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Health and Safety Research Division

**NUCLEAR FACILITY DECOMMISSIONING
AND
SITE REMEDIAL ACTIONS**

**A SELECTED BIBLIOGRAPHY
Volume 9**

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Remedial Action Program Information Center
Information Research and Analysis

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ABSTRACT

The 604 abstracted references on nuclear facility decommissioning, uranium mill tailings management, and site remedial actions constitute the ninth 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 programs. Major sections are (1) Surplus Facilities Management Program, (2) Nuclear Facilities Decommissioning, (3) Formerly Utilized Sites Remedial Action Program, (4) Facilities Contaminated with Naturally Occurring Radioisotopes, (5) Uranium Mill Tailings Remedial Action Program, (6) Uranium Mill Tailings Management, (7) Technical Measurements Center, and (8) General Remedial Action Program Studies. Subsections for sections 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.

This report is a product of the Remedial Action Program Information Center (RAPIC), which selects and analyzes information on remedial actions and relevant radioactive waste management technologies. 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
 - Weston (Roy F.), Inc.
 - H&R Technical Associates, Inc.
- **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, Inc.

RAPIC, which is part of the Information Research and Analysis section, Health and Safety Research 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 604 abstracted references constitute the ninth 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 sections: 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) section 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 section 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) section 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 section 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) section 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 section 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) section lists reports published by TMC, Grand Junction, Colorado, on the subject of detection and measurement of radioactive/hazardous contaminants, instrument calibration, and field calibration facilities.

The section 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 sections 1, 2, 5 and 6, they have been subdivided into the following subsections: 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 subsections mentioned are not necessarily contained in each of the four

primary sections listed above, only those subsections 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*, *tailings*, etc.). 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 section 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 section 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, NaIO₃ (for example) means NaIO₃.
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

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 fields 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:

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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

⁶**Incorporating 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

SURPLUS FACILITIES MANAGEMENT PROGRAM

- **Design, Planning, and Regulations**
- **Environmental Studies and Site Surveys**
- **Decortamination Studies**
- **Dismantlement and Demolition**
- **Waste Disposal**
- **Remedial Action Experience**
- **General Studies**

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1

Work on Schedule for 1990 Completion at Shippingport

Nuclear Engineering International 32(399):50 (1987, October)

The Shippingport reactor in Pennsylvania will be the first large-scale commercial nuclear power plant to be completely decommissioned following a long history of operation. The significant objectives of the decommissioning project are: (1) to demonstrate safe, cost effective dismantlement of a large scale nuclear power plant; (2) to provide useful data for future similar decommissioning projects by way of a technology transfer program; and (3) to unconditionally release the site for future productive use. The reactor pressure vessel (RPV) and the neutron shield tank (NST) are to be removed as one piece. So far, the removal of components from the containment chamber has been complete, and the RPV has been filled with concrete. Removal of the RPV/NST package is expected to take place in the fall of 1988.

2

Briggs, P.M., General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

A Quality Assurance Program for Decommissioning

DOE/SSDP-0032; Proceedings of the Pittsburgh Quality Conference, Monroeville, PA, April 15, 1988; (4 pp.) (1986, October 28 ?)

This report outlines the Quality Assurance Program established for the U.S. Department of Energy Shippingport Station Decommissioning Project (SSDP). The Shippingport Station is the first full-sized commercial nuclear power plant to be decommissioned. The program was designed to provide monitoring of subcontractor work, radiation safety monitoring, detailed planning, inspection and auditing, and operated with a minimum of personnel.

3

Brown, B.W., D.L. Crandall, R.E. Dafoe, M.R. Dolenc, and D.M. LaRue, EG&G Idaho, Inc., Idaho Falls, ID

Functional and Operational Design Requirements for Decontamination and Decommissioning of the EBR-I Mark-II NaK: Final Report - NaK Eutectics

EGG-WM-7264; 74 pp. (1987, September)

Approximately 180 gal of sodium/potassium (NaK) eutectic liquid metal were severely radioactively contaminated during a meltdown of the Mark-II core of the Experimental Breeder Reactor-I (EBR-I) in November 1955. This contaminated NaK, which is contained in four vessels, is currently stored in an underground bunker located at the Army Reentry Vehicle Facility Site (ARVFS) located approximately at the center of the Idaho National Engineering Laboratory (INEL). This document presents the Functional and Operational Requirements (F and ORs) for the decontamination and decommissioning (D&D) of the contaminated NaK and the ARVFS bunker site. This project plans to chemically deactivate the NaK; dispose of the radioactively contaminated product at a designated burial site; chemically deactivate any residual NaK in the containers, and dispose of the containers at a designated burial site; decontaminate and decommission any contaminated process equipment used in these operations; and decontaminate and decommission the ARVFS bunker site. Completion of the above technical objectives will allow for the effective disposition of the NaK, and will return the ARVFS bunker and immediate area to a reusable condition. Upon completion, the ARVFS NaK, which is now considered a significant potential hazard, will be removed from the Surplus Facilities Management Program priority listing of projects.

4

Burwinkle, T.W., L.E. Stratton, and T.E. Myrick, Oak Ridge National Laboratory, Oak Ridge, TN

The ORNL Surplus Facilities Management Program Long-Range Plan, Revision 1

ORNL/TM-8957/R1; 156 pp. (1987, June)

The Surplus Facilities Management Program (SFMP) at Oak Ridge National Laboratory (ORNL) is part of the Department of Energy's national civilian and defense SFMPs. This program was established to provide for the management of DOE's surplus radioactively contaminated facilities from the end of their operating life until

SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

final facility disposition is completed. As part of this program, the ORNL SFMP oversees some 75 individual surplus facilities ranging from abandoned waste storage tanks to large experimental reactors. The ORNL SFMP has prepared a long-range plan (ORNL/TM-8957) and this update (ORNL/TM-9957/R1) to outline the long-term management strategy for those facilities included in the program. The primary objectives of these plans are to: (1) maintain a current base of information for each ORNL SFMP facility; (2) update preliminary decommissioning analyses to identify feasible alternatives; (3) discuss the regulations applicable to ORNL; (4) describe ORNL waste management practices; (5) update the priority list for the decommissioning projects; and (6) integrate the individual project costs and schedules into an overall program schedule and cost estimate for the ORNL site. The long range plans also provide an overview of the ORNL SFMP management structure and identify special technical problems, research and development needs, and special facilities and equipment that may be required for decommissioning operations. As detailed in this plan, final disposition of the current inventory of surplus ORNL facilities will require on the order of 18 years of dedicated operation. Resource requirements in support of the defense program are expected to increase significantly within the next five years to support high priority decommissioning projects including waste tanks and other underground structures. Requirements for the civilian program will similarly increase to support phased decommissioning of experimental reactors. Total estimated costs (FY 1988 dollars) for decommissioning defense and civilian facilities are \$67 million and \$74 million respectively, including maintenance and surveillance support for facilities awaiting decommissioning. Continuation of work beyond the scheduled endpoint would be dependent upon the availability of funds and the addition of projects during the interim. The waste volume projections for the program point to the significant impacts that decommissioning activities will have on the ORNL waste disposal systems during this period and account for much of the cost increase since the previous long-range plan was issued. Although the annual waste generation rates are not expected to result in any major disruptions of routine activities, the total volume of solid waste (23,000 cubic meters) represents a significant allocation of the available on-site storage and disposal space. Because the long-range plan and this update represent the ORNL SFMP management strategy for site decontamination, routine updating will be necessary in order to reflect changing program guidance, regulatory requirements, management philosophy, project priorities, and resource availability. As decommissioning projects are completed

and as surplus facilities are added to the program, significant alterations in program direction can be expected.

5

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

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

ORNL/TM-10268; 141 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 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&S) programs established for each site. This report has been prepared to provide this documentation for those facilities included in the ORNL SFMP.

6

Eger, K.J., M.J. Gulgoul, and J.B. Carr, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Implementation of Site Release Criteria at Shippingport

DOE/SSDP-0040; (Preprint, 4 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 76-78); Transactions of the American Nuclear Society 56:76-78 (1988)

This report discusses the "Final Consolidated Implementation Plan". The plan was developed by the decommissioning operations contractor for Shippingport

SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

Atomic Power Station Site and will be used concurrently with the decommissioning operations to demonstrate that the site and materials left following decommissioning meet the criteria for the unconditional release. The proposed steps are arranged in a flow diagram which will be initiated individually for each distinct concrete structure at the facility. After the concrete work is completed, the methodology will be applied singularly for the site soil.

7

Eger, K.J., R.J. Giordano, D.L. Gardner, and M.J. Gulgoul, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Establishment of Criteria for the Unconditional Release of the Shippingport Atomic Power Station Site

DOE/SSDP-0024; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. 11.48-11.64) (1987)

The Shippingport Atomic Power Station is the first major remedial action project where the residual radioactivity will not be uranium daughter products. Therefore, new site specific limits have to be specified beyond those generic promulgated values in U.S. Department of Energy guidelines. This paper describes the key elements that have led to the specification of the site release criteria for the Shippingport site. These elements include the initial site characterization, the radiological conditions found, and the application of the DOE document, "A Manual for Implementing Residual Radioactivity Guidelines." The direct recommendation of release limits is discussed as an alternative to basing the limits on a cost benefit basis. However, the paper shows that both the direct recommendation and the cost benefit analysis were important in defining the final release criteria. Finally, the release limits are defined and a proposed plan for implementing them is presented. The work emphasizes the development of a procedure which will: (1) consider the cost of postulated remedial actions, and (2) employ an appropriate number of scenarios to demonstrate compliance with applicable limits and the ALARA philosophy.

8

Griffin, P.W., Kaiser Engineers Hanford Company, Richland, WA

Decommissioning Conceptual Study: In Situ Decommissioning of Eight 105 Reactor Buildings in the 100 Areas

UNI-2898 (Rev.); 204 pp. (1987, March)

Eight deactivated production reactors on the Hanford Site will be decommissioned. This decommissioning conceptual study report is based on performing the decommissioning with the recommended preferred method (in situ). Final selection of the method of decommissioning is dependent upon the completion of the national Environmental Policy Act (NEPA) process. For the purpose of estimating this effort, it is assumed that the work will be done as follows: UNC Nuclear Industries Decommissioning Operations will do the radiological characterization, all decontamination and decommissioning nonexplosive destruction, fixing of contaminants, and void filling; an off-site explosives contractor will assist in destruction of some concrete walls; and a large scale earth-moving contractor will construct the burial mound. Before demolition, loose contamination will be stabilized. Building walls and ceilings will be safely and cost-effectively demolished using a wrecking ball and/or explosives. Most of the reinforced concrete walls that reside within the berm envelope will be retained. The rubble will be spread and left as fill. After demolition and void filling is completed, an off-site contractor will mound over the entire building with earth and gravel to extend a minimum of 16 ft above the reactor block. The mound will be seeded to establish plant growth which will minimize run-off erosion, and promote transpiration of precipitation. The depth of the mound will be sufficient so that precipitation penetration will be negligible thereby reducing the potential for radionuclide transport down into the water table. The total estimated cost of this project, including escalation, contingency, and engineering, is \$42,760,000, and is estimated to take 5 years to complete. The project funding is scheduled to commence with capital equipment procurement and design in the first quarter of FY 1987.

9

Hammond, J., MK-Ferguson Company, St. Charles, MO

SURPLUS FACILITIES MANAGEMENT PROGRAM DESIGN, PLANNING, AND REGULATIONS

Weldon Spring Site Remedial Action Project Startup - Project Management Contractor's Point of View

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 105-149) (1987)

The project management viewpoint of the Weldon Spring Site remedial action project is summarized. The strategy, organization, and chronology of operations are presented by view graphs and numerous detailed figures. Chemically and radioactively contaminated areas, proposed sampling, and monitoring locations are identified. These details are supplemented by photographs of present on-site conditions.

10

Kocher, D.C., Oak Ridge National Laboratory, Oak Ridge, TN

Regulatory and Institutional Issues for Development of Remedial Action Strategies at ORNL

CONF-880201; Waste Management '88: Symposium on Radioactive Waste Management, Tucson, AZ, February 26, 1988; (17 pp.) (1988)

This paper discusses a number of unresolved regulatory and institutional issues of fundamental importance to the development of strategies for cleanup of sites contaminated by the radioactive materials at Oak Ridge National Laboratory. These issues include: the development of criteria for limiting radiation exposures of the public from remedial action sites; the time period to be assumed for active institutional controls over contaminated sites and the location at which such controls will be maintained; and the applicability of current standards for radioactivity in drinking water to surface waters and groundwaters on the Oak Ridge Reservation. Proposals for resolution of these issues emphasize the need to protect public health, but in a cost-effective manner.

11

Kocher, D.C., and J.R. Trabalka, Oak Ridge National Laboratory, Oak Ridge, TN

Issues in Prioritization for Remedial Action at ORNL

CONF-870859; Proceedings of the Ninth Annual Participants' Information Meeting of the DOE Low-Level Waste Management Program, Denver, CO, August 25-27, 1987; (6 pp.) (1987)

A primary goal of the remedial action program at Oak Ridge National Laboratory (ORNL) is to effect closure of existing sites contaminated by radioactive material so that public health will be protected now and in the future. An important aspect of planning for remedial action is assessing programmatic priorities. Two types of remedial actions are: (1) the imposition of institutional controls over contaminated sites; and (2) cleanup and closure of sites to an extent sufficient to ensure protection of public health in the absence of institutional controls. Current efforts in prioritizing remedial action sites at ORNL have focused principally on identifying broad issues that must be addressed in developing remedial action strategies. This paper briefly discusses the regulatory and institutional issues of importance to the development of remedial action strategies. A preliminary assessment of radiation doses associated with current levels of radioactivity at contaminated sites and their environs is discussed. This can provide useful information on the need for and most appropriate types of remedial action. Data and modeling needs for prioritization and their relationship to different options for program planning are also presented.

12

Nyquist, J.E., and C.F. Baes, Oak Ridge National Laboratory, Oak Ridge, TN

Allowable Residual Contamination Levels of Radionuclides in Soil from Pathway Analysis

CONF-871075; Waste Problems, Proceedings of the Third Oak Ridge Model Conference, Oak Ridge, TN, October 13-16, 1987; (pp. 333-350) (1987)

The uncertainty regarding radionuclide distributions among Remedial Action Program (RAP) sites and long-term decommissioning and closure options for these sites requires a flexible approach capable of handling different levels of contamination, dose limits, and closure scenarios.

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ios. We identified a commercially available pathway analysis model, DECOM, which had been used previously in support of remedial activities involving contaminated soil at the Savannah River Plant. The DECOM computer code, which estimates concentrations of radionuclides uniformly distributed in soil that correspond to an annual effective dose equivalent, is written in BASIC and runs on an IBM PC or compatible microcomputer. We obtained the latest version of DECOM and modified it to make it more user friendly and applicable to the Oak Ridge National Laboratory (ORNL) RAP. Some modifications involved changes in default parameters or changes in models based on approaches used by the EPA in regulating remedial actions for hazardous substances. We created a version of DECOM as a LOTUS spreadsheet, using the same models as the BASIC version of DECOM. We discuss the specific modeling approaches taken, the regulatory framework that guided our efforts, the strengths and limitations of each approach, and areas for improvement. We also demonstrate how the LOTUS version of DECOM can be applied to specific problems that may be encountered during ORNL RAP activities.

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Podmajersky, O.E., General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Scheduling for Decommissioning Projects

DOE/SSDP-0026; CONF-871018; Decommissioning. G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.24-II.30) (1987)

The Project Scheduling System being employed by the Decommissioning Operations Contractor at the Shippingport Station Decommissioning Project (SSDP) is described. Results from the planning system show that the project continues to achieve its cost and schedule goals. Initial technical, cost, and schedule baseline guidance was issued for the project in the Decommissioning Plan, September 1983. An integrated cost and schedule control system (C/SCS) which uses the concept of earned value for measurement of performance was instituted in accordance with Department of Energy orders. The schedule and cost variances generated by the C/SCS system are used to confirm management's assessment of project status. The types of schedules and tools used on

the SSDP to plan and monitor the work are described, and the factors that are unique to a decommissioning project and that make scheduling critical to the achievement of the project goals are identified.

14

Trabalka, J.R., Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN

Developing a Strategy and Closure Criteria for Radioactive and Mixed Waste Sites in the ORNL Remedial Action Program: Regulatory Interface

ORNL/TM-10228; ESD-2799; 106 pp. (1986, September)

Some options for stabilization and treatment of contaminated sites can theoretically provide a "once and for all" solution, e.g. by removing or destroying contaminants. Most realizable options, however, leave contaminants in place (in situ), potentially isolated by physical or chemical, but more typically, by hydrologic measures. As a result of the dynamic nature and interactions of contaminants, remedial measures, and the environment, in situ stabilization actions are likely to have limited life spans, and maintenance and monitoring of performance becomes an essential part of the scheme. The need for monitoring (and maintenance) should not be perceived as casting doubt on the effectiveness of the selected option, but, rather, as a reflection of current reality. Future technology advancements will depend in large part on the ability to recognize the limitations of existing techniques to deal with contaminated sites. Site closure actions must be affordable, and funding should take into account the need for a phased approach. A program of the magnitude currently envisioned for the ORNL site will probably require a structured federal financing effort, covering a period of decades for planning, technology development, implementation and evaluation, and of centuries for necessary follow up activities such as monitoring and maintenance. The length of formal institutional control over the site and related questions of future uses of the land and waters are thus of paramount importance. Unique features of the ORNL site and environs appear to be key ingredients in achieving the very long-term institutional control necessary for successful financing and implementation of in situ stabilization. The key issue is whether the principal performance objective for site closure actions (and regu-

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tations), long-term protection of human health and the environment, can be met using in situ approaches. Regulatory requirements and standards for stabilization and closure are currently complete, uncertain, and to some extent negotiable, making it difficult to judge their applicability to the unique and complex characteristics of ORNL site conditions. Thus, an inescapable conclusion is that some formal regulatory interface is necessary to ensure that regulatory limitations and new guidance which can affect Program planning and implementation are communicated to ORNL staff. Also, potential technical and financial limitations which could impact schedules or alternatives for achievement of long-term site stabilization and the capability to meet environmental regulations must be provided to regulatory bodies as early as possible. Such an interface should allow decisions on closure criteria to be based primarily on technical merit and "protection of human health and the environment". A plan for interfacing with regulatory staff from DOE/EPA, and the State of Tennessee is described.

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Trabalka, J.R., and T.E. Myrick, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN; Oak Ridge National Laboratory, Operations Division, Oak Ridge, TN

ORNL Remedial Action Program Strategy and Long-Range Planning (FY 1986-FY 1991)

ORNL/TM-10244(86); 240 pp. (1986, September)

The Oak Ridge National Laboratory (ORNL) Remedial Action Program represents a comprehensive effort to meet new regulatory requirements and ensure adequate protection of on-site workers, the public, and the environment by providing appropriate corrective measures at over 100 sites contaminated with radioactive, mixed, or hazardous chemical wastes. A structured path of program planning, site characterization, alternatives assessment, technology development, engineering design, continued site maintenance and surveillance, interim corrective action, and eventual site closure or decommissioning is required to meet these objectives. The site closure/decommissioning phase is designed to provide long-term containment of residual contaminants by placing each site into a "permanently" stabilized state, requiring only periodic monitoring and minimal

maintenance to ensure proper performance in protecting human health and environment. The complexity of the ORNL environment, the great diversity and number of remedial action sites, and the magnitude of current projections of overall resources needed for completion of remedial measures dictated that a comprehensive effort be established to guide necessary actions. These actions include closure criteria development and the most efficient application of available resources. The initial Remedial Action Program strategy, documented in the Preliminary ORNL Long-Range Environmental Management Plan, was designed to identify, characterize, and address a group of high-priority sites, deferring major actions on lower-priority sites until additional information and resources became available. Recent information, including new regulatory guidance under the corrective action requirements of the Resource Conservation and Recovery Act, has dictated a change in strategy in order to provide earlier characterization and assessment of all sites. The program is now focused primarily on the thorough site decommissioning/closure. The long-term program remains unchanged and is oriented toward the concepts of in situ stabilization and facility decontamination for reuse. This report documents the evolution of the Remedial Action Program as a result of information generated through its assessment, characterization, and strategy development activities and regulatory interface. It provides recommendations for a comprehensive, long-term strategy, consistent with existing technical, institutional, and regulatory information, along with a five-year plan for achieving its initial objectives.

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Trabalka, J.R., and T.E. Myrick, Oak Ridge National Laboratory, Oak Ridge, TN

ORNL Remedial Action Program Strategy (FY 1987-FY 1992)

ORNL/TM-10244; ESD-2812; 113 pp. (1987, December)

Over 40 years of Oak Ridge National Laboratory (ORNL) operations have produced a diverse legacy of contaminated inactive facilities, research areas, and waste disposal areas that are potential candidates for remedial action. The ORNL Remedial Action Program (RAP) represents a comprehensive effort to meet new regulatory requirements and ensure adequate protection of on-site workers, the public, and the environment by providing appropriate corrective measures at over 130

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sites contaminated historically with radioactive, hazardous chemical, or mixed wastes. A structured path of program planning, site characterization, alternative assessment, technology development, engineering design, continued site maintenance and surveillance, interim corrective action, and eventual site closure or decommissioning is required to meet these objectives. This report documents the development of the Remedial Action Program, through its preliminary characterization, regulatory interface, and strategy development activities. It provides recommendations for a comprehensive, long-term strategy consistent with existing technical, institutional, and regulatory information, along with a six-year plan for achieving its initial objectives.

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Trabalka, J.R., and T.E. Myrick, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN; Oak Ridge National Laboratory, Operations Division, Oak Ridge, TN

ORNL Remedial Action Program Strategy (FY 1987-1992)

ORNL/TM-10244; 114 pp. (1987, April)

Over 40 years of Oak Ridge National Laboratory (ORNL) operations have produced a diverse legacy of contaminated inactive facilities, research areas, and waste disposal areas that are potential candidates for remedial action. The ORNL Remedial Action Program (RAP) represents a comprehensive effort to meet new regulatory requirements and ensure adequate protection of on-site workers, the public, and the environment by providing appropriate corrective measures at over 130 sites contaminated historically with radioactive, hazardous chemical, or mixed wastes. A structured path of program planning, site characterization, alternatives assessment, technology development, engineering design, continued site maintenance and surveillance, interim corrective action, and eventual site closure or decommissioning is required to meet these objectives. This report documents the development of the Remedial Action Program through its preliminary characterization, regulatory interface, and strategy development activities. It provides recommendations for a comprehensive, long-term strategy, consistent with existing technical, institutional, and regulatory information, along with a five-year plan for achieving its initial objectives.

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Van Sickle, G.E., Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Licensing and Regulatory Process for the Shipment of the Shippingport RPV Package

DOE/SSDP-0036; Spectrum '88: Nuclear and Hazardous Waste Management, Proceedings of the International Topical Meeting, Pasco, WA, September 11-15, 1988; (Preprint, 6 pp.) (1988, September 11-15)

The disposal of radioactive components is a major consideration in the decontamination process of a nuclear power station. At the Shippingport Station Decommissioning Project (SSDP) the irradiated hardware was essentially confined to those components that were part of the reactor. This made it practical to transport and dispose of the complete reactor vessel and its shielding as a single package. After packaging, the Reactor Pressure Vessel (RPV) will be transported by barge to Richland, Washington. Due to the unique approach of this shipment method, few regulations exist that are applicable. This required extensive testing of the containment vessel. Whereas this approach promises to be an economic and practical means of removing contaminated material for decommissioning, a reasonable and efficient regulatory approach is lacking.

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Voorhees, L.D., and R.E. Saylor, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN; Oak Ridge National Laboratory, Energy Division, Oak Ridge, TN

Preliminary Analysis of Environmental Regulations Related to Remedial Action Activities at the Oak Ridge National Laboratory

ORNL/TM-9996; ESD-2695; 105 pp. (1986, November)

Past research and development activities at Oak Ridge National Laboratory (ORNL) have resulted in the presence of several areas where low-level radioactive and/or hazardous waste have been disposed of or that have been

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contaminated through accidental spills or planned releases of radionuclides. Although these areas have been monitored and controlled to ensure that on-site and off-site releases of contaminants are within applicable Department of Energy (DOE) guidelines, ORNL established the Environmental Restoration and Facilities Upgrade (ERFU) Program to address formally the immediate and long-range needs of meeting all applicable federal and state regulations regarding waste disposal. The environmental laws, regulations, and DOE Orders governing the cleanup activities are numerous and complex. Hence, a synthesis of the principal regulations related to the ERFU Program is presented to facilitate efficient planning for characterization and cleanup of contaminated sites. Because of regulatory decisions made after this report was finalized, several statements presented herein may no longer apply to the ERFU Program. Nevertheless, the report is issued as originally written so that ORNL's early planning efforts to comply with environmental laws and legislation are formally documented. Several general principles which would be of use to others who must comply with legislation related to the cleanup of sites contaminated with radionuclides and hazardous chemicals are also discussed. It is important to consider these principles when developing a plan for environmental compliance.

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Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, ID

Idaho Chemical Processing Plant's Radioactive Waste Management Program - Annual Summary, 1986: Environmental Engineering Subsection

WINCO-1040; 137 pp. (1986, August)

The U.S. Department of Energy (DOE) Order 5820.2, "Radioactive Waste Management," establishes policies and guidelines for managing its radioactive waste, waste products, and radioactively contaminated surplus facilities. The order requires that field office managers document detailed radioactive waste management practices and procedures that apply to all operations at their respective sites and prepare annual updates of Waste Management Programs for all operations under their cognizance. As a major operating contractor to the DOE-ID Operations Office at the Idaho National Engineering Laboratory, Westinghouse Idaho Nuclear Company, Inc. (WINCO) operates the Idaho Chemical Processing Plant (ICPP) which generates, stores, and treats radioactive waste. All of WINCO's waste management activities are performed under a series of programs and procedures which implement DOE, federal, state, and local laws, regulations, and guidelines for waste management. The purpose of WINCO's Waste Management program is to: (1) develop radioactive waste generation, packaging, transportation, storage, treatment, and monitoring activities at the ICPP facility; (2) develop appropriate administration of ICPP's radioactive contaminated surplus facilities; and (3) report on the status of compliance of WINCO's Waste Management policies with the requirements of DOE Order 5820.2.

