. Joel M. Liederman, Atomic Energy of Canada, Limited, Canada Operations, Montreal, 1155 Metcalfe Avenue, Suite 200, Montreal, Quebec, Canada H3B 2V6
680. Alan C. Littlejohn, National Nuclear Corporation, Limited, R.J.D. Division, Warrington Road, Risley, Warrington, Cheshire, England, United Kingdom
681. Larry L. Lloyd, Chief, Occupational Health Bureau, Montana Department of Health and Environmental Sciences, Cogswell Building A-118, Helena, MT 59620
682. Dr. Lochstet, University of Pittsburgh at Johnstown, Department of Physics, Johnstown, PA 15904
683. J. Mark Loizeaux, President, Loizeaux Group International, 2737 Merrymans Road, Phoenix, MD 21131
684. Jacqueline Loop, E.I. International, Technical Information Services, P.O. Box 786, Idaho Falls, ID 83402
685. William T. Lough, Virginia State Corporation Commission, Energy Regulation Division, P.O. Box 1197, Richmond, VA 23209
686. Jon R. Luellen, Colorado Department of Health, Office of Health and Environmental Protection, 421C East 11th Avenue, Denver, CO 80220
687. Donald L. Lush, Best Consultants, Limited, Environmental Services, 6870 Goreway Drive, Mississauga, Ontario, Canada L4V 1P1

688. Patrick J.L. Lyons, Umetco Minerals Corporation, Uranium Division, P.O. Box 151, Riverton, WY 82501
689. Eli Maestas, U.S. Department of Energy, West Valley Project Office, P.O. Box 191, West Valley, NY 14171
690. Debu Majumdar, U.S. Department of Energy, Idaho Operations Office, 785 DOE Place, Idaho Falls, ID 83402
691. Hersch K. Manaktala, Westinghouse Electric Company, Nuclear Fuel Division, P.O. Box 1551, Columbia, SC 29202
692. M. Frank Manchak, Jr., President, Alternative Technologies for Waste, Inc., Remediation Division, 11300 South Norwalk Boulevard, Santa Fe Springs, CA 90670
693. John W. Mandler, EG&G Idaho, Inc., Physics Division, P.O. Box 1625, Idaho Falls, ID 83415
694. Michael J. Manetas, Humboldt State University, Environmental Resources Engineering, Arcata, California 95521
695. William J. Manion, Nuclear Energy Services, Inc., Shelter Rock Road, Danbury, CT 06810
696. Dan E. Martin, U.S. Nuclear Regulatory Commission, NNMS/LLOB, Mail Stop SS-623, Washington, DC 20555
697. Mark L. Matthews, U.S. Department of Energy, Albuquerque Operations Office, UMTRA Project Office, 5301 Central Avenue, NE, Albuquerque, NM 87108
698. Henry D. May, U.S. Environmental Protection Agency, Region VI (6T-AS), 1445 Ross Avenue, 12th Floor, Dallas, TX 75202-2733
699. Gregory D. McCabe, U.S. Environmental Protection Agency, Region VII, Superfund Branch, 726 Minnesota Avenue, Kansas City, KS 66101
700. Kevin T. A. McCarthy, Connecticut Department of Environmental Protection, Radiation Unit, 165 Capitol Avenue, Hartford, CT 06106
701. Bradley C. McClelland, Tennessee Valley Authority, Nuclear Engineering Division, 400 West Summit Hill Drive, MS W10C161, Knoxville, TN 37902
702. Michael W. McClurg, Black and Veatch Engineers-Architects, Power Division/Mechanical Department, P.O. Box 8405, 1500 Meadowlake Parkway, Kansas City, MO 64114
703. Chuck B.C. McConnel, Bechtel National, Inc., P.O. Box 350, Oak Ridge, TN 37831-0350
704. Michael W. McCoy, Pacific Northwest Laboratory, P.O. Box 999, Federal Building, Richland, WA 99352
705. Steven H. McCracken, U.S. Department of Energy, Weldon Spring Site Remedial Action Program, Route 2, Highway 94 South, St. Charles, MO 63303
706. James G. McCray, University of Arizona, Department of Nuclear and Energy Engineering, Tucson, AZ 85721
707. Brian F. McCully, U.S. Department of Energy, Office of Remedial Action and Waste Technology, NE-20, Washington, DC 20545
708. Joan K. McCurley, Black and Veatch Engineers-Architects, Industrial/Special Projects Division, P.O. Box 8405, 1500 Meadowlake Parkway, Kansas City, MO 64114
709. Ethel Quinn McDonald, Kaiser Engineers, 685 Emory Valley Road, Suite B, Oak Ridge, TN 37830
710. Frank X. McGarvey, Sybron Chemical Company, Research Division, 89 Woodbury Drive, Cherry Hill, NJ 08003
711. Richard G. McGregor, Bureau of Radiation and Medical Devices, 775 Brookfield Road, Ottawa, Ontario, Canada K1A 1C1