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

A Survey Plan for the Radiological Characterization of the Weldon Spring Quarry, Weldon Spring, Missouri

DOE/OR/20722-47; 18 pp. (1984, October)

This survey plan describes the measurements and analyses needed to characterize the current radiological and chemical status of the Weldon Spring Quarry (WSQ) to facilitate planning the remedial action for this site. Particular attention will be given to locating the boundaries of surface and subsurface radioactive contamination and obtaining data to determine the feasibility of removing the contaminated material from the bottom of the quarry pond. In addition to a general description, the plan includes details of the measurement grid system, radiological survey measurements to be taken, soil sampling and analysis, water and sediment sampling and analysis, and background measurements and sampling procedures.

22

Bechtel National, Inc., Oak Ridge, TN

Niagara Falls Storage Site Annual Site Environmental Report, Lewiston, New York - Calendar Year 1987

DOE/OR/20722-197; 82 pp. (1988, April)

The environmental monitoring program was continued during 1987 at the Niagara Falls Storage Site (NFSS), a U.S. Department of Energy (DOE) surplus facility located in Niagara County, New York. The facility is presently used for the interim storage of radioactive residues, contaminated soils, and rubble. 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 DOE radiation protection standards 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 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 19 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 1987 monitoring show that the NFSS is in compliance with DOE radiation protection standards.

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Hoffman, D., Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, MO

Shallow Groundwater Investigations at Weldon Spring, Missouri: Status Report

DOE/OR/21755-T1; 2 pp. (1988, April 29)

All work elements of the proposed investigation have been initiated. The schedule has been pushed back to compensate for the four month difference between the proposed starting date and the actual awarding of the grant. Following is a summary of the status of each work element. A review of existing reports has been conducted to locate information on the physical characteristics of the soil and bedrock units and the shallow bedrock aquifer. This review process will continue as new reports are released and copies of old reports are found.

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Huber, L.A., W.G. Holmes, R.V. Simmons, and I.W. Marine, Savannah River Laboratory, Aiken, SC

Ford Building Waste Site: Environmental Information Document

DPST-85-708; 51 pp. (1987, March)

The Ford Building Waste Site is located north of the Ford Building in the Central Shops Area of the Savannah River Plant (SRP). Evidence indicates that work with potential for radioactive contamination was performed in the area and that the protective clothing worn by the personnel was disposed of at the site. The closure options

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considered for the Ford Building Waste Site are waste removal and closure, no waste removal and closure, and no action. No human health risk calculations were performed for this site because no materials disposed at the site were identified as presenting a health or environmental risk. A cost analysis, proposed for each closure option, shows that the removal of surface soils from the Ford Building Waste Site and disposal in a waste storage/disposal facility is more expensive than site maintenance and monitoring under the other two options.

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Jones, M.G., C.R. Johnson, and J.A. Blanke, Bechtel National, Inc., Oak Ridge, TN

Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure, Lewiston, New York - Calendar Year 1986

DOE/OR/20722-159; 56 pp. (1987, July)

A performance monitoring system has been developed for the Niagara Falls Storage Site (NFSS) Waste Containment Structure, which contains the soils contaminated with residual radioactive materials, rubble, and radioactive residues removed from various areas of the NFSS and vicinity properties during remedial action conducted by the Department of Energy (DOE) from 1982 through 1986. The design and construction of the containment structure and the post-closure activities have been previously documented. The purpose of the performance monitoring system is to verify that the Waste Containment Structure's main engineering elements are functioning to minimize infiltration of rainfall, prevent pollution of groundwater, preclude formation of leachate, and prevent radon emission. This report presents the findings of performance monitoring conducted at the Waste Containment Structure during the calendar year 1986 to establish the base data for comparing future monitoring cycles.

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Kirsch, G.E., Battelle Memorial Institute, Columbus, OH

Annual Survey of the Retired Piqua Nuclear Power Facility

DOE/CH/10335-1; 27 pp. (1988, January)

The annual environmental radiological survey of the retired Piqua Nuclear Power Facility was performed. The radiation survey was performed on site. Samples were also collected for analyses at the Battelle West Jefferson radiochemistry laboratory. Samples collected included area smears (to be counted for removable surface contamination), tap water, a sump water sample, a sump sludge sample, and soil samples from the ground area adjacent to the facility. Additional analyses performed for these media are described in the survey specifications. Smears, air samples, and water samples which were collected and analyzed for tritium are also described in the survey specifications. The results of the analyses indicate that no significant change over past years' surveys has occurred, and that all criteria for release of the Piqua facility are met.

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Kuhaida, A.J., and D.P. Carnes, Bechtel National, Inc., Gaithersburg, MD

Environmental Monitoring of the DOE- Owned Surplus Facility Weldon Spring Site (WSS)

Proceedings of the American Public Health Association 111th Annual Meeting, Radiological Health Session, Dallas, TX, November 13-17, 1983; (Preprint, 22 pp.) (1983, November 16)

The Weldon Spring Site (WSS), located in St. Charles County, Missouri, consists of two separate radioactive storage properties. The first is the 52-acre Raffinate Pits site which consists of four raffinate pits that contain radioactive residues from uranium and thorium processing operations. The second site, located about four miles southwest of the Raffinate Pits area, is an abandoned rock quarry, 9 acres in size, containing contaminated building rubble, scrap, and various residues from decontamination work done by the Atomic Energy Commission and the Department of the Army. A Surplus Facilities Management Program was set up by the Department of Energy for these sites. The objectives of this program were: (1) to continue to provide maintenance and surveillance of WSS; (2) to investigate the development of the Raffinate Pits as a disposal area for wastes from WSS and other sites; (3) to conduct integrated planning, engineering and technology development to support long-range disposition alternatives; (4) to select a preferred plan for long-term

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disposition of the site and wastes; (5) to plan and implement the remedial action program that is necessary to accomplish disposition of WSS; and (6) to perform planning and remedial activities in coordination with the DOE and other waste management programs. This paper presents the results of the first of these objectives.

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

Weldon Spring Site: Annual Environmental Monitoring Report, Calendar Year 1986

DOE/OR/21548-T1; 100 pp. (1986)

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 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 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. 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. The maximum calculated annual radiation dose to a hypothetically exposed individual at the WSRP and WSCP area was 3 mrem, or 3% 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% 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.

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

Weldon Spring Site: Annual Environmental Monitoring Report, Calendar Year 1987

DOE/OR/21548-015; 100 pp. (1987)

This report summarizes the environmental monitoring activities conducted during 1987 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 a DOE surplus facility consisting of a 52-acre raffinate pits site (Weldon Spring Raffinate Pits (WSRP)), a 9-acre quarry (Weldon Spring Quarry (WSQ)), and the Weldon Spring Chemical Plant (WSCP), an inactive, 169-acre former uranium feed materials plant. The WSRP and WSQ areas are presently used for the interim storage of radioactively and chemically contaminated waste materials. Radiological monitoring measured uranium, Radium-226, and Thorium-230 concentrations in surface water, groundwater, and sediment; radon gas concentrations in air; all long-lived natural series isotopes in air particulates; and external gamma radiation exposure rates. Potential radiation doses to the public were 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. The maximum calculated annual radiation dose to a hypothetically exposed individual at the WSRP and WSCP area was 3 mrem, or 1 percent of DOE radiation protection standard of 100 mrem. The maximum calculated annual radiation dose to a hypothetically exposed individual at the WSQ was 14 mrem, or about 14 percent of the standard. Thus the WSS currently complies with DOE Offsite Dose Standards. Chemical contamination monitoring measured nitroaromatics, total organic carbon and the inorganic anions chloride, nitrate, fluoride and sulfate in surface water, groundwater, and sediment. The degree of environmental degradation from these contaminants can only be judged in light of measurements of the magnitude of the release. Off-site discharge by surface runoff of nitroaromatic compounds is extremely small, although detectable. Discharge of nitrate compounds is relatively large but is

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generally regarded as beneficial to the ecosystem. The most important contamination release pathways from the WSRP/WSCP continue to be both surface and subsurface discharge of uranium which flows via several different pathways to three lakes on the August A. Busch Wildlife Area. Fish tissue consumption was assumed to be the primary pathway for the hypothetically exposed individual. The most important contamination release pathway from the WSQ continues to be subsurface discharge of uranium which flows into the alluvial aquifer system bordering the St. Charles County drinking water well field. However, no detectable levels of uranium or chemical contaminants above background have been measured entering the well field.

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Reyes, B.D., J.W. Tkachyk, P.D. Ritter, and R.N. Wilhelmsen, EG&G Idaho, Inc., Idaho Falls, ID

Annual Report - 1986, Environmental Surveillance for the EG&G Idaho Radioactive Waste Management Areas at the Idaho National Engineering Laboratory

EGG-2502; 91 pp. (1987, August)

The 1986 environmental surveillance report for the EG&G Idaho, Inc., radioactive waste management areas at the Idaho National Engineering Laboratory describes environmental monitoring activities at the Radioactive Waste Management Complex, the Waste Experimental Reduction Facility, the Radioactive Mixed Waste Storage Facility, the Process Experimental Pilot Plant, and two surplus facilities. The purposes of the monitoring activities are 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 Radioactive Waste Management Complex, Waste Experimental Reduction Facility, Radioactive Mixed Waste Storage Facility, Process Experimental Pilot Plant, and surplus facility environmental data with past results and derived concentration guides established for operation of Department of Energy facilities.

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

Characterization of the Homogeneous Reactor Experiment No. 2 (HRE) Impoundment

ORNL/TM-10002; ESD-2687; 118 pp. (1986, July)

A characterization study was conducted on a radioactive waste impoundment for the Homogeneous Reactor Experiment No. 2 (HRE) at the Oak Ridge National Laboratory, to provide information necessary for its proper disposition. The impoundment received low-level radioactive wastes from 1957 until 1963. In 1970, the pond was backfilled with clay soil and the impoundment capped with asphaltic concrete, but no wastes were removed. The mixed soil fill and sediment, approximately 4.8 m (16 ft) deep, was sampled using soil boring methods. The samples were analyzed to determine if the material would classify as a hazardous waste under regulatory definitions promulgated in accordance with the Resource Conservation and Recovery Act (RCRA). The impoundment is not regulated under RCRA because it was a land disposal unit and received no wastes after November 19, 1980. However, if the soil and sediment mixture contained RCRA-defined hazardous waste, it would be subject to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Chemical analyses indicate that the sampled material does not contain hazardous chemical constituents above the levels permitted by RCRA regulations. The sediment was found to contain an estimated radioactivity inventory of approximately 2700 GBq (70 Ci) of Sr-90 and 600 GBq (16 Ci) of Cs-137. The impoundment was excavated in clay soil and weathered sedimentary rock of the Conasauga Group. Four wells for monitoring the groundwater were constructed around the perimeter of the impoundment to depths ranging from 7.6 to 9.1 m (25 to 30 ft). Sampling and analyses of the groundwater have been completed for the winter and spring seasons (1985) and will be continued in the future for at least two more quarters, to account for possible natural seasonal variation in groundwater quality. At that time, the effect of the impoundment on the groundwater quality will be determined. Analyses from the first two quarters indicate that radioactivity (gross beta resulting from predominately Sr-90) of the groundwater exceeds limits allowed by RCRA regulations.

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UNC Geotech Inc., Grand Junction, CO

Environmental Monitoring Report on the U.S. Department of Energy's Inactive Mill-

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site Facility, Monticello, Utah, for Calendar Year 1987

DOE/ID/12584-27; 36 pp. (1988, May)

The inactive Monticello Millsite is located in San Juan County, Utah, just south of the town of Monticello. Environmental monitoring at the site is funded by the Surplus Facilities Management Program (SFMP) and focuses on releases due to preexistent mill tailings. All contaminant discharges result from the leaching of uranium mill tailings-related elements by groundwater and surface water, and from the release of radon gas and particulate matter into the atmosphere. Pathways facilitating the migration of contaminants from the Monticello site include groundwater in the shallow alluvial aquifer underlying the inactive facility, surface water running across the site, and the surrounding atmosphere. Extensive measurement of radon contamination from the tailings piles was conducted during 1984, 1985, and to a lesser extent during 1986 and 1987. On-pile, site-boundary, and off-site atmospheric radon measurements, as well as on- and off-pile radon-flux measurements, were taken. Results of these measurements demonstrate that the EPA standard for radon emissions from inactive uranium processing sites is exceeded at all four tailings piles at the Monticello site. Air particulate monitoring was conducted during 1987 at two on-site locations and at one background location using high-volume Sierra-Anderson model 300 air particulate samplers. So that only the inhalable particles would be collected, 10-micron-size screens were added to the samplers. The maximum airborne concentrations of radium-226, thorium-230, and uranium were all several orders of magnitude below the regulatory limits specified by DOE Order 5480.1.

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University of Nebraska, Lincoln, NE

Hallam Environmental Radiation Surveillance

DOE/CH/10334-1; 36 pp. (1988)

An environmental surveillance report is presented for the decommissioned Hallam power plant. Statistical analysis shows that the spring data mean is significantly greater than the fall data mean for all water sources. The spring variation is also significantly greater than the fall variation. The water sources demonstrate homogeneity for spring and fall subsurface sources. Surface water has significantly more radiation than subsurface water. This may be attributed to increased tritium content in surface water due to atmospheric leaching. Finally, the surface water samples are in close proximity to Sheldon Station, a coal fired plant, and increased coal particulate matter may be increasing the environmental radioactivity. A linear regression model suggests spring readings are decreasing and fall readings significantly increasing from 1975 to 1987. The spring recharge water probably contains natural and man-made radioactivity leached from the atmosphere, as well as natural radioactivity leached from the soil and rocks. The lower mean and less variance for the fall data may better characterize the aquifer.

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Elder, J.C., Los Alamos National Laboratory, Los Alamos, NM

TA-2 Water Boiler Reactor (Phase 1) Decommissioning: Resolving Groundwater Interference During Outdoor Component Removal and Soil Decontamination

CONF-871016, Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.201-III.209) (1987)

Extensive groundwater was encountered in excavations as structures, pipe, and soil contaminated with Cs-137 were removed during the outdoor phase (Phase 1) of the TA-2 Water Boiler Reactor decommissioning. Because it was imperative to avoid releasing contamination to a nearby surface stream, a relatively simple and effective method was employed to confine contaminated soil and water. The method of confinement involved pumping or scooping large quantities of contaminated soil and water to secondary pits above the level of groundwater interference. These pits served as holding tanks/natural filters because high soil pH in the area enhanced attachment of Cs-137 to soil particles. Water seeped out of the secondary pits, leaving contaminated soil behind to be easily scraped from the surfaces of the pit. This method and the stabilization techniques are described. Stabilization and revegetation of the area, complemented by a long-term environmental surveillance program, has resulted in successful closure, although total removal of all contamination was not possible.

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Green, S., and R.H. Miller, Jacobs Engineering Group, Inc., St. Charles, MO

A Statistical Plan for Radiological Survey and Unrestricted Release of Structures and Equipment

Proceedings of the Oak Ridge National Laboratory Technical Workshop, Oak Ridge, Tennessee, June 21, 1988; (19 pp.) (1988, June 21)

The Weldon Spring Site (WSS) contains 44 structures, approximately one mile of asphalt roadways, a network

of overhead lines and pipes, and a large amount of equipment and scrap. The buildings range in size from a 100-square-foot one-story shed to 70,000 square foot multi-story buildings. Equipment ranges from metal scrap, nuts and bolts, electrical and plumbing spare parts, to trucks, 30,000-gallon propane tanks and a 12-cylinder diesel generator. Many of these materials exhibit surface radioactive contamination. Since the combined specific activity of the main contaminants at the WSS (U-238 and immediate daughter products Pa-234, Th-234 and U-234), is relatively low (1.3 uCi/g), materials on which these contaminants have been deposited exhibit very low levels of radioactivity. In fact, many of the materials and equipment at the WSS exhibit surface levels of radiation below current regulatory surface radioactivity standards and could therefore be released from the site to minimize the amount of waste to be managed at the site. However, the number of measurements required to document compliance with the current regulatory guidelines for surface contamination, in conjunction with the large inventory of buildings and equipment at the WSS, makes release of uncontaminated (below guidelines) materials an extremely manpower-intensive task. This paper presents a radiological survey strategy which relies on statistical data analysis to greatly limit the number of measurements needed to document compliance with established uncontrolled-use release criteria.

36

Jugan, M., U.S. Department of Energy, Oak Ridge Operations Office, Technical Services Division, Oak Ridge, TN

ORO Scrap Metal Decontamination Program

CONF-871075; Waste Problems, Proceedings of the Third Oak Ridge Model Conference, Oak Ridge, TN, October 13-16, 1987; (pp. 235-249) (1987, October 13-16)

This paper contains viewgraphs and the abstract from a presentation given at the Oak Ridge Model Conference addressing the scrap metal decontamination program run by the Oak Ridge Operations Office. The estimated amounts of scrap metal and contamination levels are tabulated. The objectives, plan of action, and techniques used are summarized for the program.

SURPLUS FACILITIES MANAGEMENT PROGRAM DECONTAMINATION STUDIES

37

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Surface Decontamination Utilizing Mechanical Vacuum Blasting Methods

DOE/SSDP-0035; (Preprint, 6 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 79-81); Transactions of the American Nuclear Society 56:79-81 (1988)

As a part of the Shippingport Decommissioning Project surface decontamination effort to meet on-site and off-site release limits, vacuum blasting techniques were successfully utilized to remove fixed radioactive contamination entrained in steel and concrete painted surfaces. This technique was determined to be cost effective and was selected for use only on the painted steel surface of the lower portions of the Reactor Plant Container. Although some equipment problems were experienced, it was concluded that application of vacuum blasting techniques is effective in terms of removal rate, man-hours expended, and waste generated.

38

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

Spent Fuel Pool Cleanup and Stabilization

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.59-IV.74) (1987)

Each of the plutonium production reactors at Hanford had a large water-filled spent fuel pool to provide interim storage of irradiated fuel while awaiting shipment to the separation facilities. After cessation of reactor operations the fuel was removed from the pools and the water levels were drawn down to a 5- to 10-foot depth. The pools were maintained with the water to provide shielding and radiological control. What appeared to be a straightforward project to process the water, remove the sediments

from the basin, and stabilize the contamination on the floors and walls, became a very complex and time-consuming operation. Some of the difficulties encountered were: (1) the sediment characteristics varied from pool to pool; (2) the ion exchange system required modification; (3) areas of hard-packed sediments were discovered on the floors; (4) special arrangements were required to handle and package high dose rate items for shipment; and (5) contract problems caused with the subcontractor. The original schedule to complete the project from preliminary engineering to final stabilization of the pools was 15 months. The actual time required was about 25 months. The original cost to perform the work was \$2,651,000. The actual cost of the project was \$5,120,000, which included \$150,000 for payment of claims to the subcontractor. This paper summarizes the experiences associated with the cleanup and radiological stabilization of the 100-B, -C, -D, and -DR spent fuel pools. It discusses a number of lessons learned.

39

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Decontamination to Achieve Site-Release Criteria

DOE/SSDP-0041; (Preprint, 7 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 78-79); Transactions of the American Nuclear Society 56:78-79 (1988)

The management and performance of component and area decontamination activities to achieve site release criteria at Shippingport Station Decommissioning Project are discussed. This success demonstrated that state-of-the-art technology can be applied cost effectively to support a full scale nuclear power plant decommissioning. Three distinct phases of work permitted mid-course corrections to allow for adjustments in approach and technique. These were: (1) preliminary planning and scheduling, (2) initial decontamination, and (3) final decontamination efforts. In planning for separate surface and internal decontamination, flexibility in scheduling was gained which minimized overlapping of tasks and reduced personnel needs.

SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

40

Airozo, D.

About 180 Components Have Been Removed from the Shippingport Power Station

Nucleonics Week 28(30):10 (1987, July 23)

Approximately 180 components have been removed from the Shippingport Power Station for analysis by various U.S. national laboratories to assess the impact of aging on nuclear power plant systems. Shippingport Atomic Power Station began operation in 1957 and was decommissioned in 1982 with significant modifications made to it during the mid-1960s and 1970s. This gives researchers an opportunity to examine equipment of different vintages. Detailed examination of Shippingport components is an important element in the Nuclear Regulatory Commission's ongoing plant aging research program. Laboratory and in situ analysis is "in the early stages" but a wealth of information is expected.

41

Coughlin, P.J., General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Removal and Transportation of Reactor Pressure Vessel Neutron Shield Tank (RPV/NST) Package

DOE/SSDP-0039; (Preprint, 5 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 75-76); Transactions of the American Nuclear Society 56:75-76 (1988)

This report outlines the procedures that will be followed in the removal of the packaged Reactor Pressure Vessel (RPV) and its associated Neutron Shield Tank (NST) from the Shippingport Atomic Power Station (SAPS) and its transportation by barge to the government-owned Hanford Reservation in Richland, Washington. Descriptions and specifications for the lifting procedures, the different towing vessels required along the route, and steps involved in the Hanford transportation are given. These activities will have national significance in representing the heaviest lift of an irradiated reactor plant component during decommissioning operations and the first use of barge transportation of a radioactive RPV package from a decommissioned land based nuclear power plant.

42

Crimi, F.P., General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Shippingport: A Relevant Decommissioning Project

DOE/SSDP-0037; (Preprint, 8 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 72-74); Transactions of the American Nuclear Society 55:72-74 (1988)

The Shippingport decommissioning project has been a relevant demonstration project to the nuclear industry safe and cost effective dismantlement of a large scale nuclear power plant. The project has provided useful data for the future decommissioning of commercial nuclear power plants. The major components of the reactor plant of the 72 MW(e) Shippingport Atomic Power Station are compared to the Portland General Electric Company's 1175 MW(e) Nuclear Plant at Rainer, Oregon in order to demonstrate this relevancy.

43

Crimi, F.P., K. Imoto, and T. Miho, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA; Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Experience Gained from the SSDP - Part 1: Overview

DOE/SSDP-0042; Proceedings of the Architectural Institute of Japan Annual Convention, October 1988; (Preprint, 14 pp.); (1988, April)

The Shippingport Decommissioning Project (SSDP) is operating with cooperative effort between the U.S. Department of Energy and the Japan Atomic Energy Research Institute (JAERI). Some of the experience gained by both parties in this venture is summarized. The objectives of the SSDP are: (1) to place the station in a radiologically safe condition following defueling the reactor; (2) to dismantle the government-owned portion of the Shippingport Station in a safe and cost effective manner using state of the art technology; (3) to demonstrate to the nuclear industry the practical and

SURPLUS FACILITIES MANAGEMENT PROGRAM DISMANTLEMENT AND DEMOLITION

affordable dismantling of a commercial large scale nuclear power plant by use of current construction, maintenance, and demolition technologies; and (4) to provide timely, useful data for future decommissioning projects.

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Experience Gained from the SS DP - Part 2: Demolition and Removal of Buildings and Structures

DOE/SSDP-0042; Proceedings of the Architectural Institute of Japan Annual Convention, October 1988; (Preprint, 14 pp.); (1988, April)

The Shippingport Atomic Power Station consists of the Nuclear Steam Supply System and associated radioactive waste processing system, which are owned by the U.S. Department of Energy (DOE); and the turbine generator and balance of plant, which are owned by the Duquesne Light Company (DLC). This station is currently being decommissioned. The Shippingport Station Decommissioning Project (SSDP) is being managed by the General Electric Company, the Decommissioning Operations Contractor (DOC) for DOE. All government-owned radioactive and nonradioactive portions are being removed and the site will be released for unrestricted use and returned to the DLC. This paper describes the methods and sequence used to demolish buildings and structures at the SSDP.

45

Draper, D.G., W.P. Davis, J.M. Garner, and J.R. Geichman. Monsanto Research Corporation, Mound Facility, Miamisburg, OH

Health Physics Procedures in the Removal of Contaminated External Ducts in a Populated Area

MLM-3462(OP); CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.135-V.145) (1987)

The Special Metallurgical (SM) Building at the U.S. Department of Energy facility, located in Miamisburg, Ohio, is currently in the decommissioning process. An early task in this project was the removal of external ductwork which was highly contaminated with plutonium-238. Approximately 450 linear feet of duct, which averaged three feet in diameter were included in the project. One duct, approximately 150-ft long, was connected an external filter bank with a stack plenum and was moderately contaminated. This duct was removed first so that contamination control techniques could be developed for use later in the removal of the second duct which was highly contaminated. Because the SM Building is located approximately 100 meters from the fence line, procedures were required which offered a high degree of assurance that airborne release of contamination would be strictly controlled. Special fixation techniques, decontamination methods, and other procedures were employed in the removal of the ductwork and subsequent removal and replacement of the roof.

46

Giordano, R.J., D.L. Gardner, and C.A. Taylor, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Practical Radiation, Contamination and Asbestos Control Techniques for Decommissioning

DOE/SSDP-0022; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.65-II.82) (1987)

Many of the needs for the control of radioactive material and asbestos during a decommissioning project are unique. First, there are the complications which arise when the two hazards are encountered simultaneously. Secondly, there are opportunities that arise because of the unique characteristics of a decommissioning project. There is additional latitude in the choice of work procedures since the end product is the ultimate disposal of the facility. This paper presents the experiences and lessons learned as these unique needs were encountered during the decommissioning of the Shippingport Atomic Power Station. The experience and lessons learned from work with radioactivity and asbestos together include discussions of the personnel and material access control, and the development of work and clearance procedures.

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Procedures especially adaptable to decommissioning were used to control contamination and airborne radioactivity during thermal cutting. Similar ventilation control innovations helped reduce both work time and personal exposure. The practical experience obtained in these areas is provided to aid in minimizing future technical problems, exposure, and costs.

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Asbestos Removal in Shippingport Decommissioning Project

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.160-III.171) (1987)

The Shippingport Station Decommissioning Project (SSDP) is being performed under contract to the U.S. Department of Energy (DOE) by the General Electric Company and its integrated subcontractor, MK-Ferguson Company, as the Decommissioning Operations Contractor (DOC). During the planning of this project, it was found that asbestos was the primary insulating material which was used on the nuclear steam supply system and the plant heating system. The original decommissioning plan required that each subcontractor remove the asbestos from the particular component(s) they had to remove. However, since removal of the radioactively-contaminated asbestos would require special procedures and worker training, the original decommissioning plan was modified so that a single subcontractor removed all of the asbestos prior to other decommissioning tasks. IT Corporation was selected as the asbestos removal subcontractor, and this paper describes their approach to the project.

48

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Reactor Pressure Vessel Preparation for Shipment and Burial

DOE/SSDP-0023; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987

International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.31-II.47) (1987)

The Shippingport Station Decommissioning Project (SSDP) is a U.S. Department of Energy (DOE) 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 including the reactor pressure vessel will be removed from the station and transported by barge to the Government-owned Hanford Reservation in Richland, Washington, for burial. The SSDP is being managed by the General Electric Company for DOE. This paper describes the preparation of the Shippingport Reactor pressure vessel/neutron shield tank (RPV/NST) for removal, barge shipment and burial. The preparation of the RPV/NST package, as outlined, resulted in a monolithic package which more than meets the requirements for a strong-tight container for transport of low specific activity material and is expected to be adequate for the analysis and scenarios required for a Type B Container. Radiological dose analyses performed on the RPV/NST package for different postulated accident situations demonstrated that radionuclide releases would be insignificant.

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LaGuardia, T.S., and S.M. Lipsett, TLG Engineering, Inc., Brookfield, CT; Cleveland Wrecking Company, Cleveland, OH

Removal of Shippingport Station Primary System Components and Piping

DOE/SSDP-0028; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.7-II.23) (1987)

The dismantling work for the Shippingport Station Decommissioning Project was divided into subtasks to permit the work to be subcontracted to the maximum extent practical. Major subtasks were identified and described by activity specifications which could then be grouped into logical work packages to be bid. Two of the largest dismantling work packages, removal of piping and components, were grouped together and designated as Activity Specifications 4 and 5. TLG Services, Inc. and Cleveland Wrecking Company formed a joint venture to

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perform this work during a two-year period at a cost of approximately \$7 million. This paper details the major portions of this dismantling work. The primary system components within this work consist of the stainless steel reactor coolant piping, check valves, reactor coolant pumps, steam generators, reactor purification demineralizers, and coolers. The steam generator heat exchangers and drums were removed as individual units without segmentation. The four reactor coolant pumps, the four check valves, and several sections of reactor coolant piping were removed and shipped to a laboratory for metallographic examination. The remaining components were packaged and shipped for burial at Hanford, Washington.

50

Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project Irradiated Components Transfer - Topical Report

DOE/SSDP-0034; 59 pp. (1988, May 23)

This report is a synopsis of the transfer of irradiated components into the Shippingport Reactor Pressure Vessel (RPV). The information is provided as a part of the Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program. This program documents preparatory activities for the one-piece removal of the Shippingport Station nuclear power reactor.

51

Yannitell, D.M., General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Preparation of the Shippingport Reactor Pressure Vessel Shipping Package

DOE/SSDP-0038; (Preprint, 6 pp.); CONF-880601; Proceedings of the American Nuclear Society 1988 Annual Meeting, San Diego, CA, June 12-16, 1988, 628 pp.; (pp. 74-75); Transactions of the American Nuclear Society 56:74-75 (1988)

This paper discusses the preparation for removal and shipment of the Shippingport Atomic Power Station Reactor Pressure Vessel (RPV) and its associated Neutron Shield Tank (NST). The sequence of major events required to prepare the RPV and its NST as an integral, one-piece package for barge shipment to, and burial at the Hanford Reservation in Richland, Washington, is outlined. This is the first application of one-piece removal and barge transport of an irradiated nuclear reactor pressure vessel. Its potential application to future decommissioning may provide significant cost, schedule, and man-rem savings over the more conventional segmentation methods.

SURPLUS FACILITIES MANAGEMENT PROGRAM WASTE DISPOSAL

52

Brown, B.W., R.M. Geimer, D.M. LaRue, F.E. Stoll, R.H. Meservey, and C.M. Voldness, EG&G Idaho, Inc., Idaho Falls, ID; U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID

Proposed Decommissioning of Radioactively Contaminated NaK

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.394-IV.404) (1987)

This paper deals with a proposed method for stabilizing radioactively contaminated eutectic sodium/potassium (NaK) liquid metal. Approximately 680 liters (180 gal) of contaminated liquid NaK were generated in 1955 during testing with the Experimental Breeder Reactor (EBR-1) at the Idaho National Engineering Laboratory (INEL). Reaction of the NaK with chlorine gas to produce solid salts of sodium and potassium is proposed as a means to stabilize this waste. Preliminary testing was initiated to determine the reaction conditions required for this process. It was found that reaction with chlorine is feasible for safely treating the liquid metal.

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Brown, B.W., D.M. LaRue, F.E. Stoll, M.R. Dolenc, and D.L. Crandall, EG&G Idaho, Inc., Idaho Falls, ID

Conceptual Design Report: Decontamination and Decommissioning of the EBR-1 Mark-2 NaK

EGG-WM-7845; 216 pp. (1987, September)

A conceptual design of a processing system for approximately 180 gallons of contaminated NaK (sodium/potassium eutectic alloy) is presented. This NaK resulted from an incident at EBR-1 at the Idaho National Engineering Laboratory in 1955. The proposed method of decommissioning the NaK is to chemically deactivate it by combining it with gaseous chlorine. This process will produce a solid mass of potassium chloride and sodium chloride salts which will mitigate the consequences of further chemical reaction of the NaK should the storage containers be breached in any way. Following the processing of the NaK, the storage vessels will be transferred to an appropriate storage facility for radioactive wastes.

SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

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Bond, W.H., W.P. Davis, D.G. Draper, J.R. Geichman, J.C. Harris, R.R. Jaeger, and R.L. Sohn. Monsanto Research Corporation, Mound Facility, Miamisburg, OH

An Overview of Plutonium-238 Decontamination and Decommissioning (D&D) Projects at Mound

MLM-3461(OP); CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2 705 pp.; (pp. IV.258-IV.269) (1987)

Monsanto Research Corporation, which operates the Mound Site (in suburban Dayton, Ohio) for the U.S. Department of Energy, has been decommissioning radioactively contaminated facilities since 1949. Mound is currently decontaminating (for restricted reuse) and/or decommissioning (for conditional release) four major plutonium-238 contaminated facilities (approximately 75,000 sq ft) that contained 1700 linear feet of gloveboxes and associated equipment and services. In addition, several thousand linear feet of external underground piping, associated tanks, and contaminated soil are being removed. Two of the facilities contain ongoing operations and will be reused for both radioactive and nonradioactive programs. Two others will be completely demolished and the land area will become available for future DOE building sites. Currently, over 30,000 Curies of plutonium-238 have been removed in waste and scrap residues. An overview of the successful techniques and equipment used in the decontamination and decommissioning of individual pieces of equipment, gloveboxes, services, laboratories, sections of buildings, entire buildings, and external underground piping, tanks, and soil in a highly populated residential area is presented.

55

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The Niagara Falls Storage Site and Its Relevance to Remedial Action at the Oak Ridge Reservation

CONF-871075; Waste Problems, Proceedings of the Third Oak Ridge Model Conference, Oak

Ridge, TN, October 13-16, 1987; (pp. 179-197) (1987, February 3-5)

The Niagara Falls Storage Site, near Lewiston, New York, is a DOE storage site for low-level radioactive waste. Remedial action has been completed on the 250,000 yd interim waste containment facility. During the course of the remedial action, several buildings were demolished and others were decontaminated. Radioactively contaminated soil was removed from more than two dozen vicinity properties, as well as from large areas of the site itself. Fourteen million gallons of water were treated for release. This paper describes the remedial action project. It also provides additional detail on several aspects of the work from which useful insights can be gained for future projects of a similar nature: the design of the facility, the hydraulic mining of residues from a 165-ft-high tower, treatment of radioactively and chemically contaminated water, environmental monitoring, personnel monitoring, and unique post-closure monitoring of the containment facility.

56

Crimi, F.P., and G.R. Mullee, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

A Summary of Lessons Learned at the Shippingport Station Decommissioning Project (SSDP)

DOE/SSDP-0025; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.1-II.6) (1987)

The Shippingport Atomic Power Station consists of the nuclear steam supply system and associated radioactive waste processing systems, which are owned by the U.S. Department of Energy (DOE), and the turbine generator and balance of plant, which is owned by the Duquesne Light Company. The station is located at Shippingport, Pennsylvania, on seven acres of land leased by the DOE from the Duquesne Light Company. The Shippingport Station Decommissioning Project (SSDP) is being managed by the General Electric Company for the DOE. This paper describes the lessons learned from a management perspective during the performance of the SSDP. The lessons learned are presented in a chronological sequence during the life of the project up to the present time. The

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careful analysis of the lessons learned at SSDP and the implementation of corresponding actions have contributed toward improving the effectiveness of the SSDP as time progresses. The lessons learned should be helpful in planning future decommissioning projects.

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Puerto Rico Water Resources Authority, San Juan, PR; United Nuclear Corporation, Research and Engineering Center, Elmsford, NY

Boiling Nuclear Superheater Power Station Decommissioning - Final Report

DOCKET 1154-2; WRA-B-70-500; 286 pp. (1970, September 1)

The BONUS reactor facility in Puerto Rico was decommissioned over a period spanning late 1969 to early 1970. The decommissioning procedure included: (1) removal of all nuclear materials and highly activated components from the plant; (2) in-place entombment of the pressure vessel and associated internal components; and (3) decontamination of the contaminated systems external to the entombment boundary. After decontamination, the total remaining radioactive materials in the plant amounted to 54,284 curies with 13.3 millicuries being external to the containment system. The decommissioning program was carried out in three phases: (1) a planning and approval phase; (2) a work phase; and (3) a close out phase. This report presents descriptions of the entombment and the remaining external systems. It also reports the entombment procedure, and the procedures by which the external systems were decontaminated. Following decontamination, an aerial radiation survey was conducted. The results of this survey, along with those from a quality assurance program are reported in this document.

58

Rader, P.L., P.W. Creech, and R.J. Michigan, Monsanto Research Corporation, Mound Facility, Miamisburg, OH

Decontamination and Decommissioning of Building 41

MLM-3463(OP); CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987

International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.210-III.218) (1987)

Building 41 was a one-story, above-ground 36-ft X 9-ft X 9-ft concrete block structure with a 15-ft poured concrete basement that contained two 3500-gallon tanks and a pumping system. A pole barn structure was erected over Building 41 to contain contamination during removal. Steel sheet piling and oak shoring eliminated cave-in dangers. Removal was accomplished with a remote excavator (Mini-Max), trackhoe and concrete bucket. Final excavation, sampling and surveying are in progress. Upon final release, the excavation will be sealed, filled and the site restored.

59

Smith, D.L., EG&G Idaho, Inc., Idaho Falls, ID

Decontamination and Decommissioning of the MTR-603 HB-2 Cubicle

EGG-M-05887; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.219-III.236) (1987)

This paper describes the decontamination and decommissioning (D&D) of the MTR-603 HB-2 cubicle located at the Idaho National Engineering Laboratory. The HB-2 cubicle became radioactively contaminated during out-of-pile circulating water loop experiments conducted in the Materials Testing Reactor in the 1950s and 1960s. This paper describes work performed to accomplish the D&D objectives of reducing the high radiation fields caused by contamination inside the cubicle, preventing future contamination spread, and making about 1400 sq ft of floor space available for reuse. Decommissioning of the HB-2 cubicle consisted of total dismantlement of the cubicle and its contents and was performed without disrupting ongoing laboratory work being conducted in areas surrounding the HB-2 cubicle.

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Stoll, F.E., H.A. Bohrer, and C.M. Voldness, Idaho National Engineering Laboratory, Idaho Falls, ID

Decontamination and Decommissioning of the Initial Engine Test Facility

SURPLUS FACILITIES MANAGEMENT PROGRAM REMEDIAL ACTION EXPERIENCE

CONF-871018: Decommissioning. G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium. Pittsburgh, PA. October 4-8, 1987. Vol. 1. 550 pp.: (pp. III.237-III.253) (1987)

The Initial Engine Test (IET) facility was constructed and operated at the National Reactor Testing Station, now known as the Idaho National Engineering Laboratory (INEL), to support the Aircraft Nuclear Propulsion Program and the Systems for Nuclear Auxiliary Power Transient test program, circa 1950 through the 1960s.

Due to the severe nature of these nuclear test programs, a significant amount of radioactive contamination was deposited in various portions of the IET facility. Characterizations, decision analyses, and plans for decontamination and decommissioning (D&D) were prepared from 1982 through 1985. D&D activities were performed in such a way that no radiological health or safety hazard to the public or to personnel at the INEL remains. These D&D activities began in 1985 and were completed in 1987.

SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

61

Broom, C.A., and M.L. McKernan, Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project Technology Transfer Program

DOE/SSDP-0020; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.172-III.175) (1987)

This paper describes the Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program, which was established to ensure that project information that is expected to be of interest to the industry is adequately documented and subsequently made available to nuclear utility owners, government agencies, the nuclear industry, and the decommissioning community. The Technology Transfer Program objectives are: (1) data acquisition and archiving; (2) report preparation; (3) conference participation and coordination; (4) on-site project participation; and (5) special studies and test documentation.

62

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The ORNL Remedial Action Program

CONF-870245; Proceedings of the Oak Ridge Model Conference, W.R. Bibb and T.H. Row (eds.), Oak Ridge Associated Universities, Oak Ridge, TN, February 3-5, 1987; (pp. 141-147) (1987, February)

Research, development and waste management activities at the Oak Ridge National Laboratory (ORNL) have produced a significant number of surplus, inactive facilities that are contaminated with low-level radioactive and hazardous chemical wastes. Monitoring and control of these sites to ensure that both personnel exposure and off-site releases are maintained within the applicable DOE guidelines is a continued responsibility of ORNL. Significant environmental legislation governing the cleanup of contaminated sites has been enacted on both the state and federal levels in the past few years. The

most important of these are RCRA, CWA and CERCLA all of which affect remedial action programs. In keeping with the DOE policy of controlling the potential hazards associated with the operation of ORNL, site remedial actions will be conducted, where appropriate, to meet the requirements laid forth in these regulations. Implementation of the Remedial Action Program at ORNL begins with the identification of those sites requiring corrective actions and will end with final certification of site closure or decommissioning activities. After identification of a site, one of two basic actions is implemented: (1) remedial actions will be deferred and the facility will be placed in a monitored, protective storage mode; or (2) site closure or final decommissioning will be carried out. Eventually all sites where remedial action is necessary will pass through the decommissioning procedure to ensure long-term containment of radioactive wastes and hazardous materials. The ORNL Remedial Action Program presently contains 164 sites in 13 categories. Present site identification efforts are focused on developing a comprehensive list of hazardous and radioactive waste sites with a preliminary assessment of site conditions. A comprehensive Remedial Investigation/Feasibility Study program is also being implemented to determine the need, the extent of and the priority of corrective programs at each site. To support remedial action planning and implementation, significant efforts in technology development are necessary. As ORNL facilities continue to age and the nature of research and development activities and waste management practices change, it is likely that additional facilities will require management under the remedial action program.

63

Newtown, G.A., and J. Hammond, U.S. Department of Energy, Weldon Spring Site Office, St. Charles, MO; MK-Ferguson Company, St. Charles, MO

SFMP Weldon Spring Start-Up

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 93-104) (1987)

Descriptions of the history of the Weldon Spring site, the types of contaminants existing there and the establishment of the DOE remedial action program are given. Following this the NEPA process is outlined and the Notice of Intent and the Environmental Impact Statement are discussed. The decision making process for the site is considered.

SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

64

Schreiber, J.J., U.S. Department of Energy, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project: An Overview and Status Report

DOE/SSDP-0021; CONF-871018; Decommissioning, G.A. Tarca (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. I.35-I.42) (1987)

The Shippingport Atomic Power Station is the first commercial size nuclear power plant to undergo decommissioning in the United States. The project is planned to demonstrate decommissioning operations within an environment of current industry practice. Dismantlement and other Shippingport Station Decommissioning Project (SSDP) operational procedures are based upon current construction, maintenance, and demolition practices. This paper presents an overview and current status of the SSDP.

65

Voigt, W.R., Jr., U.S. Department of Energy, Office of Remedial Action and Waste Technology, Washington, DC

Statement of William R. Voigt, Jr., Director, Office of Remedial Action and Waste Technology, U.S. Department of Energy Before the House Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment

U.S. House of Representatives, Subcommittee on Energy and the Environment, Testimony (1987, April 23)

The DOE's Shippingport Station Decommissioning Project (SSDP) is a pioneering project of its type. It will involve dismantlement of the reactor systems, removal of any radioactive material, and restoration of the site to an unrestricted radiological status. After removal of the spent nuclear fuel, the remaining radioactive waste met the Nuclear Regulatory Commission's (NRC) low-level waste criteria. Immediate dismantlement was considered to be the most cost effective method of decontaminating

the remainder of the plant. The plant was removed as one piece and shipped by barge to the Hanford Reservation near Richland, Washington. The pertinent information and the lessons learned during decommissioning and decontamination of the Shippingport facility will be transferred by DOE to the U.S. nuclear industry in several ways: (1) by performing the work through several subcontractors; (2) by thorough documentation of all aspects of the project; (3) by enhancement of information availability through the establishment of a technology transfer; (4) by providing components and samples of the plant materials to the NRC so that research on plant component aging may be done; and (5) through the establishment of an international program on decommissioning research under the auspices of the Organization for Economic Cooperation and Development's Nuclear Energy Agency (NEA). Although the present technology is sufficient for decommissioning industrial scale facilities, further development is necessary to reduce worker radiation exposure levels, as well as costs and waste volumes. This implies that it is desirable to continue development of: (1) decontamination methods; (2) remotely operated equipment for plant disassembly; (3) techniques for minimizing the wastes generated through treatment; (4) new methods of waste volume reduction; and (5) new methods of discriminating radioactivity levels in waste. Other than the normal removal of spent nuclear fuel, four types of waste that required removal were generated at SSDP: (1) low-level radioactive waste; (2) nonradioactive hazardous wastes; (3) "mixed" wastes containing both types (1) and (2); and (4) nonradioactive, nonhazardous wastes. These are the same wastes that would be generated at any other commercial nuclear power facility. SSDP radioactive wastes are being handled in accordance with DOE regulations and transported in accordance with applicable DOT and DOE regulations. DOE directives concerning worker safety are the same as NRC and DOT regulations. Non-radioactive hazardous wastes are being disposed of in commercial facilities that are permitted under the Toxic Substances Control Act or the Resource Conservation and Recovery Act. "Mixed" wastes are being stored above ground at the DOE Hanford site pending a decision by the State of Washington and the EPA on the requirements for disposal of such materials. Nonradioactive, nonhazardous wastes are being sent to nearby municipal landfills or sold for scrap.

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Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

SURPLUS FACILITIES MANAGEMENT PROGRAM GENERAL STUDIES

Shippingport Station Decommissioning Project FYs 1984-1985 Annual Progress Report for Fiscal Year Period October 1, 1983 Through September 30, 1985

DOE/SSDP-0018; 112 pp. (1987, May 29)

The U.S. Department of Energy is decommissioning the Shippingport Atomic Power Station located at Shippingport, Pennsylvania. The project purpose is to demonstrate nuclear plant decommissioning and dismantlement operations in an environment of current industry practices. This is the first annual progress report and summarizes the decommissioning activities and technical support provided during fiscal years 1984 and 1985. The technical objectives of the project are as follows: (1) removal of all government-owned facilities and radioactive portions of the Shippingport Station; (2) optimization of subcontractor participation; and (3) documentation of management, planning, engineering, and operations. The following Project Milestones were completed: (1) award Decommissioning Operations Contractor contract - March 1984; (2) Department of Energy Headquarters approval to start decommissioning operations - June 1984; (3) Shippingport site turnover and initiation of caretaker status - September 1984; and (4) initiate decommissioning operations - January 1985. At the end of FY 1985, decommissioning operations were 15.5 percent complete versus 16.0 percent planned. At the conclusion of FY 1985, budgeted cost of work scheduled was \$18.3 million; budgeted cost of work performed was \$17.9 million; and actual cost of work performed was \$17.7 million. This is an unfavorable schedule variance of \$0.4 million (2%) and a favorable cost variance of \$0.2 million (1%). Both were considered acceptable.

67

Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project FY 1986 Annual Progress Report for Fiscal Year Period October 1, 1985 Through September 30, 1986

DOE/SSDP-0019; 77 pp. (1987, January 29)

The U.S. Department of Energy is decommissioning the Shippingport Atomic Power Station located at Shippingport, Pennsylvania. This is the second annual progress report and summarizes the decommissioning activities and technical support provided during fiscal year 1986. The technical objectives of the project are as follows: (1) removal of all government-owned facilities and radioactive portions of the Shippingport Station; (2) optimization of subcontractor participation; and (3) documentation of management, planning, engineering, and operations. The Project Milestone consisting of transfer of irradiated components to the reactor pressure vessel was completed March 1986. At the end of FY 1986, decommissioning operations were 30.9 percent complete versus 31.6 percent planned. Budgeted cost of work scheduled was \$35.4 million; budgeted cost of work performed was \$35.1 million; and actual cost of work performed was \$34.9 million. This is an unfavorable schedule variance of \$0.3 million (1%) and a favorable cost variance of \$0.2 million (1%). Both were considered to be acceptable.

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Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project FY 1987 Annual Progress Report for Fiscal Year Period October 1, 1986 Through September 30, 1987

DOE/SSDP-0031; 79 pp. (1988, June 16)

This report presents progress on the Shippingport Station Decommissioning Project for FY 1987. There are two main topics: Project Management and Decommissioning Project Activities. Changes from technical and managerial concepts developed in the original Decommissioning Plan are presented with the related technical, economic, or schedule considerations.

NUCLEAR FACILITIES DECOMMISSIONING

- **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**
- **General Studies**

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NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

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News from the Deutsches Atomforum (DAF): Decommissioning and Dismantling of Nuclear Installations - A Paper Presented for Discussion by the DAF

ATW, Atomwirtschaft, Atomtechnik 32(8-9):A162-A164 (1987, August-September)

The following aspects, shown by practical experience to be due for discussion, are treated in the DAF paper: (1) What are the conditions suggesting application for a permit? (2) Is the plant subject to the same nuclear laws during its operating phase and while it is shut down and destined for decommissioning? (3) What are the safety engineering requirements to be met during the phase of decommissioning and dismantling? (4) Are there possibilities of standardizing the activities of the licensing authorities in the Federal Republic of Germany with regard to reprocessing and waste management aspects? (5) Are there possibilities of making the licensing procedure easier?

70

Cost Estimate Structure

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp.; (pp. 6.1-6.30) (1986)

After an introduction to Cost Estimate Structure, cost estimate results format is discussed for prompt removal/dismantling and entombment/mothballing with delayed dismantling.

71

Collateral Costs

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp.; (pp. 5.1-5.37) (1986)

The following outlines the topics discussed under Collateral Costs: (1) undistributed site equipment; (2) plant energy; (3) liquid waste processing; (4) nuclear liability insurance; (5) taxes; (6) licenses and permits; (7) health physics equipment and supplies; and (8) small tools.

72

Period-Dependent Cost Factors

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp.; (pp. 4.1-4.23) (1986)

The following topics were discussed under Period-Dependent Cost Factors: (1) utility staff position descriptions; (2) utility staff position requirements; (3) decommissioning operations contractor (DOC) staff position descriptions; (4) DOC staff position requirements; (5) double shift operations staffing; and (6) plant size variations on staffing.

73

Unit Factor Development

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp.; (pp. 3.1-3.123) (1986)

The following topics under Unit Factor Development were discussed: (1) piping and valves; (2) mechanical and electrical components; (3) steel and concrete structures; (4) decontamination; (5) miscellaneous setup and packaging factors; (6) grading, landscaping, and site restoration; and (7) unit factor development references.

74

List of Decommissioning Work Activities

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp.; (pp. 2.1-2.25) (1986)

The following topics were discussed under List of Decommissioning Work Activities: (1) decommissioning project work breakdown structure; and (2) decommissioning work activities including prompt removal/dismantling work activities, entombment/delayed dismantling work activities, and mothballing/delayed dismantling work activities.

NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

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Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates - Volume 2

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 2, 262 pp. (1986)

These guidelines were prepared in response to a nuclear industry need to facilitate the preparation of cost estimates to decommission nuclear power plants. The objective of these guidelines is to enhance the credibility and thoroughness of cost estimates by providing detailed breakdown of costs to measurable, comprehensible levels in order to ensure that all estimates employing the guidelines will properly identify and account for all activities and elements of cost. These guidelines were prepared for decommissioning commercial nuclear power reactors of the pressurized water reactor and boiling water reactor types. Chapter 1 defines the purpose and scope of the document and discusses the general approach, i.e. elements of decommissioning costs and cost estimating processes. A separate abstract has been prepared for each of the additional five chapters entitled: List of Decommissioning Work Activities; Unit Factor Development; Period-Dependent Cost Factors; Collateral Costs; and Cost Estimate Structure. Volume 2 contains the detailed user reference information similar to a cost estimator's notebook.

76

Cost Estimate Structure

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 14.1-14.4) (1986)

After an introduction, the following topics are discussed under Cost Estimate Structure: (1) study report scope and content; and (2) cost estimate documentation and format.

77

Contingency

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 13.1-13.9) (1986)

After an introduction, the following topics are discussed under Contingency: (1) definitions; (2) application of contingency principle; and (3) application of allowances.

78

Site-Specific Characteristics - Plant Modifications and Other Cost Adjustments

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 12.1-12.11) (1986)

After an introduction, the following topics are discussed under Site-Specific Characteristics, Plant Modifications, and Other Cost Adjustments: (1) integration of modifications; (2) cost adjustments for current dollar values; (3) segregation of cost elements for multiple unit sites; (4) integration of site-specific equipment; (5) single versus double shift operations; and (6) ten-hour days versus eight-hour days.

79

Salvage and Scrap

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 9.1-9.9) (1986)

After an introduction, the following topics are discussed under Salvage and Scrap: (1) methodology for determining salvage and scrap values; (2) criteria for disposition; (3) sources for salvage and scrap value; and (4) guidelines to account for salvage and scrap.

80

Collateral Costs

NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 8.1-8.30) (1986)

After an introduction, the following topics are discussed under Collateral Costs: (1) undistributed site equipment; (2) plant energy; (3) liquid waste processing; (4) nuclear liability insurance; (5) taxes; (6) licenses and permits; (7) health physics equipment and supplies; and (8) small tools.

81

Period-Dependent Costs

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 7.1-7.7) (1986)

After an introduction, the following topics are discussed under Period-Dependent Costs: (1) decommissioning periods; (2) period durations; (3) management and staffing; (4) utility project staffing; and (5) decommissioning operations contractor staffing.

82

Decommissioning Schedule Development

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 6.1-6.14) (1986)

After an introduction, the following topics are discussed under Decommissioning Schedule Development: (1) schedule development; (2) generic overall project schedule; and (3) critical path work activity guidelines and their bases.

83

Unit Factors

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost

Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 5.1-5.74) (1986)

After an introduction, the following topics are discussed under Unit Factors: (1) development of unit factors; (2) cost elements of unit factors; (3) unit factor format; (4) adjustment factors for work duration; (5) application of unit factors; and (6) application of nonroutine factors.