712. J.Dale McHard, Oklahoma State Department of Health, Radiation and Special Hazards, P.O. Box 53551, Oklahoma City, OK 73152
713. W. Jean McKenna, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Federal/Room 369/F22, Richland, WA 99352
714. Mike L. McKernan, Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, P.O. Box 323, Shippingport, PA 15077
715. John W. McKlveen, Arizona State University, College of Engineering and Applied Sciences, Tempe, AZ 85287
716. Christopher C. McLeod, Earth Image Films, P.O. Box C-151, La Honda, CA 94020
717. James T. McVey, Diversified Scientific Services, Inc., 508 North Kentucky Street, Kingston, TN 37763

718. Paul E. Melton, Mound Facility, Monsanto Research Corporation, Health Physics/Administration, P.O. Box 32, Miamisburg, OH 45342-0032
719. Richard H. Meservey, EG&G Idaho, Inc., D&D Programs, P.O. Box 1625, Idaho Falls, ID 83415
720. Ernest M. Miholits, EM2 Engineering Consultants, P.O. Box 4265, Foster City, CA 94404
721. Charles G. Miller, Bechtel National, Inc., Project Management Division, 7 Crossbow Court, Palm Coast, FL 32037
722. Clarence E. Miller, Jr., U.S. Department of Energy, Richland Operations Office, P.O. Box 550, Richland, WA 99352
723. Forest L. Miller, Jr., Desert Research Institute, Water Resources Center, 2505 Chandler Avenue, Suite 1, Las Vegas, NV 89120
724. Steven R. Miller, U.S. Department of Energy, GC-11, Washington, DC 20585
725. Doyle Mills, Kentucky Department of Environmental Protection, Maxey Flats Section, 18 Reilly Road, Frankfort, KY 40601
726. Dennis J. Mirda, Consolidated Edison of New York, Technical Support Division, 4 Irving Place, Room 1300, New York City, NY 10003
727. Adolph V. Mitterer, Union Pacific Resources, Mineral Division, P.O. Box 1257, Englewood, CO 80150-1257
728. Duncan Moffett, Eldorado Resources, Limited, 255 Albert Street, Suite 400, Ottawa, Ontario, Canada K1P 6A9
729. A. Alan Moghissi, Institute for Regulatory Science, P.O. Box 7166, Alexandria, VA 22307
730. William S. Mohr, Duratek Corporation, Marketing Department, 6411 Ivy Lane, Suite 204, Greenbelt, MD 20770
731. J.A. Mohrbacher, Quadrex Recycle Center, Regulatory Compliance, 109 Flint Road, Oak Ridge, TN 37830
732. Emmett B. Moore, Pacific Northwest Laboratory, P.O. Box 999, Federal Building, Richland, WA 99352
733. M.T. Tsai Morgan, Taiwan Power Company, Nuclear Operations Division, 242 Sec. 3, Roosevelt Road, Taipei, Taiwan, Republic of China
734. E.O. Morris, Gardiner, Inc., Environment Development Division, P.O. Box 3269, Tampa, FL 33601
735. James J. Mueller, Controls for Environmental Pollution, Inc., 1925 Rosina Street, P.O. Box 5351, Santa Fe, NM 87502
736. John B. Mulligan, United Engineers and Constructors, Inc., Nuclear Services Division, 30 South 17th Street, Philadelphia, PA 19101
737. Larry T. Murdock, Dames and Moore, 250 East Broadway, Suite 200, Salt Lake City, UT 84111-2480
738. Strat Murdock, Pathfinder Mines Corporation, Environmental Department, HC 33, P.O. Box 204, Shirley Basin, WY 82615
739. William E. Murphie, U.S. Department of Energy, Division of Facility and Site Decommissioning, NE-23, Washington, DC 20545
740. Sally L. Murphy, UNC Geotech, Inc., Document Services Division, P.O. Box 14000, Grand Junction, CO 81502-5504
741. Richard L. Murri, UNC Geotech, Inc., UMTRA Division, P.O. Box 14000, Grand Junction, CO 81502-5504
742. Bruce A. Napier, Pacific Northwest Laboratory, Earth and Environmental Science Center, P.O. Box 999, Federal Building, Richland, WA 99352
743. Marc E. Nelson, Jacobs Engineering Group, Inc., 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
744. Robert A. Nelson, Sargent and Lundy, Radiation Waste Division 30029, 55 East Monroe Street, Chicago, IL 60607
745. Rod Nelson, U.S. Department of Energy, Remedial Action Project Office, Waldon Spring Site, Route 2, Highway 94 South, St. Charles, MO 63303
746. Joseph F. Nemec, Bechtel National, Inc., RI/FS Project, P.O. Box 350, Oak Ridge, TN 37831-0350
747. Netherlands Energy Research Foundation, Netherlands Energy Research Foundation, TWI-Acquisitions Department, P.O. Box 1, 1755 ZG Petten, The Netherlands

748. Glenford A. Newtown, Jr., U.S. Department of Energy, Weldon Spring Site Remedial Action Project Office, Route 2, Highway 94 South, St. Charles, MO 63303
749. James F. Nicholas, U.S. Department of Energy, Albuquerque Operations Office, Budget and Resource Management Division, P.O. Box 5400, Albuquerque, NM 87115
750. Thomas J. Nicholson, U.S. Nuclear Regulatory Commission, Waste Management Branch, Engineering Division, MS NC-007, Washington, DC 20555
751. Ueli Niederer, Federal Office of Energy, Nuclear Safety Inspectorate, CH-5303 Wuerenlingen, Switzerland
752. Susan J. Nish, Atomic Energy of Canada Limited, Canada Operations, Montreal, Library, 1155 Metcalfe Avenue, Suite 200, Montreal, Quebec, Canada H3B 2V6
753. Robert C. Noren, G.A. Technologies, Inc., Nuclear Fuel Fabrication, P.O. Box 85608, San Diego, CA 92161
754. Soren Norrby, Swedish Nuclear Power Inspectorate, Nuclear Waste Division, P.O. Box 27106, S-10252 Stockholm, Sweden
755. Alvin W. Norwood, Sequoyah Fuels Corporation, Cimarron Facility, P.O. Box 315, Crescent, OK 73028
756. Nuclear News, 555 North Kensington, La Grange Park, IL 60525
757. Donald A. Nussbaumer, U.S. Nuclear Regulatory Commission, Office of Governmental and Public Affairs, Washington, DC 20555
758. William J. O'Brien, New York Department of Health, Bureau of Environmental Radiation Protection, 584 Delaware Avenue, Buffalo, NY 14202
759. Dennis M. O'Shea, Florida Power Corporation, Nuclear Operations Division, P.O. Box 14042, MAC-C2M, St. Petersburg, FL 33733
760. Office of Assistant Manager, U.S. Department of Energy, Energy Research and Development, P.O. Box E, Oak Ridge, TN 37831
- 761-762. Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831
- 763-767. Office of Technical Services, 20251 Century Boulevard, 4th Floor, Germantown, MD 20874
768. Kathy Muller Ogle, 6146 Kevin Avenue, Cheyenne, WY 82009
769. Won-Zin Oh, Decontamination Department, Korea Advanced Energy Research Institute, Daeduk Danji, P.O. Box 7, Daejeon, 300-31 Korea
770. James G. Oldham, MK Ferguson, P.O. Box 9136, Albuquerque, NM 87119
771. Cynthia Ortiz, U.S. Department of Energy, Nevada Operations Office, Technical Library, P.O. Box 98518, MS 505, Las Vegas, NV 89193-8518
772. Richard V. Osborne, Atomic Energy of Canada Limited, Environmental Research Branch, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada K0J 1J0
773. Osvaldo Ilari, Organisation For Economic Co-Operation and Development, Nuclear Energy Agency, Radiation Protection and Waste Management, 28 Boulevard Suchet, Paris, France 75016
774. Gerald L. Palau, Bechtel National, Inc., Advanced Technology Division, 962 Innsbruck Park, Hummelstown, PA 17036
775. Robert E. Palmer, Bechtel Eastern Power Corporation, Business Development (1C-4), 15740 Shady Grove Road, Gaithersburg, MD 20877-1454
776. Ray D. Paris, Manager, Radiation Control Section, Oregon State Health Division, 1400 SW Fifth Avenue, Portland, OR 97201
777. S. Parker, Electrical Power Research Institute, Technical Information Center, Technical Library, 3412 Hillview Avenue, Palo Alto, CA 94304
778. Frank L. Parker, Vanderbilt University, Environmental and Water Resources Engineering, P.O. Box 1596, STA. B, Nashville, TN 37235
779. Martin J. Pasqualetti, Department of Geography, Arizona State University, Tempe, AZ 85287
780. Robert S. Pattison, Rio Algom Mining Corporation, Lisbon Mine La Sal Route, Moab, UT 84532
781. Virginia H. Perkins, Wisconsin Electric Power Company, Library, 231 West Michigan, P.O. Box 2046, Milwaukee, WI 53201
782. Carl V. Peterson, U.S. Environmental Protection Agency, Region VIII, 999 18th Street, Denver Place Suite 500, Denver, CO 80202-2405

783. John M. Peterson, Argonne National Laboratory, Energy and Environmental Systems Division, 9700 South Cass Avenue, Argonne, IL 60439
784. Stephen J. Pfaff, Radiation Coordinator, Petrotonics Company, P.O. Box 8509, Shirley Basin, WY 82615
785. Henry G. Pfanner, NASA Plum Brook Station, 6100 Columbus Avenue, Sandusky, OH 44870
786. Esteban D. Picaso, Dames and Moore, West Valley Nuclear Services, Safety and Environmental Assessment, P.O. Box 191, West Valley, NY 14171