84

Decommissioning Alternatives, Process and Work Activities

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 3.1-3.17) (1986)

The following topics are discussed under Decommissioning Alternatives, Process and Work Activities: (1) decommissioning alternatives; (2) work activities for prompt removal/dismantling; (3) work activities for entombment with delayed dismantling; and (4) work activities for mothballing with delayed dismantling.

85

Use of Cost Estimating Guidelines

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 2.1-2.15) (1986)

The following topics are discussed under Use of Cost Estimating Guidelines: (1) decommissioning alternative review and selection; (2) site tour; (3) assumptions development; (4) decommissioning work activity development; (5) inventory plant equipment and structures; (6) develop unit factors; (7) equipment/structure decontamination and removal costs; (8) decommissioning crew requirements; (9) calculate waste disposal costs; (10) program schedule development; (11) develop decommissioning staff; (12) calculate activity development costs; (13) calculate collateral and special item costs; (14) calculate period dependent staff costs; and (15) calculate total decommissioning costs.

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Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates - Volume 1

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp. (1986)

These guidelines were prepared in response to a nuclear industry need to facilitate the preparation of cost estimates to decommission nuclear power plants. The objective of these guidelines is to enhance the credibility and thoroughness of cost estimates by providing a detailed breakdown of costs to measurable, comprehensible levels. This will ensure that all estimates employing the guidelines will properly identify and account for all activities and elements of cost. These guidelines were prepared for decommissioning commercial nuclear power reactors of the pressurized water reactor and boiling water reactor types. Chapter 1 describes the background, objectives, and scope of the document and presents the general organization of the guidelines study. A separate abstract has been prepared for each of the thirteen additional chapters. Volume 1 contains a description of the suggested cost estimating methodology and supporting reference information.

87

NEA Finds No Problem with Costs

Nuclear Engineering International 32(392):42-43 (1987, March)

A report from the OECD Nuclear Energy Agency concludes that decommissioning costs will be a relatively small fraction of the lifetime cost of a nuclear power plant and that delayed dismantling is economically preferable. The cost estimates are based on previous experience with decommissioning small nuclear facilities, with maintenance and component replacement costs in large nuclear plants, and with similar nonnuclear work.

88

Sweden Plans Earlier Phase-Out

Nuclear Engineering International 32(396):6-7 (1987, July)

The Swedish Government has proposed to its Parliament that a first nuclear unit be permanently shutdown between 1993 and 1995 in its plans to phase out nuclear reactors. The last of the 12 reactors must be shut down not later than 2010 under current Swedish law. Future replacement electricity needs will be met through a conservation program and nonnuclear replacement power plants.

89

CEGB Orders Decommissioning Studies

Nuclear Engineering International 32(398):6 (1987, September)

The Central Electricity Generating Board (CEGB) has awarded contracts for detailed studies on decommissioning of its early Magnox nuclear stations. The four year contracts cover the areas of safety, engineering, and project management. While there are no definite plans for nuclear power station decommissioning, the CEGB is gaining practical experience and developing a basis for future planning.

90

Survey of Older Operating Reactors

Nuclear Engineering International 32(399):48-49 (1987, October)

This article consists of three tables listing: (1) power reactors which had been shut down as of August 1987; (2) operating reactors which will be over 40 years old by the year 2000; and (3) operating reactors which will be over 30 years old by the year 2000. Each table lists the country, the number of reactors in the category indicated by the table's title, the reactor's power and type, and operating dates or start-up date. For the shutdown reactors, notes on decommissioning are given.

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Proving Decommissioning Techniques with the JPDR

Nuclear Engineering International 32(399):49-50 (1987, October)

NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

Decommissioning of the Japan Prototype Demonstration Reactor (JPDR), a 90 MW(t) BWR which operated between 1963 and 1976, began on December 4, 1984. The reactor and its ancillary buildings are to be completely removed and the site landscaped by 1992. Dismantling the reactor is the second phase of a decommissioning research program which started in 1981. The first phase, which ended in 1985, involved the development of dismantling techniques. Phase two is designed to prove the feasibility of using these techniques to decommission a commercial plant. The anticipated schedule for dismantlement of the JPDR reactor is presented in this paper along with descriptions of the methods and equipment to be used for the work.

92

Decommissioning: Where is it Going?

Radwaste News 5(19):157 (1984, November 19)

There are indications that regulators such as the Environmental Protection Agency are in the process of significantly restricting the standards for decommissioned facilities. There is much uncertainty over the real criteria for future decommissionings and the sources for funding. Understandably, vendors worldwide are gearing up for a long and stable market for decommissioning.

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A.T. Kearney, Inc., Washington, DC; Baker Engineers, Beaver, PA

Protocol for Evaluating Interim Status Closure/Post-Closure Plans

Report; 87 pp. (1986, August)

This protocol has been developed to provide a format for evaluating the quality of interim status closure and post-closure plans approved by states or by EPA Regions. It is divided into four major parts: (1) Facility Information; (2) Available Records; (3) Closure/Post Closure Plan Checklist; and (4) Guidance for Evaluation of Closure and Post-Closure Plans. The structure of the protocol lends itself to a multi-level review of approved plans. The reviewer can use Parts 1 and 2 to determine whether the administrative record for a facility is complete and whether the appropriate procedural requirements were followed. Utilizing Parts 3 or 4 of the protocol, the

reviewer can determine if the approved plan addresses all required elements of closure and post-closure (as applicable) and if the elements of the plan are technically sound and enforceable. This protocol is designed to focus on the documentation associated with the agency's initial review of the closure/post-closure plan, rather than on the technical judgements made during that initial review.

94

Atomic Energy Control Board, Ottawa, Ontario, Canada

Proposed Regulatory Policy Statement: Policy on the Decommissioning of Nuclear Facilities

Atomic Energy Control Board Consultative Document C-90 (1985, October 15)

The Atomic Energy Control (AEC) Regulations and the conditions of certain licenses prohibit a licensee from abandoning nuclear facilities or prescribed substances except in accordance with the conditions of the license, written instructions of the Atomic Energy Control Board (AECB) or its approval. This document outlines the AECB's policy concerning the decommissioning of nuclear facilities, decommissioning being a requirement of the AECB before it will agree to the abandonment of a facility. Nuclear facility decommissioning activities include all actions taken to retire the nuclear facility permanently from operation.

95

Azorsky, T.L., and H.L. Fenster, McKenna, Conner and Cuneo, Washington, DC

Managing the Present and Future Costs of Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.269-III.280) (1987)

The lack of state and federal standards for decommissioning and decontamination (D&D) of nuclear facilities may result in additional costs years after the D&D is complete. Increased costs may result from the applica-

NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

tion of certain environmental statutes to the facility or from personal injury and property damage, i.e. tort, litigation. Companies, operating facilities that provided a service or product for the government, have certain financial protections and certain immunities from suit. Companies operating commercial facilities, however, have little or no protection from future liabilities. Accordingly, this country needs federal standards for D&D, standards that would govern the level of decontamination required and protect companies completing the D&D effort from future liability.

96

Bergman, C., R. Boge, and J.O. Snihs, National Institute of Radiation Protection, Stockholm, Sweden

Decommissioning Policy in Sweden

CONF-871018; Decommissioning, G.A. Tarca (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.83-II.96) (1987)

In Sweden the nuclear power program is, according to a parliamentary decision, limited to twelve power producing reactors. The last reactor shall be taken out of service no later than the year 2010. As a result of the Chernobyl accident the program for taking the reactors out of service will be accelerated. This report is the first approach by the Swedish authorities to formulate a decommissioning policy. It is not the final policy document, but it discusses the principal questions from the Swedish viewpoint.

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

Criteria for Uncontrolled Release of a Depleted Uranium Manufacturing Facility

Proceedings of the Health Physics Society 33rd Annual Meeting, Boston, MA, July 4-8, 1988; (p. S7); Health Physics 54(Suppl. 1):S7 (1988)

Aerojet decommissioned its Compton, California, depleted uranium (DU) manufacturing facility. Final decontamination was started in May 1987 and completed in early 1988. The project included removal of subgrade tanks, pipes, and sewers, and extensive cleaning of the building structure. The cleaning efforts included extensive replacement of roofing, removal of a section of exterior building wall, concrete scabbling, and internal cleaning of electrical switch gear and lights. The decontamination was done under State of California license with on-site inspections by the County of Los Angeles. The release criteria, included in a license amendment, was California DECON 1, which is based on U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 (basically 5000 dpm/100 sq cm). The criteria for dispersed activity (e.g. soil) was 35 pCi/g DU averaged over a 15 cm depth and 100 sq m area, or a 3 m length for trenches. The surface contamination criteria of DECON 1 were implemented using a beta/gamma thin-window pancake G.M. probe. Implementation as based on the minimal use of area averaging or hot spot concepts and conservative detection efficiencies. The detector efficiency was verified using DU and other NBS traceable sources and intercomparison of smears counted on survey instruments and laboratory counting equipment. Facility decontamination and certification monitoring were performed by a contractor and performance was verified by third party inspection by Rogers and Associates.

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Bernow, S.S., and B.E. Biewald, Energy Systems Research Group, Inc., Boston, MA

Nuclear Power Plant Decommissioning: Cost Estimation for Planning and Rate Making

Public Utilities Fortnightly (871029):14-20 (1987, October 29)

Despite the inherent uncertainties in the projected life spans of nuclear power plants and widely disparate cost estimates for the safe decommissioning of those units, sufficient funds must be available when needed to assure the proper disposition of contaminated materials. The authors of this article analyze the differences between site-specific and generic cost estimates and suggest the use of process contingency factors as a means of providing more accurate projections of decommissioning costs.

NUCLEAR FACILITIES DECOMMISSIONING DESIGN, PLANNING, AND REGULATIONS

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Chapuis, A.M., P. Guetat, and H. Garbay, Commissariat à l'Energie Atomique, Institut de Protection et de Sureté Nucleaire, Department de Protection Technique, Fontenay-aux-Roses, France

Exemption Limits for the Recycling of Materials from the Dismantling of Nuclear Installations

CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.107-II.121) (1987)

Present regulations are not adequate for recycling or disposal of large quantities of waste from dismantled nuclear installations. Exemption limits may be set for particular types of materials normally produced during operation and dismantling. Exemption activity limits are based on dose levels and take into account the total mass of expected waste and all the possibilities of exposure. Case-by-case authorization procedures would only then be necessary for materials not treated by the exemption limits. Exemption limits for steel have been evaluated for some radionuclides. This evaluation is based on usual industrial practices and working condition measurements and leads to mass and surface activity limits.

100

Crijns, M.J., and J. Vira, Organization for Economic Cooperation and Development, Nuclear Energy Agency, Paris, France; Technical Research Centre of Finland, Helsinki, Finland

The Impact of Decommissioning on Electricity Generation Costs

CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.145-II.159) (1987)

By definition, the leveled decommissioning cost is the weighted average cost that should be charged for each unit of electricity produced through the lifetime of a facility, so that all costs of decommissioning of the facility are covered. Although the mode in which decommissioning costs enter the electricity rates

depends on utility and regulatory practices, the levelization offers a consistent means for estimating the cost impact of decommissioning. An international group of experts, called together under the auspices of the OECD Nuclear Energy Agency (NEA), has prepared estimates on leveled decommissioning costs for nuclear power plants, starting from the cost information provided by some of its member countries. Three basic strategies for decommissioning were considered, including immediate dismantling and two strategies for deferred dismantling. The Working Group calculated the leveled decommissioning costs for several assumptions on discount rates and reactor lifetimes. The calculations showed that decommissioning has a very small impact on electricity generation cost of a large nuclear power plant. The uncertainties in cost estimates, applicable interest rates, or facility operating lifetimes are large but still unlikely to significantly affect this conclusion.

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Interagency Task Force Report on the Proposed Decommissioning of the Sheffield Nuclear Waste Disposal Site

Report; 128 pp. (1979, September)

The decision makers and legal staffs of the State of Illinois and the U.S. Nuclear Regulatory Commission have requested that this interim document be prepared to define the current status of the Sheffield Nuclear Waste Disposal site (SNWDS). Its purpose is to collect and present pertinent facts and informal opinions of the task force to those entities concerned and/or involved with the problems of decommissioning and long-term custodial care of the site. The objectives of decommissioning of the site are reviewed and their current status evaluated with the conclusion that none of the objectives has been fully met. The exposure pathways from radionuclides buried at the site to man are explored. The information and uncertainties involved in understanding and predicting the long-term performance of the site are discussed. Many uncertainties concerning regulatory and institutional aspects exist primarily because of the long time frames involved. Ten alternatives are described.

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ranging from doing nothing to complete exhumation. None of the alternatives should be chosen until the U.S. Geological Survey and other geotechnical studies have been completed. No cost/benefit analyses have been done to assess the alternatives. In spite of all the present uncertainties, the task force can make certain recommendations. Alternatives IX (total migration control by man-made structures) and X (exhumation) provide the greatest assurance of protection of the public but at the highest premium both in costs and in the case of Alternative X, worker exposure and possible environmental releases. It is the task force's opinion that Alternative VI or VII (stabilized trenches with covers and optional perimeter drains) will afford the best long-term protection of the environment because site stability is provided and minimum active maintenance is required. No health and safety reasons currently exist that would preclude an orderly decommissioning of the site following completion of geotechnical studies.

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Decommissioning Nuclear Facilities Following Postulated Accidents

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1338-1349) (1987, July)

Nuclear facilities that have undergone accidents must be cleaned up and restarted or decommissioned. The cost, safety and technology of cleanup and decommissioning of fuel cycle and non-fuel cycle facilities have been analyzed. Cost and safety data have been developed for reference mixed oxide and various fuel plants, a pharmaceutical lab and an ore processing facility. Comparisons have been made with normal decommissioning and information is provided on 10 CFR 61 impacts.

103

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

IAEA Activities in Decommissioning and Decontamination

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. I.16-I.29) (1987)

To assist Member States in the development and implementation of the required decommissioning expertise, the International Atomic Energy Agency (IAEA) is developing an integrated database covering, in a systematic way, the wide range of technical, regulatory, and safety aspects associated with the decommissioning and decontamination (D&D) of all types of nuclear facilities, sites, and large contaminated areas. The program also includes the maintenance and refurbishment of nuclear facilities and the rehabilitation and closeout of uranium mill tailings impoundment facilities.

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Fuller, P.E., American Nuclear Insurers, Farmington, CT

Decommissioning - An Insurance Perspective

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1963-1974) (1987, July)

The nuclear insurance pools, through American Nuclear Insurers (ANI) and the Mutual Atomic Energy Liability Underwriters (MAELU), have been providing third-party nuclear liability insurance to the nuclear industry since 1957. Third-party liability and property damage coverage resulting from the nuclear hazard are provided by separate insurance policies issued by the nuclear insurance pools. This paper addresses a liability insurer's view of decommissioning by discussing the following: (1) Insurer's perspective of potential nuclear liability, (2) Insurance claim experience and trends, (3) Objectives and accomplishments of ANI/MAELU's involvement with facility decommissioning, (4) Important nuclear liability considerations for facility decommissioning.

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Fuller, P.E., American Nuclear Insurers, Farmington, CT

Decommissioning - An Insurance Perspective

CONF-871018; Decommissioning. G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.281-III.292) (1987)

The nuclear insurance pools, through American Nuclear Insurers (ANI) and the Mutual Atomic Energy Liability Underwriters (MAELU), have been providing third-party nuclear liability insurance to the nuclear industry since 1957. Third-party liability and property damage coverage resulting from the nuclear hazard are provided by separate insurance policies issued by the nuclear insurance pools. This paper addresses a liability insurer's view of decommissioning by discussing the following: (1) insurer's perspective of potential nuclear liability; (2) insurance claim experience and trends; (3) objectives and accomplishments of ANI/MAELU's involvement with facility decommissioning; and (4) important nuclear liability considerations for facility decommissioning.

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Gibson, S.M., and W.L. Carter, Oak Ridge National Laboratory, Oak Ridge, TN

Technical and Economic Assessment for Decommissioning the Air Force Nuclear Engineering Center, Wright-Patterson AFB, Ohio: Hazardous Waste Remedial Actions Program

DOE/HWP-35; 264 pp. (1987, August)

Each of four options was screened for the entombed nuclear reactor on the basis of technical feasibility, environmental impact, economics, and fulfillment of the goals of the Installation Restoration Plan. The four options for study were: facility upgrade and surveillance program; removal of radioactive material inside the entombment and adjacent facilities; the latter plus removal of concrete monolithic structure; or raze all structures and restore site to allow unrestricted use. All options are technically feasible, but the handling of

radioactive metal and concrete materials requires careful foreplanning. The first has the potential for the highest environmental impact because no radioactive materials will be removed. Some atomic species will not decay to acceptable levels to allow unrestricted access for centuries. The environmental impacts for the remaining options are short-term and focus on the decommissioning activities, primarily waste disposal, occupational exposure, and waste transportation. Economic assessment of the four options was based on past experience with similar decontamination and decommissioning projects.

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Gupta, B., Atomic Energy of Canada Limited, Montreal, Quebec, Canada

Cost Estimation for Gentilly-1 Decommissioning

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1723-1733) (1987, July)

The preparation of a credible decommissioning cost estimate is made more difficult due to a lack of an accepted industry methodology standard. It is also a complex task because there is a large variety of plant inventories, radioactive levels, waste volumes and decommissioning options to be considered. Atomic Energy of Canada Limited, as a part of the Gentilly-1 decommissioning study utilized a rational cost estimation methodology. A computer program called DECOM and used it to estimate radioactive waste volume, decommissioning cost and radiation exposure to workers was also developed. During the actual decommissioning period, April 1984 to April 1986, this program was used again to compare actual man-hours and costs against those estimated two years previous.

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Knowles, A.N.

Nuclear Power: Policy and Prospects

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Decommissioning, Jones, P.M.S. (ed.). John Wiley and Sons, Chichester, England, United Kingdom; (pp. 157-168) (1987)

This paper discusses nuclear power station decommissioning. The reactors that are partially or completely decommissioned are listed, including: the reactor at Elk River; the advanced gas-cooled reactor at Windscale; and the Shippingport reactor. The three stages of decommissioning are defined and the benefits of delaying decommissioning until the level of activity decreases are discussed. The wastes resulting from decommissioning, the cost, and packaging problems are considered. Some generalized comments are made concerning decommissioning active process plants. General features on simplifying plant decommissioning are listed. Although there are no major technical problems in decommissioning, the scale of the operation does make organization and logistics difficult.

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Decommission Plans for Loviisa 1 and 2 Units in Finland

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.350-IV.360) (1987)

The Loviisa Nuclear Power Plant consists of two VVER-440 type PWRs. The first unit started commercial operation in May 1977 and the second unit in January 1981. The plant operator, Imatra Power Company, plans to start decommissioning the units to Stage III by about 2015. The plant will be decontaminated but the buildings and structures will not be dismantled unless radiation levels cannot be brought down to comply with existing standards, or unless the buildings are in the way of new construction. The plant site will continue to be used for future power production. The decommissioning plan is to remove and transport the reactor, the reactor internals, and the steam generators to the final storage repository as intact components. The final storage repository is in a rock cavern at a depth of 100 meters. The reactor pressure vessel will be removed in one piece and serve as a waste package for reactor internals and dummy fuel elements. The dummy fuel elements were put into the

reactor core peripheral area as neutron absorbers to decrease the neutron dose to the pressure vessel and to decrease radiation embrittlement.

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Decommissioning Cost Estimating and Contingency Application

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.16-V.33) (1987)

State public utility commission regulators and the U.S. Nuclear Regulatory Commission have recognized the need to assure the availability of funds to safely decommission nuclear power plants when they reach the end of their useful lives. Cost estimates for decommissioning need to reflect the changes in labor and material costs due to inflation, changes in waste disposal costs for packaging, transporting and burying radioactive materials, and the site-specific factors for each unit that account for differences in plant design and construction. Decommissioning activities involve remote tooling to segment the reactor vessel and internals, decontamination of contaminated systems to reduce occupational exposure, controlled blasting to demolish concrete structures, and removal and disposal of radioactive wastes by controlled burial. The unforeseeable problems encountered in performing these activities result in additional costs that are accounted for through contingency. This paper summarizes the recent progress in nuclear power plant decommissioning cost estimation and contingency application. The important factors to be included in planning for the establishment of a decommissioning fund are identified, and typical results of recent estimates are provided. The nuclear industry is probably one of the first industries to plan for the eventual retirement of its facilities, and the public needs to be aware of these efforts.

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LaGuardia, T.S., and R.I. Smith, TLG Engineering, Inc., Brookfield, CT; Pacific Northwest Laboratory, Richland, WA

Decommissioning of First-Generation Nuclear Power Plants in the United States

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PNL-SA-15077; (Preprint, 19 pp.); IAEA-CN-48/21; CONF-870911; Technical and Economic Performance of Nuclear Power, Proceedings of an International Conference, Vienna, Austria, September 28, 1987 (1987)

The plans and estimated costs for the first-generation of utility nuclear power plants in the United States are discussed in this paper. These plans are being prepared to satisfy utility planning needs and regulatory requirements to establish a basis for collecting a decommissioning fund from a charge to ratepayers. The technology to be used in the dismantlement will be summarized, including the plans for waste transportation and disposal. Estimates of radioactive waste volumes and worker exposures are presented. The estimated costs for decommissioning are provided for the principal categories of dismantlement activities in decommissioning the first-generation pressurized water reactors and boiling water reactors. Relevant experience from decommissioning projects and related reactor operations maintenance activities in the U.S. are presented.

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

Nuclear Decommissioning

NOR-4124; 17 pp. (1987, January)

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 Windscale Advanced Gas-cooled Reactor. 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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Levy, L.H., Northeast Utilities, Hartford, CT

The Utility Perspective Regarding Nuclear Power Plant Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.293-III.306) (1987)

Nuclear plant decommissioning has become an important public issue over the past several years mainly due to increasing cost estimates and publicity from the media concerning nuclear energy. From the nuclear utility perspective, it is of utmost importance that they are allowed to recover from their customers enough revenue that will adequately cover the expense of decommissioning their nuclear plant by the time of retirement. A major hindrance to this recovery is the \$100 million certification amount identified in the proposed U.S. Nuclear Regulatory Commission (NRC) Rule on Decommissioning. Current experience with site-specific studies of large scale nuclear power plants have shown the costs to be substantially higher. The Rule, therefore, should encourage the use of site-specific studies in lieu of the \$100 million generic certification amount which can, and has been used by regulators as a ceiling on rate recoveries for decommissioning. Another important issue is whether the technology available today is sufficient to dismantle a large commercial nuclear plant. Experience from Elk River and Shippingport, as well as operating plant maintenance activities such as steam generator replacements, thermal shield removals, and reactor coolant piping replacements, have proven that the technology is more than adequate to handle a large nuclear plant dismantlement. These issues as well as NRC decommissioning regulations, decommissioning funding methods, and cost estimates are discussed in this paper.

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Lough, W.T., Virginia State Corporation Commission, Richmond, VA

Public Attitudes Toward Nuclear Power Plant Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.307-III.313) (1987)

A public workshop was conducted with a group of citizens to obtain the concerns and preferences of the group with respect to decommissioning. Seventeen concerns about decommissioning were identified and prioritized.

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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 were also rated highly. The estimated increase in electric utility rates was not a major concern. The participants were split fairly evenly on preferences about the methods of decommissioning. However, nine of the ten participants preferred power plant life extension over decommissioning by any method. Finally the participants were given an evaluation questionnaire about the workshop. In general, they concluded that the process was effective.

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Shutdown Decision for the Nuclear Power Plant KRB A at Gundremmingen

Nuclear Power Plant Life Extension, Proceedings of an NEA/IAEA Symposium, Paris, France, February 27, 1987. Organization for Economic Cooperation and Development, Paris, France; (pp. 143-163) (1987)

The nuclear power station Gundremmingen unit A (KRB A) was built from 1962 to 1966 as the first of three demonstration nuclear power stations in the Federal Republic of Germany. At the time, the two-cycle boiling water reactor corresponded to the stage of development of General Electric and had an electrical power output of 250 MW. During its operations from 1966 to 1977, KRB A delivered approximately 15,000 GWh to the public power supply and attained an average capacity factor of approximately 75%, and in several operating years averaged over 90%. In January 1977, the facility was placed out of operations due to an accident. The associated repairing and back-fitting measures would have led to several years shutdown and considerable costs, without the guarantee of a long-term operating license being granted. For these reasons and also due to progress in the construction of the two 1300 MW(e) units B and C at the same site, it was decided to decommission the facility in early 1980.

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Organizing and Conducting Decommissioning Cost and Exposure Estimates

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1924-1937) (1987, July)

The methodology for organizing and conducting decommissioning cost and exposure estimates is described in relation to a methodology flow diagram. The working tools include a work breakdown structure, description, logic diagram, cost element summary, and computerized estimating.

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The Importance of Funding in Decommissioning Cost Estimates

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.361-IV.367) (1987)

Decommissioning cost estimates have been made by several study groups for the decommissioning of pressurized water and boiling water nuclear power stations. The results of these studies are comparable when corrected for inflation and the differences in contingency factors applied by the study groups. The estimated dismantling costs differ far less than a factor of two in all cases, despite the design differences found in the plants that were studied. An analysis of the different methods available for funding the dismantling of these facilities shows the much stronger effect that the choice of funding methods has on the net cost of decommissioning. The total cost of dismantling may vary more than a factor of four from one funding method to another, assuming current or recent historical inflation rates. The funding methods evaluated include sinking funds, deposits, negative-salvage value depreciation, and insurance. These funding methods are taken from the Nuclear Regulatory Commission's Notice of Proposed Rulemaking description of acceptable funding methods. The funding analysis for this paper is performed using the DECOST-86 computer

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code, which is a code designed for decommissioning cost and funding analysis. The evaluation of funding options for a nuclear facility, and the appropriate choice of the funding method best for that facility, are found to be more important than detailed engineering studies in determining the net cost of decommissioning during the early portions of a plant's operating lifetime. This finding is independent of the difficulty in determining available decommissioning technology up to 30 years in advance of actual decommissioning.