787. Paul L. Piccolo, Ecology and Environment, Inc., P.O. Box D, Buffalo, NY 14235
788. Jeffery L. Pintosch, AWARE Incorporated, Waste Management, 227 French Landing Drive, Nashville, TN 37228
789. A.M. Platt, Pacific Northwest Laboratory, Strategic Planning, P.O. Box 999, Federal Building, Richland, WA 98352
790. Anthony Playfair, Motor Columbus Consulting Engineers, Inc., Parkstrasse 27, 5401 Baden, Switzerland
791. Cindy Pollock, Worldwatch Institute, 1776 Massachusetts Avenue, NW, Washington, DC 20036
792. Charles R. Porter, U.S. Environmental Protection Agency, Eastern Environmental Radiation Facility, 1890 Federal Drive, Montgomery, AL 36109
793. Kenneth R. Porter, Dames and Moore, 1626 Cole Boulevard, Golden, CO 80401-3387
794. C.L. Potter, Saskatchewan Environment, Mines Pollution Control Branch, P.O. Box 3008, Prince Albert, Saskatchewan, Canada S6V 691
795. Robert F. Potter, UNC Geotech, Inc., Strategic Planning, P.O. Box 14000, Grand Junction, CO 81502-5504
796. Jim Powers, MK-Ferguson Company, P.O. Box 1510, 7026 County Road, #211, Durango, CO 81302
797. Robert Poyser, Pathfinder Mines Corporation, 550 California Street, San Francisco, CA 94104
798. James T. Pride, Scientific Ecology Group, Projects Division, P.O. Box 2580, Oak Ridge, TN 37831-2580
799. W.F. Quinn, Arizona Public Service Company, Licensing Department, 11226 North 23rd Avenue, Phoenix, AZ 85029
800. Phillip L. Rader, Monsanto Research Corporation, Mound Facility, P.O. Box 82, Miamisburg, OH 45342
801. Bernard G. Randolph, Dames and Moore, Project Management, 1626 Cole Boulevard, Golden, CO 80401-3387
802. William N. Rankin, E.I. DuPont de Nemours and Company, Inc., Savannah River Laboratory, Aiken, SC 29808-0001
803. Walter Rast, U.S. Geological Survey, Water Resources Division, 300 East 8th Street, Austin, TX 78701
804. Pertti T. Raty, Raty (P.T.) Engineering Limited, 51 Norden Crescent, Don Mills, Ontario, Canada M3B 1B7
805. C.L. Ray, Jr., Duke Power Company, Design Engineering Department, P.O. Box 33189, Charlotte, NC 28242
806. Joseph W. Ray, Battelle, Columbus Division, Nuclear Operations Department, 505 King Avenue, Columbus, OH 43201
807. B.K. Reaveau, Rio Algom Mining Corporation, Environmental Department, La Sal Route, Moab, UT 84532
808. Ervin L. Reed, U.S. Ecology Nuclear, Inc., Waste Management Services, 9200 Shelbyville Road, Suite 300, Louisville, KY 40222
809. John R. Reesey, Public Service Company of Colorado, Nuclear Engineering Division, 2460 West 26th Avenue, Suite 100D, Denver, CO 80211
810. Dennis W. Reisenweaver, General Dynamics Services Company, Reactor Plant Services, 14 Holmes Street, Mystic, CT 06355-2644
811. Joanne M. Reneel, Washington State Department of Ecology, Nuclear Waste Reference Center, PV-11, Olympia, WA 98504
812. Callie Ridolfi, UNC Geotech, Inc., Engineering Section, P.O. Box 14000, Grand Junction, CO 81502-5504
813. Karim Rimawi, New York Department of Health, Bureau of Environmental Radiation Protection, 2 University Plaza, 8rd Floor, Albany, NY 12237

814. Carlyle J. Roberts, Dames and Moore: West Valley Nuclear Services, P.O. Box 191, West Valley, NY 14171
815. McLouis J. Robinet, Argonne National Laboratory, OHS/HP Building 201, 9700 South Cass Avenue, Argonne, IL 60439
816. Ronald K. Robinson, Stone and Webster Engineering Corporation, Management Division, 1200 Jadwin Avenue, Suite 425, Richland, WA 99352
817. Vern C. Rogers, Rogers and Associates Engineering Corporation, P.O. Box 330, Salt Lake City, UT 84010
818. Howard A. Roitman, Colorado Department of Health, Office of Health and Environmental Protection, 4210 East 11th Avenue, Denver, CO 80220
819. Roger L. Roofthoof, LABORELEC, Section C, Rodenstraat 125, 1360 Linkebeek, Belgium
820. Richard C. Ropp, 138 Mountain Avenue, Warren, NJ 07060
821. Howard D. Rose, U.S. Environmental Protection Agency, Region IV, Uranium Recovery Field Office, P.O. Box 25325, Denver, CO 80401
822. David M. Rosenbaum, Technical Analysis Corporation, 6723 Whitter Avenue, Suite 202, McLean, VA 22207
823. John E. Ross, Teledyne Isotopes, Inc., Plum Brook Operations, P.O. Box 2304, 6100 Columbus Avenue, Sandusky, OH 44870
824. Susan M. Rush, UNC Geotech, Inc., Waste Management Programs, P.O. Box 14000, Grand Junction, CO 81502-5504
825. Jack C. Sabin, Kaiser Engineers Hanford Company, Project Management, P.O. Box 888, Richland, WA 99352
826. Christopher E. Sanchez, Anaconda Minerals Company, Reclamation and Environmental Divisions, P.O. Box 638, Grants, NM 87020
827. Ernest A. Sanchez, TMA/Eberline, Quality Assurance Division, 5635 Kircher Boulevard NE, Albuquerque, NM 87109
828. Arman Sanver, Bechtel Civil and Minerals, Inc., Engineering and Geotechnical Division, 15740 Shady Grove Road, Gaithersburg, MD 20877-1454
829. Noel F. Savignac, Noel Savignac Consultants, 2501 Yale Boulevard, #201, Albuquerque, NM 87106
830. John Sawyer, Penhall Company, Nuclear Service Division, 1801 Penhall Way, Anaheim, CA 92630
831. Jack C. Scarborough, NUS Corporation, Consulting Division, 910 Clopper Road, Gaithersburg, MD 20878
832. Walter S. Schieb, Jr., GA Technologies, Inc., Chemical Demilitarization Division, P.O. Box 85608, San Diego, CA 92138
833. Scott L. Schierman, UMETCO Minerals Corporation, Radiation Safety, P.O. Box 660, Blanding, UT 84511
834. John F. Schlatter, Bechtel National, Inc., P.O. Box 350, Oak Ridge, TN 37831-0350
835. Mary Ann Schmidt, Milwaukee School of Engineering, Walter Schroeder Library, P.O. Box 644, Milwaukee, WI 53201-0644
836. Volken W. Schneider, ALKEM GmbH, Chemistry Division, Postfach 1100 69, D 6450 Hanau 11, Federal Republic of Germany
837. Robert P. Schoenfelder, Roy F. Weston, Inc., Health and Safety Division, 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
838. Fred C. Schrag, Rockwell International, Rocketdyne Division, 6633 Canoga Avenue, MS T-020, Canoga Park, CA 91303
839. John J. Schrieber, U.S. Department of Energy, Shippingport Station Decommissioning Project Office, P.O. Box 335, Shippingport, PA 15077
840. Joseph E. Sciarro, Atlantic Electric Company, Joint Generation Projects Department, P.O. Box 1500, Pleasantville, NJ 08232
841. Jack G. Scott, Westinghouse Idaho Nuclear Company, Inc., Technical Division, P.O. Box 4000, Idaho Falls, ID 83401
842. William W. Scott, Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, P.O. Box 323, Shippingport, PA 15077
843. Michael G. Segal, Central Electricity Generating Board, Technology Planning and Research Division, Berkeley Nuclear Laboratories, Berkeley, Gloucester, England, United Kingdom GL13 9PB

844. Eugene H. Senger, Westinghouse Hanford Company, Decommissioning Program Planning Department, 5001 West Rio Grande Avenue, Kennewick, WA 99336
845. Francis W. Seymore, TLG Engineering, Inc., P.O. Box 237, Route 67, Bridgewater, CT 06752
846. Jacob Shapiro, Harvard University, Environmental Health and Safety, 46 Oxford Street, Cambridge, MA 02138
847. Helen M. Sheehy, Pennsylvania State University, Pattee Library Documents Section, Room C207-A, University Park, PA 16802
848. Dottie Sherman, American Nuclear Insurers, Library, The Exchange/Suite 245, 270 Fairmont Avenue, Farmington, CT 06032
849. James K. Shillenn, Penn State University, Nuclear Engineering Department, 231 Sackett Building, University Park, PA 16802
850. LeRoy N. Shingoitewa, Hopi Indian Tribe, UMTRA Project, P.O. Box 1229, Tuba City, AZ 86045
851. Richard E. Shinshak, Dairyland Power Cooperative, Director-Power Engineering, 2615 East Avenue South, La Crosse, WI 54602-0817
852. Richard D. Silvey, Westinghouse Hanford Company, Decontamination and Decommissioning, P.O. Box 1970, Richland, WA 99352
853. David R. Simpson, Oak Ridge Associated Universities, MERT/PTP Division, P.O. Box 117, Oak Ridge, TN 37831-0117
854. J.M. Skarpelos, General Electric Company, M.C. 783, 175 Curtner Avenue, San Jose, CA 95125
855. John A. Slaughter, U.S. Department of Energy, Construction Division, P.O. Box 550, Richland, WA 99352
856. Donald K. Slingsby, Proto Power BISCO Nuclear, Inc., 440 Williams Street, New London, CT 06320
857. Enid M. Slivka, R.W. Beck and Associates, Information Center, 2121 Fourth Avenue, Suite 600, Seattle, WA 98144