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Notz, K.J., Oak Ridge National Laboratory. Oak Ridge, TN

Decommissioning of the Molten Salt Reactor Experiment, A Technical Evaluation

ORNL/RAF-17; 101 pp. (1988, January)

This report completes a technical evaluation of decommissioning planning for the former Molten Salt Reactor Experiment, which was shut down in December, 1969. The key issues revolve around the treatment and disposal of some five tons of solid fuel salt which contains over 30 kg of fissionable uranium-233 plus fission products and higher actinides. The chemistry of this material is complicated by the formation of elemental fluorine via a radiolysis reaction under certain conditions. Supporting studies carried out as part of this evaluation include: (a) a broad scope analysis of possible options for storage/disposal of the salts; (b) calculation of nuclide decay in future years; (c) technical evaluation of containment facility and hot cell penetrations; (d) review and update of surveillance and maintenance procedures; (e) measurements of facility groundwater radioactivity and sump pump operation; (f) laboratory studies of radiolysis reaction; and (g) laboratory studies which resulted in finding a suitable getter for elemental fluorine. In addition, geologic and hydrologic factors of the surrounding area were considered, and also the implications of entombment of the fuel in-place with concrete. The results of this evaluation show that the fuel salt cannot be left in its present form and location permanently. On the other hand, extended storage in its present form is quite acceptable for 20 or 30 years, or even longer. For continued storage in-place, some facility modifications are recommended. To provide a basis for future, permanent disposal, the material should be melted and repackaged into smaller containers, to facilitate handling. During this operation, a fluorine getter can be

added, which will eliminate the need for periodic reheating. The repackaged material can then be stored for an additional period of time, in a manner similar to remotely-handled TRU waste, an operation already being conducted routinely ORNL. In the repackaged and gettered form, interim storage can be done safely for many years. Final disposal can then follow any number of pathways, none of which are actually available today, but all of which are technically sound, including: (1) disposal in a high-level waste repository, (2) disposal in the Waste Isolation Pilot Plant, (3) disposal via intermediate depth disposal, or (4) blending in with a fluoride-based high-level liquid waste from reprocessing at other DOE sites. Utilization of the melt-repackage-dispose concept should save many millions of dollars relative to the original reprocess-dispose concept. In addition, because melt-repackage is much simpler than reprocessing and uses only benign or inert chemicals, it poses a far smaller threat to both the environment and to the operators assigned to the task. The existing facility was inspected and all cell penetrations catalogued and examined. These were found to be in acceptable condition, but several improvements are recommended: capping off some additional lines to assure against accidental water entry, and providing additional isolation valves to two instrument lines to avoid accidental leakage. During the course of this study an excellent getter for elemental fluorine in a radiation field was discovered. A patent disclosure was submitted and an application is being filed on this invention.

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Decommissioning of Nuclear Power Plants and Their Life Extension

Jaderna Energie 33(3):81-88 (1987, March)

Two basic variants are given for the decommissioning of nuclear power plants and for ways of acquiring the means to cover the decommissioning costs. A study done in the U.S. which investigated the cost to extend the life of a 1000 MW LWR nuclear power plant is briefly discussed. For Czechoslovakia four variants are given for the end of service life of WWR power plants, namely: (1) the construction of alternate sources at the level of unit power (WWR 1000, later even higher); (2) extending the life of the WWR 440 and prospectively also the WWR 1000; (3) extending the operation by 5 years beyond the

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planned life without shutdown for restoration; or (4) by extending operation by 10-20 years following shutdown for restoration. The economic evaluation of all three variants is presented. The third variant appears to be the best.

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Decommissioning of the Olkiluoto Nuclear Power Plant

YJT-87-15; 51 pp. (1987, December)

A conceptual plan is presented for the decommissioning of the Olkiluoto nuclear power plant. Deferred dismantlement after a storage period of 30 years is the main alternative. No detailed work plan for the demolition of structures is included. However, the world-wide development of demolition techniques for nuclear facilities has proven that the task can be performed using the existing technology. The decommissioning waste will be packed into concrete containers and wooden boxes. The total package volume is estimated at 8,000 and 30,000 cu m depending on the treatment method. The higher figure stands for packing without any volume reduction. The activated reactor core components (fuel channels, control rods, neutron flux detectors) from the operational time of the Olkiluoto power plant are included in the decommissioning plan. The total activity of the contaminated and activated structures to be dismantled will be about 1×10^{16} Bq after 30 years from the shutdown. The corresponding figure for the activated core components will be about 2×10^{16} Bq. The radiation doses to personnel can be kept very low if the surface contamination of the large systems remains at a low level as it has done so far. The decommissioning waste is planned to be disposed of at the Olkiluoto site next to the reactor waste repository in the granitic bedrock at a depth of 50-100 m. The decommissioning waste repository will consist of two silos for the low-level waste and a hall for the activated metal waste. The barriers in the case of the metal waste hall will consist of the waste packages themselves, of 0.75 and 1 m thick concrete walls, of the 1 m thick bentonite/crushed rock backfill, and of the bedrock. The dismantlement will be finished by the year 2050, and the repository can be closed and sealed by 2055. The estimated decommissioning cost is FIM 808 million including the long-term storage and disposal.

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Onodera, S., S. Yanagihara, T. Kitanaka, and M. Tanaka, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development and Verification of Code System for Management of Reactor Decommissioning (COSMARD) for the JPDR Decommissioning

CONF-871618; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.67-V.78) (1987)

A code system for management of reactor decommissioning (COSMARD) has been developed to estimate management data such as manpower, worker exposure, and cost related to the decommissioning of the Japan Power Demonstration Reactor (JPDR). It is also possible to make schedules of the dismantling activities by PERT calculations using the data in the code system. Researchers at the Japan Atomic Energy Research Institute (JAERI) have used the COSMARD to evaluate and plan the dismantling activities in the JPDR decommissioning program. During this study, the COSMARD proved to be a useful tool for the management of the decommissioning activities.

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Decommissioning at Ground Level - Sizewell and the Uncertainties of Faith

Land Use Policy 5(1):45-62 (1988, January)

The development of nuclear power is based on a faith which the public places in technology to solve all problems. Decommissioning of nuclear power plants will be the next leap the public is asked to make. This article uses evidence from the Sizewell inquiry to identify generic and geosocial decommissioning uncertainties and discusses them within a policy and research framework. Six conclusions are advanced: social uncertainties will not be resolved within technical context alone; decommissioning costs are underestimated; most

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decommissioning decisions must be made on a case-by-case, not generic, basis; decommissioning should be included routinely in local land planning decisions; further nuclear development should await decommissioning experience; and decommissioning should be included in all future nuclear policy decisions.

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Pasquini, L.A., J.K. Shillenn, J.R. Vincenti, and W.F. Witzig, UNC Nuclear Industries, Inc., Shippingport Station Decommissioning Project Office, Shippingport, PA; Pennsylvania State University, University Park, PA

A Survey of Commercial Nuclear Facility Decommissioning Plans

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1566-1573) (1987, July)

A number of nuclear facilities in the United States that have become or are about to become likely candidates for decommissioning over the next 5 to 15 years have been surveyed on their decommissioning plans. Survey items included in the study were questions identifying the size, location and start-up date of the facility and decommissioning plans relating to the estimated date of decommissioning, the extent of decommissioning planning to date, the planned decommissioning mode (DECON, SAFSTOR or ENTOMB), contracting plans, method of contracting and financing. Of the 93 questionnaires mailed out to these facilities, 66 respondents provided varying amounts of information relating to their decommissioning plans. This report summarizes those responses and the indicated trends that can be concluded from the data.

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

Electric Rate and Corporate Regulation Filings: 5 - Vermont Yankee Power Corp.

Federal Register 52(132):26072-26073; DOCKET ER85-300-000 (1987, July 10)

On June 25, 1987, Vermont Yankee Nuclear Power Corporation filed a revised schedule of decommissioning collections that effectuates the terms of an Offer of Settlement approved by the Federal Energy Regulatory Commission on September 18, 1985. Vermont Yankee states that the compliance filing revises the schedule of decommissioning collections to reflect the reduction in the federal corporate income tax rate effective July 1, 1987 and the limitation on net operating loss carrybacks enacted by the Vermont legislature.

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Computer Program for Estimating Decommissioning Costs of Nuclear Power Plants

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.79-V.88) (1987)

During the initial decommissioning studies on the Gentilly-1 Nuclear Station, Atomic Energy of Canada Limited (AECL) developed a computer program (DECOM) that can be used for estimating decommissioning costs. DECOM utilizes approximately 150 models or Unit Cost Factors to describe the various decommissioning activities. In addition to providing cost estimates, DECOM can compute predicted radiation exposure to workers and waste volumes for nearly any decommissioning scenario. The program, which has been converted for use on an IBM-PC type microcomputer, has been used for computing decommissioning estimates for both CANDU (Canada Deuterium Uranium) and pressurized water type reactors. It can be adapted to other types of reactors and may be extended to nonnuclear facilities with suitable modifications of the cost codes. To test the validity of the cost estimates prepared using DECOM, a sample of actual cost and man-hour data from the Gentilly-1 decommissioning operation has been processed using DECOM. Results indicate that the total cost figures were accurate within a 20% range, though costs for individual activities in some instances differed.

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Rechard, R.P., M.S.Y. Chu, and S.L. Brown, Sandia National Laboratories, Albuquerque, NM

SRS: Site Ranking System for Hazardous Chemical and Radioactive Waste

DOE/HWP-26; 294 pp. (1988, May)

This report describes the rationale and presents instructions for a site ranking system (SRS). SRS ranks hazardous chemical and radioactive waste sites by scoring important and readily available factors that influence risk to human health. Using SRS, sites can be ranked for purposes of detailed site investigations. SRS evaluates the relative risk as a combination of potentially exposed population, chemical toxicity, and potential exposure of release from a waste site; hence, SRS uses the same concepts found in a detailed assessment of health risk. Basing SRS on the concepts of risk assessment tends to reduce the distortion of results found in other ranking schemes. More importantly, a clear logic helps ensure the successful application of the ranking procedure and increases its versatility when modifications are necessary for unique situations. Although one can rank sites using a detailed risk assessment, it is potentially costly because of data and resources required. SRS is an efficient approach to provide an order-of-magnitude ranking, requiring only readily available data (often only descriptive) and hand calculations. Worksheets are included to make the system easier to understand and use.

127

Rubenstein, L.S., U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, DC

Proposed Issuance of Orders Authorizing Disposition of Component Parts and Terminating Facility License: Westinghouse Electric Corporation Nuclear Training Reactor

Federal Register 52(177):34732-34733; DOCKET 50-87 (1987, September 14)

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of Orders authorizing the dismantlement of the Westinghouse Electric Corporation Nuclear Training Reactor. These Orders would be

issued following NRC's acceptance of a complete decommissioning plan for the reactor. After decommissioning is completed and acceptable radioactive levels have been reached, a second Order terminating the license of the facility would be issued. The procedure to petition for intervention in the hearings concerning the issuance of these orders is discussed at length.

128

Shapiro, J., Harvard University, Environmental Health and Safety, Cambridge, MA

HPS/ANSI Health Physics Guide

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.122-II.131) (1987)

The recently approved standard of the Health Physics Society Standards Committee on surface radioactivity guides for materials, equipment, and facilities to be released for uncontrolled use is discussed. The comments received by the committee on the limits and measurement methods are reviewed. Major topics include the limits for total alpha radioactivity, the reduction in the limits for natural uranium and thorium, the distinction between fixed and loose radioactivity, and hazard analyses relating to the limits.

129

Speer, D.R., and P.A. Holmes, Rockwell Hanford Operations, Richland, WA; UNC Nuclear Industries, Inc., Richland, WA

Decommissioning Project Readiness Reviews at the Department of Energy's Hanford, Washington, Site

RHO-WM-SA-87; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.56-V.66) (1987)

Two Hanford Site contractors independently formulated readiness review methods to prepare for decontamination and decommissioning (D&D) projects. One readiness review method provided a review by synopsis

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directly involved in the project and concise documentation procedures. A unified system is now used at Hanford which combines the best aspects of both readiness review methods. The unified method assigns category levels based on certain job characteristics. The category assigned to the project then indicates the required level of management review prior to proceeding with the D&D project. In addition, the concise documentation procedures are now used for all category levels.

130

Stearn, S.M., HM Inspectorate of Pollution, London, United Kingdom

The Recycle and Reuse of Components Arising from Decommissioning Nuclear Installations: An Overview

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.100-III.114) (1987)

Recycling offers savings in both acquiring new materials and disposing of old. This must be set against the associated economic, social and administrative costs. There is considerable experience with the problems involved, and research is in hand to expand our understanding of these. Materials may be recycled within the nuclear industry only if there is a ready use for it. Release for unrestricted use depends on the existence of suitable criteria and a means to assure compliance with them. The interaction between these two factors could be a determinant factor. Work is in progress to prepare workable release criteria based on a dose to the public of not more than 10 microsieverts, and a figure of 1 Bq/g is proposed. Quality assurance will be important in any recycling program. Public acceptance is crucial and unrestricted release must not operate so as to jeopardize this.

131

Tawil, J.J., Pacific Northwest Laboratory, Richland, WA

Using Cost/Risk Relationships in Restoring Radiologically Contaminated Sites

PNL-SA-15069; Nuclear Power Performance and Safety, Proceedings of an International Confer-

ence, Vienna, Austria, October 1, 1987; (22 pp.) (1987, September)

In the event of a major radiological accident at a nuclear power plant, large populated areas could become severely contaminated. In the United States, local public officials would have the responsibility of establishing radiation recovery criteria or cleanup levels that would allow the displaced members of the population to return safely to their jobs and homes. The range of acceptable criteria could imply variations in property losses in the billions of dollars. Given the likely public concern over the health consequences, and the magnitude of the potential property-related losses, a cost/risk analysis can provide important input to establishing the recovery criteria. This paper describes procedures for conducting a cost/risk analysis, using the Indian Point reactor site in New York State as a case study. The procedures are illustrated with the aid of computer software developed for determining the property and health effects of major reactor accidents. The software is also used to demonstrate how a decontamination plan might be developed by evaluating a number of alternative decontamination strategies.

132

Taylor, M.

The CEBG Gets Set for Magnox Decommissioning

Nuclear Engineering International 32(399):52 (1987, October)

A new round of investigations that have been instigated by the Central Electricity Generating Board (CEGB) are announced. The objective of these investigations is to complete a Pre-Decommissioning Safety Report (PDSR) for both the Berkeley and the Bradwell Magnox nuclear stations. These reports will help CEGB to define its decommissioning plans. Completion of the PDSRs is expected in three years. The work for the PDSRs has been divided into four parts: (1) a technical support function to the CEGB; (2) a safety study; (3) an engineering methods study; and (4) a project management study. Each of the four parts is described.

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U.S. Department of the Treasury, Internal Revenue Service, Washington, DC

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Income Taxes: Special Rules Relating to Nuclear Decommissioning Costs

Federal Register 53(42):6800-6821 (1988, March 3)

This document contains final regulations relating to the Federal income tax treatment of nuclear decommissioning costs. Changes to the applicable law were made by the Tax Reform Act of 1984 and the Tax Reform Act of 1986. The regulations affect all taxpayers that include nuclear decommissioning costs in cost of service for ratemaking purposes.

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

Final Environmental Statement for Decommissioning Humboldt Bay Power Plant, Unit No. 3 (Docket No. 50-133)

NUREG-1166-F; DOCKET 50-133; 164 pp. (1987, April)

The Final Environmental Statement contains the assessment of the environmental impact associated with decommissioning the Humboldt Bay Power Plant Unit 3 pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, of the Nuclear Regulatory Commission regulations. The proposed decommissioning would involve safe storage of the facility for about 30 years, after which the residual radioactivity would be removed so that the facility would be at levels of radioactivity acceptable for release of the facility to unrestricted access.

135

U.S. Nuclear Regulatory Commission, Washington, DC

Meeting of the Advisory Panel for the Decontamination of Three Mile Island, Unit 2, GPU Nuclear Corporation

Federal Register 53(106):20195-20196; DOCKET 50-320 (1988, June 29)

Notice is hereby given pursuant to the Federal Advisory Panel for the Decontamination of Three Mile Island, Unit (TMI-2) will be meeting on July 14, 1988, from 7:00 p.m. to 10:00 p.m. at the Holiday Inn, 23 South Second Street, Harrisburg, Pennsylvania. The meeting will be open to the public. At this meeting, the Panel will receive a status report on the progress of defueling from the licensee, GPU Nuclear Corporation. The Panel will also conduct a working session to review the recently issued draft supplement to the Programmatic Environmental Impact Statement, NUREG 0683 (Supplement 3).

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U.S. Nuclear Regulatory Commission, Washington, DC

General Requirements for Decommissioning Nuclear Facilities - Final Rule

Federal Register 53(123):24018-24056 (1988, June 27)

The Nuclear Regulatory Commission (NRC) is amending its regulations to set forth technical and financial criteria for decommissioning licensed nuclear facilities. The amended regulations address decommissioning planning needs, timing, funding methods, and environmental review requirements. The intent of the amendments is to assure that decommissioning of all licensed facilities will be accomplished in a safe and timely manner and that adequate licensee funds will be available for this purpose. The final rule also contains a response to a petition for rulemaking concerning financial assurance, initially filed by the Public Interest Research Group on July 5, 1977.

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U.S. Nuclear Regulatory Commission, Washington, DC

General Requirements for Decommissioning Nuclear Facilities

Federal Register 53(126):24679-24682 (1988, June 30)

The Nuclear Regulatory Commission (NRC) staff is in the process of reappraising its regulatory position relative to the decommissioning of nuclear facilities. The

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initial part of this activity consisted of obtaining the information base to support subsequent regulatory changes. Highly detailed studies were completed, through technical assistance contracts, of the technology, safety, and costs of decommissioning various nuclear facilities. These studies were, in turn, utilized along with other information to prepare a draft environmental impact statement. On February 11, 1985, NRC published a notice of proposed rulemaking on decommissioning criteria for nuclear facilities. The final report, NUREG-0586, is being published based on public comment on the draft report and on the proposed rule as well as on updated information in the technical information base. This statement is required because the regulatory changes that might result from the reevaluation of decommissioning policy may be a major NRC action affecting the quality of the human environment.

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U.S. Nuclear Regulatory Commission, Washington, DC

Environmental Assessment and Finding of No Significant Impact Regarding Termination of Operating License No. CX-10: Babcock and Wilcox Critical Experiment Facility

Federal Register 53(36):5481; DOCKET 50-13 (1988, February 24)

The U.S. Nuclear Regulatory Commission is considering issuance of an Order Terminating Facility Operating License No. CX-10 for the Babcock and Wilcox Critical Experiment Facility located in Lynchburg, Campbell County, Virginia, in accordance with the application dated August 7, 1984, as supplemented. Babcock and Wilcox is requesting authorization to decontaminate and dismantle its critical experiment facility, to dispose of its components parts in accordance with the proposed dismantling plan, and to terminate the facility operating license. NRC has determined not to prepare an environmental impact statement for the proposed action. Based upon the foregoing environmental assessment, it is concluded that the proposed action will not have a significant effect on the quality of the human environment.

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U.S. Nuclear Regulatory Commission, Washington, DC

Dairyland Power Cooperative: Notice of Consideration of Issuance of Amendment to Facility License and Opportunity for Hearing

Federal Register 53(68):11718-11719 (1988, April 8)

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an amendment to Provisional License No. DPR-45, issued to Dairyland Power Cooperative for the La Crosse Boiling Water Reactor (LACBWR) located in Vernon County, Wisconsin. The amendment would involve approval of the LACBWR Decommissioning Plan and associated Technical Specifications (TS) and an extension of the Provisional License. On April 30, 1987, LACBWR was permanently shut-down. All spent fuel has been transferred from the reactor to the Spent Fuel Storage Well and the Provisional License was amended to "process but not operate" status. This amendment would: (1) approve the Decommissioning Plan which involves 30-50 years of on-site storage of residual radioactivity followed by its removal (SAFSTOR); (2) revision of TS to reflect the long term storage of fuel and residual radioactivity on-site; and (3) extension of the Provisional License for 40 additional years to be consistent with 10 CFR 50.51, which restricts the period of time of a license extension to 40 years, and consistent with the period time outlined in the Decommissioning Plan.

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Webster, D.

Juggling the Figures

SCRAM (Scotish Campaign to Resist the Atomic Menace): Anti-Nuclear and Safe Energy Journal (Nov-Dec 1987):12-13 (1987, November-December)

There are three options for handling a nuclear reactor when it reaches the end of its operating life: (1) simply withdraw the fuel rods and leave the structure standing, (2) entombment, or (3) dismantling. The United Kingdom Atomic Energy Authority (UKAEA) has chosen to dismantle the WAGR reactor. This decision is criticized

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on the grounds that it will create large quantities of radioactive dust and liquids and disperse the radioactivity throughout the environment. The removal of the low- and intermediate-level wastes will be expensive. They will be packaged in reinforced concrete boxes, however, no disposal site has been found for the wastes yet. Greenpeace supports the option of leaving retired reactors alone until a better option is available for waste disposal. Greenpeace argues that dismantling an AGR will not give the UKAEA the dismantling experience it needs because the Magnox reactors will end their service life first, and the decommissioning techniques needed will be different.

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Weil, L., and R. Goertz, Federal Ministry for the Environment, Nature Conservation and Reactor Safety, Bonn, Federal Republic of Germany; Brenk Systemplanung, Aachen, Federal Republic of Germany

Health and Safety Aspects of Decommissioning Relevant to Licensing

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.114-V.128) (1987)

In the Federal Republic of Germany, plans for decommissioning nuclear power plants and other nuclear facilities must contain safety goals that comply with existing standards and regulations. This paper discusses some health and safety aspects of decommissioning which are important issues within the licensing procedure. The purpose of the licensing procedure is to establish the following safety goals: (1) to protect life, health, and property against the hazards of nuclear energy and the harmful effects of ionizing radiation; (2) to provide compensation for the damage caused by nuclear energy or ionizing radiation; (3) to prevent any unnecessary radiation exposure; (4) to keep all types of radiation exposure as low as practical, even where the values are below the specified limiting values; (5) 30/90 MREM/A-concept; (6) planning value for incidents; (7) arrangements for mitigating the consequences of accidents or incidents; and (8) utilization of radioactive residues without harmful effects and disposal of radioactive

waste. The licensee has to prove that his decommissioning plan meets these central goals and thus the workers, the public and the environment are adequately protected.

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Whitehead, E., Atomic Weapons Research Establishment, Aldermaston, United Kingdom

Decommissioning Work at the Atomic Weapons Research Establishment UK

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1531-1540) (1987, July)

A program of decommissioning work at AWRE is identified and the policy and strategy being adopted is discussed. A phased approach is described covering the planning and operational stages of the work. Development of decommissioning technology is recognized as a key factor and important areas are described. Design for decommissioning is discussed and principles identified.

143

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

Decommissioning Costs: Coal Compared to Nuclear

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.97-II.106) (1987)

A comparison is made of the cost of decommissioning nuclear power plants and the cost of decommissioning coal-fired power plants. The comparison examines assumptions and labor factors and makes adjustments to enhance the similarity of the bases for selected previous cost estimates before comparing results of the cost estimates. Results indicate that the decommissioning cost of a large coal-fired power plant can be expected to be similar, on a dollar per megawatt basis, to that for a nuclear power plant.

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Berger, C.D., Oak Ridge National Laboratory, Oak Ridge, TN

Alpha, Beta, Gamma Spectrometer for Directing Decontamination of Soils

Health Physics 44(6):684-688 (1983, June)

An alpha, beta, gamma spectrometry system is described which permits rapid assessment of particulate and photo-emitter contamination in soils at sufficiently low concentrations to direct initial field decommissioning and decontamination operations. In order to check the accuracy of this system, soil samples known to be contaminated with Pu-239, Sr-90 and Cs-137 were analyzed, after which radiochemical analyses were performed on the samples. The estimated Pu-239 activities from both of these measurement techniques are given. Of particular importance is the applicability of the system during initial surveys when characterization of alpha and beta contamination in the presence of a high gamma background is necessary.

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

Post-Remedial-Action Radiological Survey Report for the Plutonium Facility of the Battelle Memorial Institute, Columbus Division, West Jefferson Complex, West Jefferson, Ohio, April 1980-June 1982

ANL-OHS/HP-85-103; 107 pp. (1987, January)

The post-remedial-action surveys involved only the remaining, newer segment of the original Plutonium Facility and those outdoor environs at the former location of the buried autoclave and old holding tanks. The assessment activities conducted during the three surveys included determination of surface contamination levels, both fixed and removable, through direct instrument and smear surveys; measurement of ambient external penetrating radiation levels at 1-meter heights throughout the involved areas; measurement of the concentrations of

radon, thoron, and actinon daughters and longer-lived radionuclides within air samples; and determination of concentrations of uranium, plutonium, americium, neptunium, the thorium-232 decay chain, and the radium-226 decay chain in soil and other material samples from the involved areas. The direct instrument and smear surveys were performed on all accessible floor, wall, and overhead surfaces and ductwork in the laboratory and corridor areas, mechanical room, and men's locker room, where the false ceiling, formerly at the 12-ft level, had been removed. In the office areas, the accessible floors, walls, and overheads were surveyed to the height of the existing 8-ft false ceiling. Although the office areas were adjacent to, not part of, the affected areas, it was possible that radioactive materials could have been carried by the ventilation system, spilled, or otherwise tracked into these adjacent areas. In some building areas, surfaces might have been retiled, painted, or otherwise covered since the beginning of use of radioactive materials; however, the instruments used for the direct survey had some capability to detect beta-gamma activity on the underlying surfaces.

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

Monitoring for Compliance with Decommissioning Termination Survey Criteria

NUREG/CR-2082; ORNL/HASRD-85; 195 pp. (1981, June)

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

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presented here furnishes part of the data base being established by the U.S. Nuclear Regulatory Commission in its reappraisal of regulations for decommissioning of licensed facilities.

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U.S. Department of Energy, Washington, DC

Decommissioning and Decontamination Program: Battelle Plutonium Facility, Environmental Assessment

DOE/EA-0092; 23 pp. (1979, September)

This assessment describes the decontamination of the Battelle-Columbus Plutonium Facility and the removal of all material contamination which was associated with or produced by the Plutonium Facility from the site. Usable uncontaminated material will be disposed of by procedures normally employed in scrap declaration and transfer. Contaminated waste will be transported to approved radioactive waste storage sites.

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

Decommissioning of the Rare Earths Facility, West Chicago, Illinois: Draft Supplement to the Final Environmental Impact Statement of June 1983

NUREG-0904 (Suppl. 1); EIS-87-0220 (Draft); 491 pp. (1987, June)

Decommissioning of the Rare Earths Facility, a nuclear facility in West Chicago, Cook County, Illinois, is proposed. The site, which contains three contiguous parcels, is owned by the Kerr-McGee Chemical Corporation. The eight-acre factory parcel was used for manufacturing operations, offices, and the utility supply system. The 27-acre disposal and storage parcel was used for disposal and storage of ore residues, sludges, and liquids from the factory. The eight-acre intermediate parcel lies between the other two parcels and was purchased to provide unrestricted access between the parcels. As a result of years of operation involving radioactive materials, the equip-

ment and buildings on the site have become contaminated with thorium, and the disposal site contains relatively large quantities of residual materials. The preferred decommissioning plan would involve licensed storage of contaminated waste on the storage parcel for at least five years. Implementation of the project would allow for safe interim disposal of contaminated material at the site and safe use of two of the three parcels. Removal of the unsightly structures at the site would improve the appearance of the area. Decommissioning activities would increase fugitive dust emissions from the site, resulting in increases in radioactive and nonradioactive air pollution in off-site areas. Radon would continue to be released into the surrounding area of Chicago for a relatively long period.