858. John P. Smalling, RMC/Canberra, Marketing Department, 3324 Pine Timbers, Johnson City, TN 37604
859. Donald L. Smith, EG&G Idaho, Inc., WMP/D&D Division, PBF-632, P.O. Box 1625, Idaho Falls, ID 83415
860. E.R. Smith, Jr., Nuclear Operations Support, Nuclear Operations, P.O. Box 26666, Richmond, VA 23261-6666
861. Edwin S. Smith, Morrison-Knudsen Engineers, Inc., Earth Sciences Division, 180 Howard Street, San Francisco, CA 94105
862. Richard I. Smith, Pacific Northwest Laboratories, Waste Systems Division, P.O. Box 999, Richland, WA 99352
863. Tokuko Smith, Nuclear Safety Research Association of Japan, P.O. Box 1307, Falls Church, VA 22041
864. Walter H. Smith, Argonne National Laboratory, SSD/HP, 9700 South Cass Avenue, Argonne, IL 60439
865. Warren D. Snell, Texas Department of Health, Bureau of Radiation Control, 1100 West 49th Street, Austin, TX 78756
866. Earl R. Sorom, Reynolds Electrical and Engineering Company, Inc., Environmental Sciences Department, P.O. Box 98521, Las Vegas, NV 89193-8521
867. William H. Spell, Louisiana Department of Environmental Quality, Nuclear Energy Division, P.O. Box 14690, Baton Rouge, LA 70898-4690
868. Scott T. Spence, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970-F22, Richland, WA 99352
869. Ralph G. Spengler, U.S. Department of the Interior, Bureau of Land Management-CO921, 2850 Youngfield Street, Lakewood, CO 80215
870. Harold L. Spiker, Kansas Department of Health and Environment, Bureau of Air Quality and Radiation Control, Forbes Field, Building 740, Topeka, KS 66620
871. Phil J. Staasi, Jacobs Engineering Group, 5301 Central Avenue, NE, Suite 1700, Albuquerque, NM 87108
872. Stuart Malcolm Stearn, H.M. Inspector of Pollution, RWP(2), 43 Marsham Street, London, England, United Kingdom SW1P3P-1
873. Robert D. Stenner, Pacific Northwest Laboratory, Earth and Environmental Science Center, P.O. Box 999, Federal Building, Richland, WA 99352

874. David A. Stewart-Smith, Oregon Department of Energy, Radioactive Materials Program Manager, 625 Marion Street NE, Salem, OR 97310
875. Keith G. Steyer, U.S. Nuclear Regulatory Commission, Engineering Division/Office of Research, 5650 Nicholson Lane, Rockville, MD 20852
876. Edwin T. Still, Kerr-McGee Corporation, Environmental and Health Management Division, P.O. Box 25861, Oklahoma City, OK 73125
877. Fred E. Stoll, EG&G Idaho, Inc., D&D Program, P.O. Box 1625, Idaho Falls, Idaho 83415
878. James C. Stouch, Dames and Moore, 7101 Wisconsin Avenue, Suite 700, Bethesda, MD 20814
879. Roland G. Strauss, Ames Laboratory, Operations Division, Iowa State University, Ames, IA 50010
880. Richard A. Suckel, WINCO, Inc., Technical Division, P.O. Box 4000, Idaho Falls, ID 83403
881. Susan A. Summers, ORNL/RASA- UMTRA, HASRD/RASA Division, P.O. Box 85, Glade Park, CO 81523
882. Charles R. Sundgren, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Fed. 394-F22, Richland, WA 99352
883. Arthur Sutherland, Rogers and Associates Engineering Corporation, 515 East 4500 South, Salt Lake City, UT 84107
884. Tim Swisse, MK-Ferguson Company, P.O. Box 15605, 560 West Billinis, Salt Lake City, UT 84115-0605
885. Gail A. Tarcza, Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Richland, WA 99352
886. Joseph E. Tarcza, Jr., Westinghouse Hanford Company, Surplus Facilities Management, P.O. Box 1970, Richland, WA 99352
887. K.K. Taylor, Long Island Lighting Company, Nuclear Engineering Department, P.O. Box 618, Wading River, NY 11792
888. Michael S. Terpilak, Nucleon Lectern Associates, 2919 Olney Sandy Spring Road, Suite D, Olney, MD 20832
889. Joseph F. Thiel, Texas Department of Health, Bureau of Radiation Control, 1100 West 49th Street, Austin, TX 78756-3189
890. James W. Thiesing, Bechtel National, Inc., Manager Technical Functions, P.O. Box 350, Oak Ridge, TN 37831-0350
891. Bruce M. Thomson, Associate Professor, Department of Civil Engineering, University of New Mexico, Albuquerque, NM 87131
892. Michael E. Thurman, Westinghouse Hanford Company, Waste and Radiological Control/Reactor Plant, P.O. Box 1970, Richland, WA 99352
893. W. John Tipton, EG&G/EM, Aerial Measurements Operation Division, P.O. Box 1912, Las Vegas, NV 89125
894. Helen K. Todosow, Brookhaven National Laboratory, Nuclear Engineering Department, Nuclear Safety Library, Building 130, Upton, NY 11973
895. Doug Tonkay, Office of Technical Services, 20251 Century Boulevard, 4th Floor, Germantown, MD 20874
896. Kinichi Torikai, Science University of Tokyo, Mechanical Engineering Department, 2641, Yamazaki, Noda, Chiba, 278, Japan
897. Gale P. Turi, U.S. Department of Energy, FUSRAP, Sr MP, NE-23, Washington, DC 20645
898. James A. Turi, U.S. Department of Energy, Division of Uranium Mill Tailings Projects, Mail Stop NE-22, GTN, Washington, DC 20645
899. Robert J. Tuttle, Rockwell International, Rocketdyne Division, Radiation and Nuclear Safety Department, 6633 Canoga Avenue, Canoga Park, CA 91303
900. Mike Usher, TLG Engineering, Inc., P.O. Box 237, Route 67, Bridgewater, CT 06752
901. Erich A. Utzinger, Aare-Tessin AG, Nuclear Department, Bahnhofquai 12, Olten, CH-4601, Switzerland
902. Garet E. Van De Steeg, Kerr-McGee Corporation, Technology Division, Technical Center, P.O. Box 25861, 3301 NW 150 Street, Oklahoma City, OK 73125
903. Luis E. Velazquez, U.S. Department of Energy, Oak Ridge Operations Office, Research and Waste Management Division, P.O. Box E, Oak Ridge, TN 37831
904. Ed L. Vincour, Allied Nuclear, Inc. 44075 Fremont Boulevard, Fremont, CA 94538
905. W. Steve Vittatoe, EG&G ORTEC, Route 9, Box 369-B, Lenoir City, TN 37771

906. Albert J. Vivyurka, Rio Algom Limited, Environmental Control Department, P.O. Box 1500, Elliot Lake, Ontario, Canada P5A 2K1
907. William R. Voigt, Jr., U.S. Department of Energy, Director, Office of Remedial Action and Waste Technology, NE-20, Washington, DC 20585
908. Frank J. Vumbaco, Nuclear Metals, Inc., Health Physics Department, 2229 Main Street, Concord, MA 01742
909. James W. Wagoner, U.S. Department of Energy, NE-23, Washington, DC 20545
910. Roger T. Waite, American Nuclear Insurers, Engineering Division, The Exchange Suite 245, 270 Farmington Avenue, Farmington, CT 06032
911. Jack R. Wakefield, United Kingdom Atomic Energy Authority, Decommissioning Group, Windscale Nuclear Laboratories, Seascale, Cumbria, United Kingdom CA20 1PF
912. Stanley J. Waligora, Jr., TMA/Eberline, 5635 Kircher Boulevard NE, Albuquerque, NM 87109
913. Charles F. Wall, EBASCO Services, Inc., 2000 15th Street North, Arlington, VA 22201
914. Daniel R. Wall, U.S. Environmental Protection Agency, Region VII, Superfund Branch, 725 Minnesota Avenue, Kansas City, KS 66101
915. John F. Wallace, Dames and Moore, 250 East Broadway, Suite 200, Salt Lake City, UT 84111-2480
916. Andrew Wallo, U.S. Department of Energy, FUSRAP Program, NE-23, Washington, DC 20545
917. John L. Warren, Los Alamos National Laboratory, HSE-7, Waste Management, P.O. Box 1663, MS E516, Los Alamos, NM 87545
918. Anna E. Wasserbachach, New York State Federation for Safe Energy, P.O. Box 2308, West Saugerties Road, Saugerties, NY 12477
919. Thurman R. Wathen, Morrison-Knudsen Engineers, Inc., Earth Science Department, 180 Howard Street, San Francisco, CA 94105
920. Chester C. Watson, Water Engineering and Technology, Inc., 419 Canyon, Suite 225, Fort Collins, CO 80521
921. Marianne N. Webb, E.I. DuPont de Nemours and Company, Savannah River Plant, Petrochemicals Department, Building 707-C, Room 334, Aiken, SC 29808-0001
922. Michael F. Weber, U.S. Nuclear Regulatory Commission, Division of Low-Level Waste Management and Decommissioning, Mail Stop 623-SS, Washington, DC 20555
923. Harriet A. Webster, Duke Power Company, Design Engineering and Research Projects Divisions, P.O. Box 33189, 525 South Church Street, Charlotte, NC 28242
924. Leopold Weil, Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, Directorate General of Nuclear Safety and Radiological Protection, Hasarenstrasse 30, 5300 Bonn 1, Federal Republic of Germany
925. Leon W. Weinberger, PEER Consultants, P.C., 1160 Rockville Pike, Rockville, MD 20852
926. Herbert Weinblatt, Jack Faucett Associates, 7300 Pearl Street, Suite 200, Bethesda, MD 20815