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

Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident, Three Mile Island Nuclear Station, Unit 2 (Docket No. 50-320): Draft Supplement Dealing with Post-Defueling Monitored Storage and Subsequent Cleanup

NUREG-0683 (Suppl. 3)(Draft); 201 pp. (1988, April)

In accordance with the National Environmental Policy Act, the Nuclear Regulatory Commission's (NRC's) implementing regulations, and its April 27, 1981, Statement of Policy, the Programmatic environmental impact statement (PEIS) related to decontamination and disposal of radioactive wastes resulting from the March 28, 1979 accident at Three Mile Island Nuclear Station, Unit 2 (NUREG-0683) is being supplemented. This draft supplement updates the environmental evaluation of cleanup alternatives published in the PEIS, utilizing more complete and current information. Also, the draft supplement includes a specific environmental evaluation of the licensee's recently submitted proposal for post-defueling monitored storage. The NRC staff has concluded that the licensee's proposal to place the facility in a monitored storage configuration will not significantly affect the quality of the human environment. Further, any impacts from the long-term storage of the facility are outweighed by its benefits.

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Valenti, P.J., C.W. McVay, and P. Bourgeois

WVNS Experiences in the Detection, Monitoring, and Leakage from Underground Tanks Containing Contaminated Kerosene/TBP

Transactions of the American Nuclear Society 52:55-56; Proceedings of the American Nuclear Society 1986 Annual Meeting, Reno, NV, June 15, 1986; (pp. 55-56) (1986)

Tanks of radioactively contaminated kerosene/tributyl phosphate (TBP) disposed of at West Valley in 1969, when the plant was being utilized to reprocess commercial nuclear fuel, were determined to be leaking. Contaminated kerosene/TBP was initially detected in November 1983 when samples taken from U.S. Geological Survey monitor wells tested positively for both radioactive and organic constituents. An extensive moni-

toring, sampling, and analysis program, which involved the installation of 100 monitor points, core bores, and scavenger wells, has been in effect since November 1983 when the migrating kerosene/TBP was initially discovered. Sample analysis has served to provide data on the radionuclide concentration as the kerosene/TBP migrates through the soil. Recent acquisition of a portable gas chromatograph is expected to yield even more definitive information on migration rates. Removal of organics from the scavenger wells will continue while more permanent control measures are finalized. The current efforts will involve the installation of a support structure, erection of a light-weight reusable weather shelter, excavation and potential removal of the tanks and contents, as well as packaging and/or otherwise stabilizing of the resulting waste. The significance of this project is that it will provide a data base for future work in former radioactive disposal sites. A discussion of the monitoring, sampling, and analysis is provided in conjunction with the stabilization efforts.

NUCLEAR FACILITIES DECOMMISSIONING HEALTH, SAFETY, AND BIOMEDICAL STUDIES

151

Brookes, I.R., Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, Gloucestershire, United Kingdom

Operational Advantages of Enhanced Primary Circuit Clean-Up Flow Rate Prior to Cold Shutdown for Refuelling Sizewell 'B'

CEGB-TPRD/B-0885/R86; 50 pp. (1986, October)

During the course of taking a pressurized water reactor (PWR) from power to cold shutdown conditions for refueling, a large spike of activity appears in the coolant. This paper investigates the way radioactivity in the coolant changes with time. It examines the affect of filtering/demineralizing rates on activity levels in the coolant. This is done by establishing a mathematical relationship between activity in the coolant, the time after shutdown and the cleanup rate. Several practical examples are used to demonstrate the general validity of the relationship and to find numerical values for parameters. The mathematical expression is used to generate the type of activity-time behavior that could be expected for Sizewell B. By varying the parameters describing the cleanup rate, it is possible to show how much time may be saved by increasing the cleanup flow rate. It is found that augmenting the cleanup flow by either connecting the refuel pool or spent fuel pool cleanup systems in parallel with the cooled, depressurized primary circuit will realize time savings between one and six days over the range of parameters studied.

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European Demolition Association, Den Haag, Netherlands

Health and Safety in the Demolition and Dismantling Industry

Report; 55 pp. (1987, May)

This report describes health and safety aspects in the demolition and dismantling industry. The demolition contractor uses a wide range of techniques depending on the structures and their construction materials. The demolition industry's future growth will be complicated by health and safety issues, environmental restrictions, the need to recycle, and the handling of hazardous materials. Workplace environmental factors that are

addressed include: climatic factors, light, noise, vibration, radiation, toxic substances and fumes, dust, and ergonomic factors. In the area of health and safety protection the employer is legally responsible for providing a safe working situation while the employee is obligated to use protective equipment and report dangerous situations to the employer. Demolition work can only be performed safely under the leadership and supervision of specialists who ensure that the workers are provided with properly approved equipment, are familiar with the current provisions, and have taken the necessary safety measures, such as issuing personal protective equipment. There is such variety in demolition techniques and objects requiring demolition that it is impossible to describe a set of working conditions which apply equally to every demolition worker. The most common hazards to which the demolition worker is exposed at work are: falls and tripping, falling materials, uncontrolled collapse of structures, incorrect use of plant or equipment, fire and explosion, electricity, becoming wedged in, and chemicals (gases, fumes and liquids). Personal protective equipment, first aid, hygiene, and clothing are other health and safety consideration areas which are addressed. Recommendations are made in the areas of: (1) responsibility; (2) demolition plan; (3) workplace; and (4) occupational health monitoring of demolition operatives. Tabulated data are presented for noise levels associated with various demolition techniques. Vibration in demolition work, whole-body vibration, and hand-arm vibration effects are topically discussed. Lead toxicology and asbestos are addressed as key topics with recommendations to avoid high levels of exposure, and to monitor both the workers health and the concentrations to which they will be exposed. A recommendation concerning asbestos handling safety as contained in the Provisional Record of the International Labor Conference's 72nd session, Geneva, 1986, is included. The recommendation outlines and details: scope and definitions, general principles, protective and preventive measures, surveillance of the working environment and workers' health, and information and education.

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Hildebrand, J.E., and M.J. Slobodien, GPU Nuclear Corporation, Parsippany, NJ

Radiation Protection Aspects of the TM1-2 Accident and Cleanup

Environmental Consequences of Energy Production: Problems and Prospects, Majumdar, S.K.,

NUCLEAR FACILITIES DECOMMISSIONING HEALTH, SAFETY, AND BIOMEDICAL STUDIES

F.J. Brenner, and E.W. Miller (eds.). Pennsylvania Academy of Science, Phillipsburg, NJ; (pp. 406-418) (1987)

On March 28, 1979, the fuel core of the Three Mile Island Unit 2 (TMI-2) nuclear reactor was severely damaged. The purpose of this paper is to discuss the radiation protection aspects of the accident and the cleanup effort. It is evident that the TMI-2 experience brought about an overall improvement in radiation safety for the nuclear work force. Activities at TMI-2 have provided considerable information on cleanup and health protection procedures for health physicists. Only minor amounts of radiation was ever received by the off-site population. Health studies are continuing to assess the long-term impact of the accident. The paper shows that as a result of comprehensive dose reduction measures, effective job planning, and a strong management, the cleanup job was performed with minimal health risk.

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International Atomic Energy Agency, Vienna, Austria

Methods for Reducing Occupational Exposures During the Decommissioning of Nuclear Facilities

Technical Reports Series 278; Report of a Technical Committee Meeting, Prague, Czechoslovakia, October 21, 1985. International Atomic Energy Agency, Vienna, Austria, 42 pp. (1987)

The decommissioning and decontamination of nuclear facilities is a topic of great interest to many Member States of the International Atomic Energy Agency (IAEA) because of the large number of older facilities which have been or soon will be retired from service. This report is a review of the current state of knowledge concerning methods for reducing occupational exposures during the decommissioning of nuclear facilities. This report focuses on water cooled nuclear power plants. In addition, other major nuclear facilities are briefly discussed to determine how they differ from water cooled power plants. The information presented should be useful in designing and constructing nuclear facilities, or in planning or implementing decommissioning activities of such installations.

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Mobley, E.V., EG&G Idaho, Inc., Idaho Falls, ID

Preliminary Safety Analysis Report for the Decontamination and Decommissioning of the ARVFS NaK

EGG-WM-7802; 79 pp. (1987, September)

This document presents the safety analysis for the decontamination and decommissioning (D&D) of the contaminated NaK (sodium-potassium) eutectic solution stored at the Army Reentry Vehicle Facility Site (ARVFS). The D&D activity of processing NaK has been planned and designed to meet appropriate safety standards. A plan to process four containers of contaminated NaK eutectic solution (180 gallons of liquid metal), including transuranics, into a waste form acceptable for disposal has been developed. The NaK is stored in two 55-gallon drums and two vessels fabricated from pipe sections. The containers have been stored in an underground bunker at the ARVFS located near the center of the Idaho National Engineering Laboratory (INEL).

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Nair, R.P., M.D. Maan, and S. Schafer, Atomic Energy of Canada Limited, Montreal, Quebec, Canada

Comprehensive Radiological Protection Program - An Essential Element of Successful Decommissioning

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp 1378-1389) (1987, July)

The decommissioning of the 250 MW(e) Gentilly-1 nuclear plant over a two-year period called for a clearly defined radiation protection program. The decommissioning activities were carried out within the framework of radiation protection guidelines and techniques structured so that all the elements of the program could be applied for the future handling of more radioactive facilities.

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Niemczyk, S.J., Gull Associates, Washington, DC

Estimation of the Risk from Residual Radioactivity

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.89-V.103) (1987)

A new approach for estimating the potential radiation hazard from residual radioactivity at decontaminated sites and facilities has recently been developed to aid the U.S. Environmental Protection Agency's selection of decommissioning criteria for regulatory purposes. The approach is intended to generate conservatively realistic estimates of radiation doses to on-site residents from radioactivity both in the environment and in buildings. It does so using a comprehensive yet relatively simple set of physically-based, state-of-the-art risk-level environmental transport and exposure pathway models. The transport models have been interfaced to permit time-dependent, mechanistic consideration of radioactive transfers within and among the various environmental media. Radioactive decay and in-growth are explicitly accounted for. Doses in contaminated multiroom buildings are estimated using a set of unique transport and exposure models. The overall approach has been encoded in a computer code REUSEIT which runs on a personal computer.

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Niemczyk, S.J., Gull Associates, Washington, DC

A New Approach for Estimating the Risk from Residual Radioactivity

Proceedings of the Health Physics Society 33rd Annual Meeting, Boston, MA, July 4-8, 1988; (p. S7); Health Physics 54(Suppl. 1):S7 (1988)

To aid the U.S. Environmental Protection Agency's selection of decommissioning criteria for unrestricted release of cleaned-up sites and facilities, a new approach has been developed for estimating the potential hazard from residual radioactivity. That approach, intended to provide conservatively realistic estimates of radiation doses to individual residents from such radioactivity in the environment and in buildings, uses a comprehensive

yet relatively simple set of physically-based, risk-level environmental transport and exposure pathway models. Doses are estimated for up to 10,000 years. Compared to other approaches which might be used for residual radioactivity, the new approach has several outstanding features. First, some of its models are less conservative than the comparable models in other approaches, thus reducing the likelihood of unwarranted over-estimation of certain doses. Second, the new approach includes models for estimating certain doses due to the neglect of contributions from "other" rooms (as happens in the one-room models typically used). Third, the approach's integrated set of transport and behavior models permits straightforward consideration of situations with significant movement of radioactivity within the environment and/or significant radioactive in-growth, thus helping to prevent overlooking of situations in which the largest potential doses occur at times long after the site's release. Fourth, the approach's extremely efficient solution techniques, combined with its comprehensive set of transport and behavior models, make consideration of a large variety of situations practical. And fifth, the approach has been implemented in a computer code which runs on a personal computer, making the approach accessible to a wide number of users. The new approach constitutes a significant first step toward a set of comprehensive relationships for providing radiation dose estimates for residual radioactivity at a variety of sites and facilities. As such it serves to fill a significant gap in the spectrum of available approaches.

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Parfitt, B.A., and E.F. Gee

Lessons Learned at TMI: Cleanup for Respiratory Protection

Transactions of the American Nuclear Society 54; CONF-870601; Proceedings of the American Nuclear Society 1987 Annual Meeting, Dallas, TX, June 7-11, 1987; (30 pp.) (1987)

The March 28, 1979, accident at Three Mile Island Unit 2 (TMI-2) presented GPU Nuclear with technical challenges unprecedented in the nuclear power industry. Among these challenges were a myriad of health physics problems that had to be solved to ensure a radiologically safe environment for workers performing cleanup activities. The application of the As Low As Reasonably Achievable (ALARA) philosophy has been a fundamental aspect in protecting cleanup workers. The unique

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conditions produced by the accident, however, have necessitated novel and innovative approaches in making this philosophy effective. The option to use respirators is based on which method will result in the lowest radiation dose to the worker. Inherent to this program has been the training of workers to overcome the perception that any internal contamination is of foremost concern and is orders of magnitude greater in biological effect than an identical external dose. It is, of course, the total dose (internal dose plus external dose) that must be minimized to implement a true ALARA philosophy. The need for considering the total radiation dose when making decisions to use respirators has been clear during the TMI-2 cleanup. Prescribing respirators is not always good for the ALARA concept.

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Whittaker, M.S., Chem-Nuclear Systems, Inc., Columbia, SC

Radiological Assurance on Decommissioning Projects

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.324-III.331) (1987)

Decommissioning projects present unique challenges to radiological safety staffs due to changing conditions as the project progresses as well as the differences from one project to another. These challenges are increased for companies, like Chem-Nuclear Systems, Inc., that perform several projects simultaneously and that employ a variety of subcontractors for various aspects of the project, often utilizing local unskilled labor. Lessons learned in the development of Quality Assurance programs can be applied to the problem of maintaining radiological safety on diverse projects. This paper describes the Radiological Assurance program currently in place at Chem-Nuclear to assure that corporate safety policy and goals are being met on decommissioning projects at multiple and temporary job sites.

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Decontamination Technology - A U.S. Perspective

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.75-IV.85) (1987)

Substantial progress has been made in the U.S. since the 1982 International Decommissioning Symposium in developing, demonstrating, and applying chemical and selected nonchemical decontamination techniques. Although much of this progress has been motivated by the decontamination requirements of operating facilities, the resulting technology is directly applicable to decommissioning-related decontamination needs. This paper provides an overview of these advances and applications to provide a U.S. perspective for the decontamination technology and application presented at the 1987 Symposium.

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Augustin, X., and S. Cohen, Societe Technique pour l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France; Societe de Travaux en Milieu Ionisant, Gif-sur-Yvette, France

Methods and Techniques for Decontamination Design and Construction of Facilities

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 256-275) (1986)

The Societe Technique pour l'Energie Atomique (TECHNICATOME) and the Societe de Travaux en Milieu Ionisant (STMI) have jointly solved a wide range of problems specific to decontamination, beginning with facility design studies all the way through facility operation. TECHNICATOME has brought its expertise in the design and construction of nuclear facilities to bear, in

particular, with decontamination and radwaste management. STMI is an experienced operator with expertise in designing tools and developing advanced techniques in the same fields. The expertise of both companies in this field, acquired through many years, has resulted in the development of techniques and tools adapted to most of the decontamination problems, including specific cases.

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

Decommissioning Plan Depleted Uranium Manufacturing Facility

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 711 pp.; (pp. 533-538) (1987)

Aerojet Ordnance Tennessee, Inc. (Aerojet) is decommissioning its California depleted uranium (DU) manufacturing facility. Aerojet has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Source Materials License. The decontamination is being performed by a contractor selected for technical competence through competitive bid. Since the facility will be released for uncontrolled use it will be decontaminated to levels as low as reasonably achievable (ALARA). In order to fully apply the principle of ALARA, and ensure the decontamination is in full compliance with appropriate guides, Aerojet has retained Rogers and Associates Engineering Corporation (RAE) to assist in the decommissioning. RAE has assisted in characterizing the facility and preparing contract bid documents and technical specifications to obtain a qualified decontamination contractor. RAE will monitor the decontamination work effort to assure the contractor's performance complies with the contract specifications and the decontamination plan. The specifications require a thorough cleaning and decontamination of the facility, not just sufficient cleaning to meet the numeric radiation cleanup criteria.

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

Decontamination and Decommissioning of Depleted Uranium Manufacturing Facility

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.176-III.188) (1987)

Aerojet Ordnance Tennessee, Inc. (Aerojet) is decommissioning its Compton, California, depleted uranium manufacturing facility. Aerojet has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Source Materials License. The decontamination and certification of cleanup is being managed by an independent company, Rogers and Associates Engineering Corporation, and the removal of government facilities and the decontamination of the facility is being performed by a contractor. The facility will be released for uncontrolled use and is being decontaminated in accordance with the U.S. Nuclear Regulatory Commission Guide 1.86. It will be decontaminated to levels as low as reasonably achievable (ALARA). The removal of government facilities/equipment was performed in early 1987. The decontamination of the facility was started in May 1987, and is scheduled for completion in August 1987.

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Beyer, V., Power Clean Industry, Mannheim, Federal Republic of Germany

A High Efficiency Suction System for Use in Controlled Areas

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.238-IV.242) (1987)

Special equipment has been used effectively for more than six years by Power Clean Industry in retrofitting, renovating, and decommissioning operations at nuclear facilities. The main components of the system are: (1) the

suction and conveyor hose (inner diameter up to 100 mm); (2) the blower with electric drive; and (3) the rubble and dust separator including a precleaner (cyclone) and high efficiency particulate filters. Precleaner, filters, and blower are mounted in a mobile rack. The conveyed materials are discharged directly into drums or containers for subsequent further conditioning. The system is capable of pneumatically suctioning and conveying: (1) dust of various consistency; (2) concrete and brickwork rubble and rubbish; (3) ion exchange and filter materials, e.g. charcoal, resins, diatomite, and sand; (4) insulating materials, e.g. asbestos, stone, and glass wool; and (5) sludges and residual liquids. These materials can be conveyed over distances up to 180 meters and level differences up to 25 meters. The efficiency of the dust separation and filter system is such that the exhaust air can be discharged directly to the working area atmosphere. The release limits for radioactively contaminated material and for hazardous material applicable to controlled areas are met by this system.

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Blazek, J., E. Hladky, D. Majersky, and V. Rehacek, Nuclear Power Plants Research Institute, Trnava, Czechoslovakia

Decontamination for Decommissioning of Nuclear Plant A-1

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.153-IV.168) (1987)

Nuclear Power Plant A-1 (NPP A-1), a CO₂-cooled and heavy water moderated reactor with a 150 MW(e) output, was shutdown in February 1977 after five years of operation. Considering the existing technological base and the availability of waste management and disposal facilities in Czechoslovakia, the NPP A-1 is currently under decommissioning to the first upgraded stage (according to the IAEA classification), with partial dismantling of the secondary and selected auxiliary circuits. The objective of the research described was: (1) to characterize the contaminated corrosion layers on both secondary and auxiliary circuit surfaces; (2) to develop chemical and electrochemical decontamination techniques enabling reduction of personnel exposure during dismantling and decontamination procedures; and (3) to elaborate a fundamental approach to the assessment of acceptable limits of radioactivity in material released for reuse.

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Decontamination Studies Related to Garigliano BWR Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.86-IV.100) (1987)

Garigliano BWR is a 160 MW(e) power plant which operated from 1964 to 1978. In 1982 the Italian Electricity (ENEL) Board of Directors declared it out-of-service. Specific studies were started to select the best decommissioning alternatives. A feasibility study on dismantling and decontamination of all the building components was performed in preparation for decommissioning of the turbine building. Specific experimental activities were started in the decontamination field. A program which deals with the dismantling and decontamination of the tube bundle of a feed-water preheater is the most important and significant task. The aim of this research is to decontaminate the tubes as much as possible in order to reach the unrestricted material release limits. Preheater No. 4, which was operated at the highest temperature and pressure, was selected for the experiments. The bundle has tubes with 16 mm OD in AISI Type 304. The tubes are about 12000 m long and are covered with a radioactively contaminated oxide layer both inside and outside. The contamination was measured to be about 65 Bq per sq cm and is mainly Co-60. Other decontamination studies reviewed include decontamination tests on small valves with aggressive chemicals, spent decontaminant treatment, and decontamination tests with more recent chemical processes. Part of the work presented in this paper is being carried out as a jointly funded project with the Commission of the European Communities, as part of the Community Research Program on the Decommissioning of Nuclear Installations (1984-1988).

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Bridenbaker, W.A., and L. Clemons, West Valley Nuclear Services Company, Inc., West Valley, NY

Decontamination of the Scrap Removal Room at the West Valley Demonstration Plant

DOE/NE-44139-33 (1987, February)

This report describes the decontamination and decommissioning (D&D) of the Scrap Removal Room (SRR) at the West Valley Demonstration Project (WVDP). The SRR is an area in the former reprocessing plant that is required for use in support of D&D for other plant areas. The SRR contained a 5.8 Mg (7.5-ton) crane for loading waste material into a shielded truck cask. 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.

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Brown, B.W., R.M. Geimer, D.M. LaRue, F.E. Stoll, R.H. Meservey, and C.L. Maggart, EG&G Idaho, Inc., Idaho Falls, ID

Proposed Decommissioning of Radioactively Contaminated NaK

EGG-M-05787; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987; (10 pp.) (1987, October)

This paper deals with a proposed method for stabilizing radioactively contaminated eutectic sodium/potassium (NaK) liquid metal. Approximately 680 liters (180 gal) of contaminated liquid NaK were generated in 1955 during testing with the Experimental Breeder Reactor (EBR-I) at the Idaho National Engineering Laboratory (INEL). Reaction of the NaK with chlorine gas to produce solid salts of sodium and potassium is proposed as a means to stabilize this waste. Preliminary testing was initiated to determine the reaction conditions required for this process. It was found that reaction with chlorine is feasible for safely treating the liquid metal.

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Conti, M., M. Mincarini, B. Bottelli, F. Mantega, and M. Oriani, Comitato Nazionale per l'Energia

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Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative, Rome, Italy; Centro Informazioni Studi Esperienze, Milano, Italy

Chemical Decontamination of the In Pile "CART-TC" Loop for Decommissioning Purposes, Some Evaluation on the Managing Aspects of the Aggressive Solutions in Radioactive Areas

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.169-IV.186) (1987)

The paper briefly describes the experience gained and the lesson learned in testing both soft and hard chemical solutions in the decontamination of the in pile CART-TC loop, located in the ESSOR reactor at the European Communities JRC of Ispra, Italy. The main objective of the work is to extend laboratory tests to a real, small-scale loop in order to get operating experience on chemical decontamination of significant nuclear reactor systems and to evaluate the real advantages and limits of this technique in decommissioning activities. The main investigations were conducted to obtain knowledge on: (1) testing both commercial and experimental chemical solutions; (2) operating problems in an aggressive environment; and (3) waste reduction and management. An evaluation of the extension of this decontamination technique to the power plant itself was made.

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Cruickshank, A.

TMI 2 Puts Robots to the Test

Nuclear Engineering International 32(399):18-20 (1987, October)

The accident at Three Mile Island Unit 2 (TMI-2) resulted in radiation exposure levels which severely limit the stay time in some areas, and completely preclude entry into others. As a result it has been necessary to use remotely operated equipment, or robots to decontaminate the facility. The robots used to decontaminate TMI-2 are described in this article. Their functions and any modifications to the original unit are also discussed.

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

Decontamination and Decommissioning of the West Valley Reprocessing Plant

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1253-1293) (1987, July)

This paper addresses the decontamination and decommissioning (D&D) activities at the West Valley site. The topics addressed are: (1) D&D of areas for reuse in the Liquid Waste Treatment System (LWTS), (2) D&D of areas for reuse for High Level Waste (HLW) canister storage, and (3) technologies developed in D&D work.

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West Valley Decommissioning Cost Benefit Analysis for Reuse of Nuclear Facilities

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1949-1962) (1987, July)

A cost benefit analysis is presented for the decommissioning of the nuclear fuel reprocessing plant at West Valley, New York. Plant characterization, evaluation of plant areas for reuse, decontamination methods, and the bases for cost estimation and decommissioning planning are discussed. Cost benefits are quantified and conclusions are drawn.

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Decontamination and Non-Pollutive Re-Use of System Parts Dismantled from Nuclear Facilities

High Serve - Services for Nuclear Engineering, Bauer, K.G. (comp.), Proceedings of a Trade Conference and Exhibition of Deutsches Atomforum e.V., Bonn, Federal Republic of Germany, October 22, 1986. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany; (pp. 286-299) (1986)

Decontamination of contaminated plant parts has a twenty year history in the Federal Republic of Germany. Major quantities have been decontaminated and re-used. Most of this was done in the Karlsruhe Nuclear Research Center. This paper briefly describes the current situation, regulations, methods for bulk reduction and decontamination, implemented decontamination actions, and experience gained with nonpolluting re-use.

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Doerge, D.H., R.L. Miller, and K.S. Scotti, UNC Nuclear Industries, Inc., Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects: Summary Status Report Three Mile Island Unit 2, Volume 1 - Reactor Coolant System and Systems Decontamination

NUREG/CR-4315 (Vol. 1); 40 pp. (1986, May)

This document summarizes information relating to the decontamination and restoration of the Three Mile Island Unit 2 (TMI-2) reactor coolant system and other plant systems. Data have been collected from activity reports, reactor containment entry records, and other sources and entered in a computerized data system which permits extraction/manipulation of specific data which can be used in planning for recovery from a loss of coolant event similar to that experienced by TMI-2 on March 28, 1979. A summary of radiation exposures, manpower, and time spent in radiation areas during the referenced period is given. Support activities conducted outside of radiation areas are not included. Computer reports included are: (1) a chronological listing of all activities related to decontamination and restoration of the reactor coolant system and other plant systems for the period of April 5, 1979, through December 19, 1984; (2) a summary of labor and exposures by department for the same time

period; and (3) summary reports for each major task undertaken in connection with this specific work scope during the referenced time period.

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Doerge, D.H., R.L. Miller, and K.S. Scotti, UNC Nuclear Industries, Inc., Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects: Summary Status Report - Three Mile Island Unit 2 Reactor Building Decontamination (Technical rept. 1 Jun 79-29 Mar 85)

NUREG/CR-4315 (Vol. 2); 164 pp. (1986, May)

This document summarizes information concerning decontamination of the Three Mile Island Unit 2 reactor building which was grossly contaminated as a result of the loss of coolant accident experienced on March 28, 1979. Data collected from activity reports, reactor containment entry records, and other sources were placed in a computerized information retrieval/manipulation system which permits extraction/manipulation of specific data which could be utilized in planning for recovery activities should a similar accident occur in a nuclear generating plant. The information is presented in both computer output form and a manually assembled summarization. The report contains only the man-hours spent and radiation exposure actually incurred during performance of tasks in radiation areas and does not include support activities outside of radiation areas. The report covers the period of activities from June 1, 1979 through March 29, 1985.

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

U.S. Department of Energy Three Mile Island Research and Development Program: 1987 Annual Report

GEND-063; 76 pp. (1988, April)

Defueling of the Three Mile Island Unit 2 (TMI-2) reactor continued through 1987. This report summarizes this work and other TMI-2 related cleanup, research, and development activities. Other major topics include: waste immobilization; core transportation, receipt, and

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storage; abnormal waste; Accident Evaluation and Technical Integration Programs; and future uses and applications of TMI-2 data. While the technology being developed is of direct benefit to the recovery operations at TMI-2, it will also benefit the entire nuclear power industry.

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Development of a Process for the Removal of Radioactively Contaminated Coatings from Concrete Structures, When Repairing or Shutting Down Nuclear Plant

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.117-IV.133) (1987)

In nuclear installations, surfaces of structural and plant components are given protective coatings to prevent radioactive contamination. The aim of the project described in this paper was to develop and test a process for the removal of contaminated coatings. Experimental equipment was built to test the performance of the coating removal process, which is based upon the rapid cooling of the coating with liquid nitrogen. The process subjects the coating to strong stresses, resulting in the separation of the coating from the component. Results of the tests are described.

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Funakawa, N., T. Kinoshita, and T. Tanaka, Sato Kogyo Company, Limited, Tokyo, Japan

New Method for Decontamination of Concrete with Milling Cutter

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.217-IV.229) (1987)

Previously, techniques for removing contaminated concrete surfaces have had some problems, such as irregular

depth of removal and difficulty of collecting the scraped debris. As a solution for these problems, a new method using an especially designed and constructed milling cutter and vacuum collecting system has been developed. The milling cutter can scrape the concrete surface accurately to a few millimeters depth with one pass. The scraped debris is in the shape of a fairly uniform powder which is collected with almost a 100% efficiency by the vacuum collecting system. This method has the advantages of: (1) radioactive waste reduction; (2) prevention of internal exposure of workers; (3) prevention of recontamination of the work area; and (4) providing an environment for easy measurement of residual radioactivity after decontamination. This paper describes the development, demonstration, experience, and outline of the new method designated as the "Clean Cut Removal System."

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Remote-Controlled Decontamination Techniques

Transactions of the American Nuclear Society 55:228-229; CONF-871101; Proceedings of an American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (pp. 228-229) (1987)

Two newly developed decontamination techniques involving the use of robotics are described in this paper. The first method described involves the use of an ultra-high-pressure water jet system mounted on a four-wheeled WASP robot. The second decontamination system uses a superheated water spray system mounted on a smaller, six-wheeled PEDESCO robot. Both methods include a vacuum system which serves to minimize the risk of airborne contamination. Cost estimates are provided for both techniques. The paper concludes that the use of these robotic techniques should provide a safer approach to current decontamination practices.

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Advances in the European Community's Programme of Research on Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. L30-L34) (1987)

The Commission of the European Communities continues a program of research on the decommissioning of nuclear installations. The program includes the development and testing of advanced techniques for decommissioning activities such as decontamination and dismantling of unnecessary installations, and the management of the radioactive waste arising from them. Among the advances achieved recently, the industrial-scale demonstrations of new procedures for decontamination and recycling of steel are of particular importance, since these procedures make it possible to substantially reduce the radioactive waste volume.

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Jones, J.M., and J.R. Wakefield, Northern Research Laboratories, Windscale, Seascale, Cumbria, United Kingdom

Review of Decontamination Techniques in Relation to Decommissioning

NRL-R-3007(W) (1987, December)

This paper reviews decontamination procedures currently used in the decommissioning of nuclear power plants. Technologies in use in Canada, France, Japan, Sweden, the United States, and the United Kingdom are included. An overview of the techniques employed in each country is presented and areas of future development are identified.

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Lasch, M., Commission of the European Communities, Luxembourg

Development of Economical Decontamination Processes

EUR-10519; 148 pp. (1986)

The activity inventory of the Gundremmingen Nuclear Power Plant [boiling water reactor (BWR), 250 MW(e)] has been investigated. Two years after shutdown, a remaining activity of $3.5(E+10)$ Bq was found to exist in the turbine hall, reactor annulus and auxiliary building. The main nuclide was cobalt-60 which accounts for more than 70% of the total activity. Different decontamination methods were tested in laboratory experiments on contaminated pipe samples. With respect to high efficiency, minimization of secondary waste and ease of handling, electrochemical decontamination proved to be the most economical decontamination method. This decontamination procedure was tested on primary steam valves and the feedwater pumps. Ten to twenty man-hours were needed for the decontamination of each ton of material. The specific secondary waste amount was 95 kg per ton of steel. These figures were evaluated for the dismantling of a 250 MW(e) BWR (except for the containment). After the decontamination of 3400 tons of metal about 260 tons of secondary waste will remain. The dismantling will take 5.9 years. The same evaluation has been performed for a 1300 MW(e) BWR.

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Lawrence, R.E., and R.A. Meigs, West Valley Nuclear Services Company, Inc., West Valley, NY

The Decontamination and Decommissioning of the Chemical Process Cell (CPC) at the West Valley Reprocessing Facility

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.8-IV.22) (1987)

To support interim storage of vitrified high-level waste at the West Valley Demonstration project, the shielded, remotely operated Chemical Process Cell (CPC) was decommissioned and decontaminated. All equipment was removed, packaged, and stored for future size reduction and decontamination. Floor debris was sampled, characterized, and vacuumed into remotely handled containers. The cell walls, ceiling, and floor were decontaminated. Three 20-Mg (22.5-ton) concrete neutron absorber cores were cut with a high pressure water/abrasive jet cutting system and packaged for disposal. All operations were performed remotely using two overhead bridge cranes which included two 1.8-Mg (2-ton) hoists, one 14.5-Mg (16-ton) hoist, and an electromechanical

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manipulator. Additional operations were performed by an industrial robot mounted on a mobile platform. Initial general area dose rates in the cell ranged from 1 to 50 R/hr and were reduced significantly. Target levels of less than 10 mR/hr general area readings were established before decontamination and decommissioning was initiated. This paper summarizes the specific results obtained.

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Decontamination of the Gentilly-1 Fuel Pool

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1701-1714) (1987, July)

The decontamination program to support the decommissioning work for the 250 MW(e) Gentilly-1 Nuclear Station, performed by Atomic Energy of Canada Limited (AECL), included both in situ decontamination and removal with storage of equipment and systems. Of the major equipment and rooms decontaminated, which included the feedwater pump room, the sumps and floor drains, the ventilation systems, the decontamination center, and various offices and workshops, the fuel pool and related systems provided the greatest challenge. Fuel pool decontamination included decontamination of both the storage pool and the shuffling bay, the purification system, the tools and equipment used in fuel manipulation and fuel storage, and the various rooms and areas associated with this equipment. This paper describes, in detail, the procedure, the tools and equipment used, and the data obtained from the various decontamination techniques used in the decontamination of the fuel pool. The decontamination techniques include hydrolyzing, scarifying, chipping, chemical cleaning, and hand scrubbing.

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Radiologically Controlled Decontamination of Concrete

Proceedings of the Health Physics Society 33rd Annual Meeting, Boston, MA, July 4-8, 1988; (p. S9); Health Physics 54(Suppl. 1):S9 (1988)

Concrete is a primary structural element in the walls and floors of all nuclear facilities. Although often covered with special protective coatings, both the concrete and coatings of walls and floors become contaminated to some extent during their service life. Data indicates that this contamination can extend from fractions of an inch to several inches into the porous concrete, depending on the integrity of coatings and service conditions encountered. Controlled removal of contaminated concrete surfaces during major repairs or decommissioning activities can significantly reduce the radiation exposure of workers, and will minimize the volume of waste requiring burial. Recently developed equipment utilizing specially configured scabblers, needle guns, and a self-cleaning HEPA-filtered vacuum system can decontaminate concrete surfaces efficiently while completely containing all contaminated concrete dust and debris; waste products are collected in sealed 21-gallon waste drums designed to fit inside standard D.O.T. 17-H overpacks for later compaction and transportation. Surfaces can be decontaminated at rates exceeding 400 square feet per hour to a depth of 1/16-in. Dust control is so effective that operators are not required to wear respiratory protection as a result of decontamination operations; this feature contributes to notable increases in worker productivity. Equipment is available to decontaminate large floor areas, perimeters, walls, sumps, trim around drains and floor penetrations, floor-wall joints, wall-wall joints, and miscellaneous nooks and crannies.

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Letschert, P.J.C., L.M. Butter, W.M.M. Huijbregts, and M.G. Segal, Keuring van Electrotechnische Materialen, N.V., Arnhem, Netherlands

Experimental Decontamination of a Reactor-Water Clean-Up Line at the Dodewaard Nuclear Power Plant by Means of the LOMI (Low Oxidation-State Metal Ion) Process

ISBN-90-353-0059-9; 24p; Kema Scientific and Technical Reports 5(12):293-316 (1987)

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An experimental decontamination of a line of the reactor water cleanup (RWCU) system at the Dodewaard BWR was carried out. A special decontamination unit, including a rack for chemical measurements and a tree with different materials and shapes, was designed and constructed for this purpose. The RWCU line was divided into two pieces before decontamination; each part was decontaminated twice in order to investigate the reproducibility of the results. A linear correlation was found between the activity and the concentration of dissolved metals in the decontamination solution. After decontamination, several pieces of the RWCU line were examined at the laboratory. No corrosion attack of the stainless steel was found. The various material samples in the tree showed no sign of attack after three decontamination treatments.

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Loiselle, V., K. Conroy, and R. Gerdingh

Chemical Decontamination Waste Processing Methods

Transactions of the American Nuclear Society 52:52-53; Proceedings of the American Nuclear Society 1986 Annual Meeting, Reno, NV, June 15, 1986; (pp. 52-53) (1986)

Chemical decontaminations have been performed at various commercial nuclear plants in the past few years. The treatment of wastes from these projects is usually done with mobile processing systems. This paper presents the criteria used for the design of waste processing equipment as well as additional considerations due to the nature of the decontamination solutions. In addition to the equipment used, several process chemistry problems need to be considered. While equipment may be built that can be used for any project, the chemistry problems are unique to each solution and project. This paper looks at the application to a specific project, the Electric Power Research Institute's (EPRI) Fuel Decontamination Project to be conducted at the Quad Cities station. The approach to solving the chemistry problems unique to Quad Cities is presented.

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Case Study: West Valley - A Status Update

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 169-189) (1987)

The West Valley Demonstration Project, directed by the United States Department of Energy, is at the site of the only commercial nuclear fuel reprocessing facility to have operated in the U.S. Operation of the plant ceased in the early 1970s. It was determined in 1980 that the facility provided a unique opportunity for demonstrating established high-level nuclear waste management technology. Engineers, scientists, and innovative thinkers here are showing the world that nuclear waste can be safely cleaned up. The heart of the high-level waste solidification system has been designed, built, and installed. Engineering tests are currently underway. Additional processing and support systems will be added this year, followed by modifications and adaptations for remote operation. The site is receiving international attention for its progress in the decontamination and decommissioning of this former nuclear fuel reprocessing facility. Miles of contaminated piping and dozens of large radioactive vessels have been removed. New handling, packaging, and disposal techniques have been developed to manage the low-level waste generated during cleanup. Additionally, engineers have directed the safe return of over 600 spent nuclear fuel assemblies from storage at West Valley back to their utility owners.

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West Valley Demonstration Project Low-Level and Transuranic Waste Assay and Methodology

DOE/NE-44139-16; 53 pp. (1987, March)

In the decontamination and decommissioning of the West Valley Nuclear Facility, waste materials are being removed and packaged in a variety of waste containers which require classification in accordance with NRC 10 CFR 61 and DOE Order 5820.2 criteria. Low-level and transuranic waste assay systems have been developed to efficiently assay and classify the waste packages. The waste is assayed by segmented gamma scanning, passive neutron techniques, dose rate conversion, and/or radiochemical laboratory analysis. The systems are capable of handling all the waste forms currently packaged as part

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of the project. The above systems produce a list of nuclides present with their concentrations and determines the classification of the waste packages based on criteria outlined in DOE Order 5820.2 and NRC 10 CFR 61.55.

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Use of Foam Chemicals for Decontamination

CONF-8710 8; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.23-IV.30) (1987)

A means of rapid, gross smearable contamination removal is being used at the West Valley Demonstration Project. Decontamination chemicals are made into a foam using foam stabilizing surfactants and blown with compressed air onto surfaces to be decontaminated. The foam is left to work for 15 to 30 minutes and is rinsed with 3500 to 7000 KPa (500 to 1000 psi) water sprays. Spent decontamination solution generated ranges from 0.03-0.14 liters per square meter (0.08-0.40 gal/sq ft). Decontamination factors for smearable contamination up to 10 are routinely achieved.

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Decontamination and Decommissioning of the Chemical Process Cell (CPC): Topical Report for the Period January 1985-March 1987

DOE/NE-44139-41; 55 pp. (1987, July)

To support interim storage of vitrified high-level waste (HLW) at the West Valley Demonstration Project, the shielded, remotely operated Chemical Process Cell (CPC) was decommissioned and decontaminated. All equipment was removed, packaged and stored for future size reduction and decontamination. Floor debris were sampled, characterized, and vacuumed into remotely

handled containers. The cell walls, ceiling, and floor were decontaminated. Three 20 Mg (22.5 ton) concrete neutron absorber cores were cut with a high-pressure water/abrasive jet cutting system and packaged for disposal. All operations were performed remotely using two overhead bridge cranes which included two 1.8 Mg (2 ton) hoists, one 14.5 Mg (16 ton) hoist, and an electromechanical manipulator or an industrial robot mounted on a mobile platform. Initial general area dose rates in the cell ranged from 1 to 50 R/hr. Target levels of less than 10 mR/hr general area readings were established before decontamination and decommissioning was initiated; general area dose rates between 200 mR/hr and 1200 mR/hr were obtained at the completion of the decontamination work.

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Decontamination Operations in the Chemical Process Cell at the West Valley Demonstration Project

Transactions of the American Nuclear Society 55:229; CONF-871101; Proceedings of an American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (p. 229) (1987)

The results of decontamination work at the West Valley Demonstration Project are reported in this paper. Initial area gamma dose rates in one of the chemical process cells (CPC) ranged from 1 to 50 R/hr. A thorough cleaning of all surfaces with an alkaline foam detergent resulted in an average dose rate decontamination factor (DF) of 1.62. Following a second decontamination pass using a foam containing dilute nitric acid, the average dose rate DF was 1.33. Smear tests before and after foam decontamination work reveal that this method has a DF for smearable contamination of 200 to 600. Since contamination levels were still too high to provide a surface suitable for repainting, it was necessary to perform a high-pressure water washing of the CPC. After the high-pressure water washing, the final general area dose rates ranged from 0.1 to 1.2 R/hr. The average dose rate DF was 2.57. The paint in the CPC was still too contaminated to repaint. Further decontamination attempts in the lab gave decontamination results that were much lower than expected. These results may have been due to poor ventilation of the CPC during painting. This could have resulted in the creation of a microporous paint

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membrane which would result in paint that was harder to decontaminate than nonporous paint. Based on this evidence, the author suggests that a controlled study should be done to determine the possible effects of coating application and curing on the performance of coatings in nuclear applications.

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Metal Melting for Volume Reduction and Recycle

UNI-SA-204; Proceeding of the Technical Advisory Group Meeting, Karlsruhe. Federal Republic of Germany, May 7, 1987; (12 pp.) (1987, March 27)

This paper summarizes the experiences with melting contaminated steel materials for volume reduction and melting uranium-contaminated copper and aluminum for possible recycle. In the past there has not been an economic incentive to reduce the volume of low-level, beta-gamma contaminated metallic scrap materials in the United States. With the rising cost of transportation and burial facility fees, new interest in volume reduction is being generated. This new interest has been primarily focused at the Idaho National Engineering Laboratory (INEL) where the Waste Experimental Reduction Facility (WERF) was established to demonstrate both metal melting and incineration of combustible material for volume reduction. Other demonstration programs involving melting for volume reduction and recycling of aluminum and copper, as well as ferrous scrap, were related to the Cascade Improvement and Cascade Upgrade Programs (CIP/CUP) at the Paducah, Kentucky facility. While the melting demonstrations for the CIP/CUP material were not primarily based on economic incentives, several observations recorded during the programs are of interest with regard to melting of copper and aluminum.

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Chemical Decontamination, Decommissioning and Waste Treatment Processes for Nuclear Facilities

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1439-1454) (1987, July)

Westinghouse has developed several chemical decontamination and waste treatment processes for nuclear reactor applications, all of which are applicable to nuclear facilities and general decontamination/decommissioning operations. The three most favorable processes are: (1) dilute chemical decontamination (DCD), (2) strong oxidation process (SOP), and (3) cerium acid decontamination process (CDP). All three processes have attained high decontamination factors (DF's) on PWR specimens, and should achieve comparable or better DF's on BWR and fuel contaminated surfaces. Waste management uses ion exchange, direct solidification, and electrolysis. Waste volume fractions as low as 7% have been experimentally obtained.

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Remote Handling in Highly Radioactive Environments and Human Intervention System in Highly Alpha Contaminated Environments

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 276-294) (1986)

Remote handling in highly contaminated environments is performed currently with the help of either mechanical manipulators connected to biological protection, or with electromechanical remote manipulators carried on mobile positions covering the whole volume of the cell. The new electromechanical remote manipulator MA 23 M, connected to a mobile positioner and to a servo TV system, allows execution of dexterous tasks with a minimum of fatigue for the operator; the total investment of handling/vision being lower when compared with the use of mechanical manipulators and vision windows, especially when using the manipulators for maintenance. The

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intervention system SCALHENE, specific application of the double door transfer system DPTE type, allows a man to be introduced directly into a hostile environment without having to pass through an intermediate chamber.

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Radiation Protection Management Program at TMI-2: Noteworthy Practices and Accomplishments - Final Report

EPRI-NP-5338; 62 pp. (1987, August)

A successful dose reduction program must utilize disparate techniques such as sound technical understanding of contamination processes, through training in ALARA principles, management and worker commitment, and adequate tools. GPU Nuclear Corporation's cleanup program at TMI-2 represents a unique opportunity to test tools and techniques under real plant conditions not readily achieved in a laboratory. The dose reduction tools and techniques described herein have proven beneficial in the course of the accident cleanup. Each has potential for operating plant applications. This overview describes the problem that each technique was developed to address, how each tool was implemented, and how the implementation contributed to dose reduction.

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TMI-2 Technology Transfer Progress Report: Interim Report

EPRI-NP-5821; 87 pp. (1988, May)

The objective of this report is: to communicate the scope and key accomplishments of the Three Mile Island Unit 2 (TMI-2) technology transfer program; and to show the relationship of various TMI-2 activities to the overall cleanup effort and to other EPRI-sponsored nuclear power programs.

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Mechanical Decontamination Techniques for Floor Drain Systems

Transactions of the American Nuclear Society 55:231-232; CONF-871101; Proceedings of an American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (pp. 231-232) (1987)

One of the persistent problems associated with the decontamination of Three Mile Island Unit 2 (TMI-2) following the 1979 accident has been the cleanup of the floor drain systems. These drains are highly contaminated with various forms of dirt and sludge containing high levels of fission products and fuel from the damaged reactor core. The bulk of this contamination is loosely adherent to the drain pipe walls; however, significant amounts of contamination have become incorporated into pipe wall oxide and corrosion layers and embedded in macroscopic pits and fissures in the pipe wall material. Two techniques are commonly used to decontaminate drains at TMI-2: a rotating brush hone system and a high-pressure water mole nozzle system. These two methods are most effective when used together. Both methods, along with several problems concerning their use are described in this report. Suggestions to resolve the problems are also provided.

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Decontamination of Nuclear Facilities by Electrochemical Methods

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.188-IV.200) (1987)

Equipment for three electrochemical, remotely operated decontamination processes was developed for the Paks

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Nuclear Power Plant. Equipment for the first process was constructed for the decontamination of the main circulating pump case. The second process equipment was for decontaminating the collectors of the steam generator, and the third process equipment was for decontaminating the main gate valve case of the primary circuit. All equipment used movable cathodes. The main circulating pump case was decontaminated eight times. The electrolyte contained sulfuric, oxalic, and phosphoric acids. The decontamination factors ranged from 10 to 500. The duration of the process was 8-12 hours. The collective dose for the staff (3-4 workers) was about 2-3 mSv. Only 100-200 liters of radioactive effluents were produced.

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Estimation of Residual Radioactivity Within a Shutdown Fuel Reprocessing Plant

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1294-1303) (1987, July)

Various cells within the fuel reprocessing plant at the Western New York Nuclear Service Center, located near West Valley, New York, are being decontaminated to allow for use in the West Valley Demonstration Project. Development of safe procedures to decontaminate these cells requires prior knowledge of the level and nature of radioactive contamination within them. The method used to estimate the amount of radioactive material within the eight major process cells is described in this paper. These estimates are compared with data compiled during cell decontamination to verify the validity of this procedure.

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Characterization of the Radioactive Deposits on PWR Primary Circuit Surfaces

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.201-IV.216) (1987)

In assessing the decontamination and decommissioning options for nuclear reactors, characterization of the radioactive deposits on the various reactor circuits is required to provide information on the radioactive inventory in the system. Knowledge of the quantities of activation products, fission products, and actinides deposited on reactor pipework during operation is essential in formulating the overall decommissioning strategy. Results from detailed examination of the oxides on a range of Inconel 600 and stainless steel specimens from a number of PWRs are reported. A variety of techniques have been employed. These include gamma spectrometry, alpha spectrometry, scanning electron microscopy, and wet chemical analysis. In addition, surface analytical techniques, including secondary ion mass spectrometry (SIMS), have been used to characterize the oxides. The sources of the major radionuclides present on circuit surfaces are considered. Procedures for decontaminating PWR surfaces are described. In addition to the PWR specimens, results from a limited number of specimens from BWRs and CANDU reactors are presented.

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Pick, M.E., A.J. Hooper, L.N. Rogers, M.G. Segal, G.C.W. Comley, and M.J. Sanders, Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, Gloucestershire, United Kingdom; United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Winfrith, Dorchester, Dorset, United Kingdom

Decontamination Techniques Developed in the UK for Reactor Application

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1399-1416) (1986)

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Decontamination techniques developed by the Central Electricity Generating Board and the United Kingdom Atomic Energy Authority for application to power reactor components and circuits are reviewed. Physical, chemical and electrochemical procedures have been developed. Particle impact cleaning and electro-swabbing have been used on commercial advanced gas reactor (CAGR) components and the results from these trials are outlined. For treatment of light water reactor (LWR) oxides a family of chemical decontamination processes has been developed as a result of basic research into oxide dissolution. These processes, low oxidation-state metal ion (LOMI), nitric permanganate/LOMI (NP/LOMI), and PWR oxidative decontamination (POD), have now been used for the decontamination of several major LWR components and reactor circuits. The LOMI process is now used annually on the Winfrith SGHW (steam generating heavy water) reactor in the United Kingdom. Results from these applications are outlined. Research has also been taking place into the possibility of combining chemical decontamination treatments like LOMI with the physical process of high pressure water jetting.

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Results of Metallic Waste Treatment by Melting

CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.115-III.127) (1987)

The idea to melt contaminated metallic waste resulting from decommissioning or backfitting nuclear facilities was conceived in 1981. To date, about 1000 tons of metallic waste have been melted and recycled. The basic steps in the melting process are: (1) cutting the material and placing it in 200-liter drums; (2) charging the material into the furnace by means of a special charging device; (3) melting in an induction furnace under low pressure, and (4) maintaining a low pressure and filtering the off-gases to prevent the escape of radioactive aerosols. Special licenses were required and standards concerning radiation levels in the metals before and after melting and in the filter dust had to be met in the performance of the melting process. The metal from the material being

melted in this manner is used to produce components for nuclear facilities, such as, waste containers, shielding plates, and crane test weights. This paper describes the process and gives the results of ten melting tests in which a total of 300 tons of material have been melted. The results show that during melting, the radioisotopes of Co, Ag, and Fe stay in the melt, while Cs, Zn and other radioisotopes leave the melt in total and can be found in the slag or the filter dust. Analysis of the melt, slag, and dust gives a good knowledge of the process. One of the important aspects of this program was to determine the quantity of secondary waste generated from the melting. The amount of secondary waste generated depended upon the quality of material being melted, e.g. carbon steel or stainless steel, and the quantity of impurities like oil, rubber, and paint. In general, a quantity of about 3-5% of secondary waste was found. To achieve the goal of producing a melt of sufficient quality for producing components for nuclear application, the melting charge must be known.

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Nonhazardous Reuse of Components Removed from Nuclear Facilities by Melting Processes

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 833 pp.; (pp. 79-82) (1987)

Melting processes are used to homogenize and/or to decontaminate radioactively contaminated metal scrap originating from repair, refitting or decommissioning of nuclear facilities. Laboratory-scale test melts were performed using beta- and gamma-contaminated material to determine whether components have to be pre-decontaminated before they are melted in the foundry. About 500 tons have already been treated in this way for reuse in nuclear facilities. Laboratory-scale melt experiments with alpha-contaminated materials resulted in a

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one-step compaction and decontamination process. The alpha-emitting radionuclides are nearly quantitatively released from the melt into the slag. A simple direct alpha-measuring technique was developed to determine the distribution of alpha-bearing material between the melt and the slag.

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TMI-2 Cleanup Techniques Applicable to Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.101-IV.108) (1987)

This paper discusses techniques and equipment used for cleanup at Three Mile Island Unit 2 (TMI-2) that could be applied directly for decommissioning any chemical or nuclear facility. The technology discussed concentrates on those approaches that either substantially reduce exposure to the work force engaged in decommissioning, or those actions that result in volume reduction of contaminated materials. The key issues presented are surface decontamination, removal of contaminated surface material, internal pipe cleaning, remote tools, and the workhorse robot.