927. Albert A. Weinstein, S.M. Stoller Corporation, Systems Division, 1250 Broadway, New York, NY 10001
928. Carl Glen Welty, Jr., U.S. Department of Energy, Environmental Guidance and Compliance Office, EH-23, Washington, DC 20585
929. Chris Weston, MK-Ferguson Company, Route 4 Box 152C, Strangford Road, Blairsville, PA 15717
930. Duncan White, New Jersey Department of Environmental Protection, Bureau of Environmental Radiation, CN 411, Trenton, NJ 08625
931. E.R. White, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415
932. Michael C. White, Atomic Energy Control Board, Waste Management Division, P.O. Box 1046, Station B, Ottawa, Ontario, Canada K1P 5S9
933. Eric Whitehead, Atomic Weapons Research Establishment, CTD/SPT, Building A75, Aldermaston, Reading, Berks, United Kingdom RG7 4PR
934. Alan M. Wiebe, Beaver Construction, 1800 Hymus Boulevard, Dorval, Quebec, Canada H9P 2N6
935. Elmer L. Wilhite, E.I. DuPont de Nemours and Company, Savannah River Laboratory, Interim Waste Technology, Building 773-43A, Aiken, SC 29808
936. Daniel H. Williams, Arkansas Power and Light Company, Nuclear Operations Division, P.O. Box 551, Little Rock, AR 72203
937. Roger L. Williams, Jacobs Engineering Group, Inc., 5301 Central Avenue NE, Suite 1700, Albuquerque, NM 87108

938. Kenneth L. Wilson, The Earth Technology Corporation, 3777 Long Beach Boulevard, Long Beach, CA 90807
939. Margaret Wilson, U.S. Department of Energy, Oak Ridge Operations Office, Environmental Protection Division, P.O. Box E, Oak Ridge, TN 37831
940. Jerry F. Wing, U.S. Department of Energy, Oak Ridge Operations Office, Technical Services Division, P.O. Box E, Oak Ridge, TN 37831
941. Frank J. Witt, U.S. Nuclear Regulatory Commission, Nuclear Reactor Regulation Division, Mail Stop P-350, Washington, DC 20555
942. Larry A. Witt, Proto-Power/BISCO Nuclear, Inc., Engineering Division, 440 Williams Street, New London, CT 06320
943. Dayton D. Wittke, Omaha Public Power District, 1623 Harney Street, Omaha, NE 68102
944. Frank J. Wobber, U.S. Department of Energy, Gaithersburg Operations Office, 14 Goshen Court, Gaithersburg, MD 20879
945. W.C. Wolkenhaver, Washington Public Power Supply System, Nuclear Fuel Division, 3000 George Washington Way, Richland, WA 99352
946. Robert S. Wood, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, DC 20555
947. Steven R. Woodbury, U.S. Department of Energy, Environmental Compliance Division, EH-232, 1000 Independence Avenue, SW, Washington, DC 20585
948. Robert J. Woods, Chemistry Department, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 0W0
949. George C. Wu, Pacific Gas and Electric Company, Nuclear Power Generation, 77 Beale Street, San Francisco, CA 94116
950. Robert A. Wynveen, Argonne National Laboratory, OHS/HP-SSD, 9700 South Cass Avenue, Argonne, IL 60439
951. Dana J. Yaffee, Radiation Control Program, Massachusetts Department of Public Health, 150 Tremont Street, Boston, MA 02111
952. David M. Yannitell, General Electric Company, Nuclear Energy Business Operations, Advanced Nuclear Technology, P.O. Box 325, Shippingport, PA 15077
953. Brooks Yeager, Sierra Club, Washington Representative, 330 Pennsylvania Avenue, SE, Washington, DC 20003
954. Charles D. Young, The Aerospace Corporation, 955 L'Enfant Plaza, SW, Suite 7900, Washington, DC 20024
955. E.J. Youngling, Manager, Nuclear Engineering Department, Long Island Lighting Company, Shoreham Nuclear Power Station, P.O. Box 618, North Country Road, Wading River, NY 11792
956. Charley Yu, Argonne National Laboratory, 9700 South Cass Avenue, EES/362, Argonne, IL 60439
957. Yuchien Yuan, Argonne National Laboratory, EES/362, 9700 South Cass Avenue, Argonne, IL 60439
958. James G. Yusko, Pennsylvania Department of Environmental Resources, Bureau of Radiation Protection, 121 South Highland Avenue, Pittsburgh, PA 15206-3988
959. Paul L. Ziemer, Purdue University, School of Health Sciences, R.E. Heine Pharmacy Building, West Lafayette, IN 47907
960. Wolfgang Zimmerman, Kernforschungszentrum Karlsruhe GmbH, Projektbereich Anlagen-KKN, Postfach 3640, D7500 Karlsruhe, Federal Republic of Germany