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Current Developments with Chemical Decontamination Reagents

CONF-861013; Water Chemistry for Nuclear Reactor Systems, Proceedings of the Fourth International Conference, Bournemouth, United Kingdom, October 13-17, 1986; (pp. 241-248) (1986)

Chemical decontamination of coolant circuit surfaces has become widely accepted as a means of reducing personnel radiation exposures on water-cooled reactors. Several different dilute processes, either acid chelants or LOMI, have been used successfully on operating plants, mostly on BWR recirculation pipe work and PWR channel-heads. The effectiveness of these processes is well established. Current developments are concentrating on minimizing the risks associated with their use and lowering their costs. Methods have been devised offering considerable savings to the reactor operator by reducing both the volume of radioactive waste generated and the time required for the decontamination operation. The latter saves both in the direct cost of the process and reactor down time.

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Method of Decontaminating Metal Wastes

Japanese Patent 61-231496/A; Japanese Patent Application 60-72087; 4 pp. (1986, October 15)

Purpose: To reduce the exposure dose during procedures such as cutting objects or the attaching of electrodes, as well as decreasing the amount of the secondary wastes upon decontaminating radioactive metal wastes at high contamination level. Method: Chemical decontamination is carried out prior to the electrolytic processing by using a solution composed of a neutral salt such as sodium sulfate and sodium nitrate dissolved in oxalic acid, or formic acid or a mixture of the two acids. The liquid wastes from the decontamination are subjected to electrolytic processing in the subsequent electrolytic decontaminating vessel using an insoluble electrode as an anode. This enables efficient electrolysis without decreasing the concentration of the electrolytes. Further, liquid wastes from the chemical decontaminating process can be treated in the electrolytic decontaminating vessel and since the processing liquid can be used as the electrolytic decontaminating solution, the amount of the secondary wastes can be reduced.

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Assay of Nuclear Fuel Residues in Building Decontamination Wastes

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1304-1313) (1987, July)

Gamma spectroscopy was used to assay miscellaneous decontamination wastes from the decommissioning of a building used for the development of uranium, thorium and plutonium fuels. Gamma rays emitted by uranium-235, americium-241 and, in highly contaminated samples, plutonium-239 were used to estimate amounts of those isotopes. Uranium-238, plutonium-241, thorium-232 and thorium-228 were estimated indirectly from decay products. Plutonium isotopes other than plutonium-241 and uranium-234 were inferred by means of scaling factors. These scaling factors were based on analyses of glove box residues, special nuclear materials (SNM) records, and accepted enrichment factors. Knowledge of the history of use of materials in the building assisted in development of the scaling factors and the indirect estimates since many of the observable radionuclides were not in an equilibrium state with parents or daughters. Cross-checks of the analyses by an independent laboratory using destructive, "wet" analytical methods and analysis of samples supplied by the Nuclear Regulatory Commission agreed with the nondestructive method used.

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Decommissioning of International Nutronics Cobalt-60 Irradiation Facility

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.68-III.76) (1987)

The decommissioning for International Nutronics cobalt-60 irradiation facility located at Dover, New Jersey, was completed in 1986 and unrestricted radiological release was obtained under the regulatory purview of the U.S. Nuclear Regulatory Commission (NRC) Region I.

The "Final Radiological Release Report for the International Nutronics Facility, Dover, New Jersey" was submitted to and approved by NRC to verify the completion of programs to achieve unconditional radiological release of the facility and environs. The decommissioning project was an extensive series of programs which utilized technologies for the disposition of kilocurie sources of encapsulated cobalt-60 sources as well as low-level environmental contamination evaluation and decontamination procedures.

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Turner, A.D., A.R. Junkison, J.S. Pottinger, and R.K. Dawson, United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Harwell, Didcot, Oxfordshire, United Kingdom

Electrochemical Decontamination of Metallic Radioactive Waste

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1427-1438) (1987, July)

Electrochemical decontamination of stainless steel in ambient temperature nitric acid has been demonstrated to be capable of achieving background levels of residual activity. Two processes have been developed. One is for the treatment of small objects by immersion in a tank of dilute acid, in which only low current densities are used. The superior uniformity of treatment in the dilute acid enables complex shapes of extended area to be treated. The second process is for in situ applications where an engineered probe is used to contain a more concentrated solution for the rapid treatment of a limited area at a time. This high rate electropolishing process for in situ decontamination has the advantage of leaving a microscopically smooth surface, which reduces the extent of subsequent contamination during reuse. In both processes, no hydrogen is produced from the cathode, and the liquid waste is compatible with existing United Kingdom effluent management procedures.

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U.S. Nuclear Regulatory Commission, Washington, DC

NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

GPU Nuclear Corporation Draft Supplement 3 to the Programmatic Environmental Impact Statement Related to TMI-2 Cleanup: Extension of Comment Period

Federal Register 53(106):20195-20196; Docket 50-320 (1988, June 2)

On April 27, 1988, a Notice of Availability of Draft Supplement 3 to the Programmatic Environmental Impact Statement on the Three Mile Island, Unit 2 (TMI-2) Cleanup was published. The notice stated that comments must be received before June 15, 1988. Since several interested persons, as well as the Commission Advisory Panel on the Decontamination of Three Mile Island Unit 2, have requested an extension, NRC is hereby extending the comment period until August 1, 1988.

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U.S. Nuclear Regulatory Commission, Washington, DC

Meeting of the Advisory Panel for the Decontamination of Three Mile Island, Unit 2, GPU Nuclear Corporation

Federal Register 53(55):9386; DOCKET 50-320 (1988, March 22)

Notice is hereby given pursuant to the Federal Advisory Panel for the Decontamination of Three Mile Island, Unit (TMI-2) will be meeting on April 14, 1988, from 7:00 p.m. to 10:00 p.m. at the City of Lancaster Council Chambers, 100 South Queen Street, Lancaster Pennsylvania. The meeting will be open to the public. At this meeting, the Panel will receive a status report on the progress of defueling from the licensee, GPU Nuclear Corporation. The licensee will also provide the Panel with current design information describing the accident-generated water evaporator. Members of the Panel will discuss the current off-site radiological monitoring program.

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U.S. Nuclear Regulatory Commission, Washington, DC

Meeting of the Advisory Panel for the Decontamination of Three Mile Island, Unit 2, GPU Nuclear Corporation

Federal Register 53(93):17129; DOCKET 50-320 (1988, May 13)

Notice is hereby given pursuant to the Federal Advisory Panel for the Decontamination of Three Mile Island, Unit (TMI-2) will be meeting on May 26, 1988, from 7:00 p.m. to 10:00 p.m. at the Holiday Inn, 23 South Second Street, Harrisburg, Pennsylvania. The meeting will be open to the public. At this meeting, the Panel will receive a status report on the progress of defueling from the licensee, GPU Nuclear Corporation. Representatives of the Nuclear Regulatory Commission (NRC) will summarize the recently issued supplement to the Programmatic Environmental Impact Statement dealing with post-defueling monitored storage and subsequent cleanup of TMI-2.

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Vallem, R.J., and B.G. Jobe, Bechtel Eastern Power Corporation, TMI Nuclear Station, Middletown, PA

Decontamination Using Ultra-High-Pressure Water at TMI-2

Transactions of the American Nuclear Society 55:226; CONF-871101; Proceedings of an American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (p. 226) (1987)

Ultra-high-pressure (UHP) waterjet equipment has been successfully used to remove contaminated coatings from metal components and concrete floors and walls at Three Mile Island Unit 2 (TMI-2). The procedures followed, as well as the results obtained at TMI-2 are reported in this paper. Due to the success of this application, it has been concluded that successful results could be expected for similar uses at other sites.

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

NUCLEAR FACILITIES DECOMMISSIONING DECONTAMINATION STUDIES

Radiological Consequences of Delaying the Final Dismantling of a Magnox Nuclear Power Station

CEGB-TPRD/B-0871/R87; 70 pp. (1987, April)

The timing of the final dismantling process after shut-down and decommissioning of Magnox power stations will depend on balancing the need to reuse the site against the advantages of allowing residual radioactivity to decay. A delay of 130 years would reduce the dose commitment to dismantling staff as far as practical and remove the need to depend on robotic systems. This in turn would lead to cost savings of about 800M pounds, 1986 prices, totaled over all the CEGB's Magnox power. If final dismantlement were to be delayed, the residual reactor building would be maintained in a sealed, weathertight condition. This report investigates the consequences of any failure in this type of containment system. The radiological consequences over time periods of one order of magnitude greater and one order of magnitude smaller than the 130 y optimum are considered. The radiological consequences which might result over a 1500 year period due to the leakage of radioactive materials from the reactor structure are determined. Any engineering constraints which these radiological consequences might impose are discussed.

217

Xianwen, R., Q. Suyun, Q. Mingcai, Z. Lianquan, and D. Dahai, Institute for Radiation Protection MNI, Taiyuan, Shanxi, China

Decontamination of Uranium-Contaminated Equipments and Parts

CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.134-IV.152) (1987)

A uranium enrichment pilot plant was decommissioned in 1985-1986. This paper describes the decontamination

of the plant components and equipment. The kinds of metals encountered in the decontamination process were copper, nickel, aluminum alloys, mild steel, and stainless steel. Results show that the surface contamination on most of the parts was reduced to the required levels. The uranium contents of aluminum ingots after melt refining ranged from 33 to 232 ppm. The decontamination liquid wastes were treated with a multiprecipitation method. The concentrations of uranium, nickel, and fluoride in the supernatant were 0.02-0.1 mg/l, 0.02 mg/l, and 0.13 mg/l, respectively.

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Yasunaka, H., M. Shibamoto, T. Sukegawa, T. Yamate, and M. Tanaka, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Microwave Decontaminator for Concrete Surface Decontamination in JPDR

CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.109-IV.116) (1987)

Radioactive contamination of nuclear facilities must be evaluated to determine appropriate decommissioning procedures which address both worker exposure and waste management. The Japan Atomic Energy Research Institute (JAERI) measured concrete surface contamination prior to the dismantlement of the Japan Power Demonstration Reactor (JPDR). Measured penetration depths of the contamination were within 2 cm of the surface. JAERI has developed a microwave decontaminator for the concrete surface removal. It can remove the surface of concrete to a depth of more than 1 cm with a single pass, and it can be used for walls as well as floors. Concrete surface contamination of the JPDR will be removed by both the microwave decontaminator and conventional machines to evaluate the usefulness of the microwave decontaminator.

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Update on WAGR Decommissioning

Atom 374:2-8 (1987, December)

The paper concerns the progress of the decommissioning of the Windscale advanced gas-cooled reactor (WAGR). To date, the upper plug stringers of the reactor have all been severed and dispatched to the radioactive waste disposal facility at Drigg. Also the main construction of the waste packaging building has been completed. A description is given of the dismantling progress, including the heat exchanger preparation, the decommissioning system design, and the waste packaging building. Waste conditioning and packaging are described with respect to recycling of waste and activity assessment. Specifications of the WAGR dismantling manipulator are given, along with the design approach and manipulator configuration. Radioactivity assay, steel surface sampling and calculation codes, are also discussed.

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Dismantling of JPDR Begins: To Demonstrate Advanced Technology

Atoms in Japan 30(12):4-9 (1986, December)

The first dismantling of the Japan Power Demonstration Reactor [JPDR, BWR, 90 MW(t), 12.5 MW(e)] began on December 4, 1986, drawing the attention of nuclear interests in Japan and overseas. The Japan Atomic Energy Research Institute undertook the project as the second phase of the six year program for dismantling the JPDR at the Tokai Research Establishment. It is the demonstration of the technology developed in the first phase of the program from 1981 to 1986, aiming at establishing a total system for dismantling commercial nuclear power plants in the future. At the ceremony for the beginning of dismantling held on December 4 at the site, a special switch was operated to fire a gas burner, and cutting of the upper head of the reactor pressure vessel on the service floor of the reactor building began. The long term program on the development and utilization of nuclear energy in 1982 decided the basic policy on reactor decommissioning. Under this policy, in July, 1984, the nuclear subcommittee of the Advisory Committee for Energy set up the guideline for standardized decommissioning suitable to the actual situation in Japan. The schedule of the program, the development of eight fundamental techniques, disassembling techniques, decontamination, measurement and robotics are described.

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Public Notice Concerning the Announcement in Compliance with Section 15(3) and Section 17 of the Nuclear Installations Ordinance, of a License Dated November 9, 1987, for Decommissioning and Partly Dismantling the KAHTER Critical Assembly with Spherical Fuel Elements for HTR-Type Reactors at Juelich Nuclear Research Center (As of December 4, 1987)

Bundesanzeiger 39(227):15706 (1987, December 4)

222

Definition of Work Units

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 4.1-4.12) (1986)

After an introduction, component removal size ranges are discussed under the chapter Definition of Work Units. Removal of pipes, valves, pumps, heat exchangers, tanks, thin vessels, filters and ion exchangers, mechanical and electrical equipment, and heavily reinforced concrete structures is included, as is removal of items without size classification.

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Windscale: Tackling the Core of the Problem

Industrial Robot 14(1):41-43 (1987, March)

The decommissioning of the Windscale advanced gas-cooled reactor requires a robot or manipulator that can enter the reactor core and cut the core into pieces so that it can be loaded into concrete-filled boxes and disposed of as nuclear waste. Existing equipment is not entirely suitable for this task; therefore, a machine is being designed specifically for the job. A British firm has been chosen to supply the equipment, which will have joystick control, and will be delivered by mid 1988. Six months development work, then a year of trials will follow, before the dismantling process will start. The machine, its operation and the remote viewing provision are discussed.

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JAERI Begins Decommissioning of JPDR

Nuclear Engineering International 32(391):10 (1987, February)

The Japan Atomic Energy Research Institute (JAERI) started decommissioning the Japan Power Demonstration Reactor (JPDR) [12.5 MW(e) BWR] on 4 December. On the same date the institute entered into a cooperative agreement with the United Kingdom Atomic Energy Authority and Atomic Energy of Canada Limited on technical development of power reactor decommissioning. Under the agreement, JAERI will provide these organizations with data from the decommissioning work on the JPDR. Several remote control techniques which JAERI has developed are to be applied to the project, which is seen as a suitable model for future decommissioning work on commercial reactors.

225

Dismantling Starts at Tullnerfeld

Nuclear Engineering International 32(396):7 (1987, July)

On June 1, 1987, Bechtel of the United States began site work on the dismantling and liquidation sale of the Tullnerfeld nuclear station at Zwentendorf, Austria. It is expected that site work will take about three years.

226

Putting on a Decommissioning Demonstration with WAGR

Nuclear Engineering International 32(399):51-52 (1987, October)

The prototype AGR at Windscale, the WAGR, is to be completely dismantled by 1995 to demonstrate that decommissioning can be done without enormous cost. Initial preparations for the project were recently initiated. The plan for decommissioning of the AGR is briefly described in this paper.

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Go-Ahead Given To Start Dismantling Work at Niederaichbach

Nuclear Engineering International 32(399):54 (1987, October)

Preparatory work for the complete dismantlement of the Niederaichbach reactor in the Federal Republic of Germany began in July, 1987. Decommissioning of the reactor is slated to begin in the spring of 1988. Dismantling equipment will be tested and then installed on the reactor by mid-1989.

228

The Windscale Fire -- 30 Years On

Nuclear Engineering International 32(400):3 (1987, November)

A progress report on the Windscale piles states the cleanup phase of decommissioning work is about to begin. Damaged by fire in 1957, Windscale was a watershed in establishing tougher nuclear safety standards for the world.

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Atomic Power's New Woe: How To Bury Old Plants

U.S. News and World Report 97(20):81 (1984, November 12)

The number of reactors that have outlived their usefulness is growing and becoming a costly problem. The challenge is getting rid of them safely. Of 86 operating reactors in the U.S., four already have shut down and are candidates for demolition. Some congressional analysts and experts at the Nuclear Regulatory Commission suggest that closed reactors could number 20 or more in the next few years. Costs for demolition of large plants are forecast at 77 million per unit in 1984 dollars.

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Adachi, T., T. Nagase, S.I. Taniguchi, F. Otsubo, and Y. Watanabe, Shimizu Construction Company Limited, Tokyo, Japan

Method of Decommissioning Nuclear Reactors

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Japanese Patent 61-250600/A/; Japanese Patent Application 60-92070; 5 pp. (1986, November 7)

A method is described for decommissioning a reactor by a simple operation which both reduces cost and eliminates the necessity of dividing the reactor and shielding walls into fine blocks. This method can be applied to any reactor contained within shielding walls which comprise an upper cylindrical portion and a lower hollow sphere portion which is supported on pedestals. The reactor is situated inside the hollow portion of the shielding walls. After removal of the pedestals, the cylindrical portion and the spherical portion of the shielding walls are separated from each other. Then, the cylindrical portion is lowered so as to surround the reactor (which is still situated inside the spherical portion). The upper opening of the spherical portion is closed and the entire spherical section containing the contaminated nuclear reactor and the upper cylindrical portion of the shielding walls is transported to the outside of the reactor building.

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Allen, R.P., L.K. Fetrow, and F.E. Haun, Jr., Pacific Northwest Laboratory, Richland, WA

Metal Segmenting Using Abrasive and Reciprocating Saws

PNL-SA-14630; CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.230-IV.237) (1987)

This paper presents the results of a study conducted at the Pacific Northwest Laboratory, under U.S. Department of Energy sponsorship, to evaluate a light-weight, high-power abrasive saw for segmenting radioactively contaminated metal components. A unique application of a reciprocating mechanical saw for the remote disassembly of equipment in a hot cell also is described. The results of this work suggest that use of these techniques for selected remote sectioning applications could minimize operational and access problems and be very cost-effective in comparison with other inherently faster sectioning methods.

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Allen, R.P., A.B. Johnson, Jr., and J.P. Vora, International Atomic Energy Agency, Vienna, Austria; Pacific Northwest Laboratory, Richland, WA; U.S. Nuclear Regulatory Commission, Washington, DC

Shippingport Atomic Power Station: A Source of Power Plant Aging Information

Safety Aspects of the Ageing and Maintenance of Nuclear Power Plants, Proceedings of an International Symposium, Vienna, Austria, June 29-July 3, 1987. International Atomic Energy Agency, Vienna; (pp. 129-137) (1988)

An important element in the strategy of the U.S. Nuclear Regulatory Commission's Nuclear Plant Aging Research (NPAR) Program is to examine and test naturally aged nuclear power plant components to (1) investigate potential failure modes and mechanisms and (2) assist in identifying performance parameters that can be monitored to determine the time-dependent effects of aging. The Shippingport Atomic Power Station, which was the first large-scale U.S. nuclear power plant and is now undergoing decommissioning, is a major source of components and specimens for these aging evaluations. Shippingport Station's reactor, steam, auxiliary, support, and safety systems parallel similar systems in other commercial pressurized water reactors. With a 25-year service life (1957-1982), Shippingport Station was in operation for almost the entire time span of currently operating reactors. Also, because of substantial modifications during the mid-1960s and 1970s, it offers unique examples of identical or similar equipment used side-by-side, but representing different vintages and degrees of aging. The U.S. Department of Energy Shippingport Station Decommissioning Project Office directs the decommissioning. General Electric Company is the Decommissioning Operations Contractor. Representative Shippingport Station components, including battery chargers/inverters, relays, circuit breakers, switches, power and control cables, electrical penetrations, check valves, solenoid valves, and motor-operated valves, are being sent to NPAR contractors for evaluation. Samples of piping from various plant systems are also being used for radiological characterization studies. Samples from the primary system check valves, main stop valves, and main coolant pumps will be used in materials degradation studies. In situ tests of electrical circuits and components before removal have also been conducted.

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Antoine, P., I. LeGarreres, G. Pilot, and M. Pourprix, Commissariat a l'Energie Atomique, Institut de Protection et de Surete Nucleaire/Unite Centrale de Declassement des Installations Nucleaires,

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Bagnols-sur-Ceze, France; Commissariat a l'Energie Atomique, Institut de Protection et de Surete Nucleaire, Department de Protection Technique, Service de Protection des Installations Nucleaires, Gif-sur-Yvette, France

Minimizing Decommissioning Gaseous Waste Volume by Prefiltration

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1360-1377) (1987, July)

The secondary emissions of particles induced by different dismantling techniques, especially the cutting techniques for metallic structures (grinding, oxy-acetylene and plasma torch) were studied. These particles can disseminate contamination all along the ventilation circuit from the cell to the HEPA filters of the facility and their characteristics, dependent upon several parameters, are important to know in order to choose the appropriate prefiltration system. The use of cleanable prefilters will bring valuable benefits: longer life of HEPA filters, decrease of deposits in the ventilation ducts, recovery of the filtrate into a small volume, and thus, a decrease of gaseous waste volume and a reduction of worker exposure.

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Araki, T., Taiheidengyo Kaisha Limited, Tokyo, Japan

Removal of Reactor Cooling Components

Karyoku Genshiryoku Hatsuden 38(6):589-595 (1987, June)

The operation of JRR-3, the first reactor in Japan, was stopped in 1983 and the plan for modifying it into a more advanced reactor is currently under way. This plan, expected to be completed in 1989, is aimed at constructing a reactor with performance of the highest level in the world by modifying JRR-3 while utilizing as many of the existing facilities as possible. Prior to the modification work, the removal of facilities that will not be used for the new reactor was started in August 1985. This report out-

lines the removal of reactor cooling components. The components removed include those for (1) handling and storage of nuclear fuel substances; (2) reactor cooling; (3) measurement control; (4) disposal of radioactive waste; (5) management of radiation; and (6) reactor containment. First, the basic scheme for the removal work is outlined concerning work methods, partition of the work area, installation of temporary shields, installation of a greenhouse and ventilation equipment, and disposal of large-sized wastes. Then, the work procedures for arrangement, initiation, component identification, removal work, washing, pipe cutting, sealing of openings and disposal of wastes are described. Various measures were carried out for the reduction in exposure, prevention of contamination and reduction in the amount of wastes. Numerical data on the work force, exposure dose and amount of wastes disposed of are also listed.

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Ashcroft, D.J., and N.W. Collins, United Kingdom Atomic Energy Authority, Risley, Cheshire, United Kingdom; Strachan and Henshaw, Bristol, United Kingdom

Engineering Design of the Windscale Advanced Gas Cooled Reactor Decommissioning System

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.29-VI.47) (1987)

This paper reviews the background to the Windscale Advanced Gas-cooled Reactor (WAGR) Decommissioning System and the stages through which it was developed before arriving at the final concept. Included is the steel materials radioactive inventory. This gives the radioactivity and weight of the steel materials to be reduced in size and handled by the system. A detailed description of the system is given together with a typical operating sequence to provide an understanding of how the machine and its handling system work together. It describes how the problem of radiation shine, where manipulator platform service lines pass through the floor shield, was overcome by careful design. Key dates of important stages in the supply of the system are included.

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Ashida, S., H. Nakamura, N. Kumagai, and M. Yokota, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development of Cutting Tools for JPDR Core Internals and Pressure Vessel Dismantlement

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.48-VI.60) (1987)

The development of remote cutting tools is one of the most important reactor dismantlement topics. Since the Japan Power Demonstration Reactor (JPDR) decommissioning program started in 1981, the Japan Atomic Energy Research Institute (JAERI) has developed an underwater plasma arc cutting system for dismantling core internals and an underwater arc saw cutting system for cutting the pressure vessel of JPDR. The final check-out tests for these systems proved they have satisfactory performance for use on JPDR dismantlement.

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Bach, F.W., T. Vinke, A. Kinzel, N. Mack, M. Kuboschek, and K. Grobe, Hannover University, Hannover, Federal Republic of Germany; Institut A fuer Werkstoffkunde, Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany

Investigation of Possible Laser Applications in Dismantling of Decommissioned Nuclear Power Plants - Final report

Report; 680 pp. (1987)

The objective of this investigation is to document the state-of-the-art of laser technology with regard to the use of lasers as tools for materials processing in dismantlement of decommissioned nuclear power plants. Therefore, the state-of-the-art is documented through investigations of technical literature, patents, and research reports on high-power-lasers (CO₂, Nd:YAG, excimer), beam guiding and shaping systems, handling and positioning systems and processing results. From

this, the uses of laser technology are defined by system requirements and boundary conditions of the operational locations. Proposals of arrangements of complete laser systems are made.

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Barker, A., and J.A. Blease, United Kingdom Atomic Energy Authority, London, United Kingdom

Decommissioning Nuclear Reactors

United Kingdom Patent 2,176,924/A/; United Kingdom Patent Application 8514794; 8 pp. (1987, January 7)

A machine for decommissioning nuclear reactors is described. The machine is comprised of: (1) a shield structure mounted rotatably at the open top of the reactor pressure vessel; (2) a mast mounted on the shield for extension through an opening in the shield; and (3) a tool-carrying manipulator mounted on the mast. A slew beam, with a hoist, that can be used for handling dismantled material created by the operation of the manipulator is provided beneath the shield. The shield is composed of several sliding sections which can be used to control the size of the opening. Increasing its size will allow the manipulator, when retracted, to be drawn upwards through the shield into a decommissioning module. The manipulator can be opened so that tool changes can be made within the module.

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Bond, R.D., and K. McSherry, United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Winfrith, Dorchester, Dorset, United Kingdom; Department of the Environment, London, United Kingdom

Decommissioning a Small Glove Box

AEW-M-2091; 9 pp. (1985, November)

An account is given of dismantling a fuel fabrication glove box using simple tooling. The fissile content of the box was first measured by several nondestructive techniques. After cleaning, the box was dismantled using hand tools and finally packed for disposal. A record of operator radiation doses, the time taken for each stage of the operation, and packing information is given.

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Boorman, T., United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

Decommissioning the Windscale AGR

Nuclear Technology International 1987, G. Neville (ed.). Sterling Publications Limited, London, United Kingdom; (pp. 69, 71-73) (1987)

The advanced gas-cooled reactor at Windscale (WAGR) is being dismantled, that is, all fuel and coolant will be discharged and the plant dismantled completely with waste disposed of to a permanent repository. It is the first power-producing reactor to be dismantled in the United Kingdom. From a study of the main categories of materials to be disposed of it can be seen that the task of reactor decommissioning can be considered as the segregation of waste materials into appropriate categories and their disposal according to the regulations governing those categories. In the radioactive categories (only 10% of the total) only low and intermediate level wastes are involved. The high-level waste was from the spent fuel which has already been removed. The remote controlled cutting, handling and packaging equipment is described. All equipment to be used has first to be tested after development. One building has been allocated as the waste packaging building and modified suitably. Dismantling is seen as a feasible process.

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Boorman, T., United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

Dismantling Progress

WAGR Decommissioning Newsletter 5 (Spring 1987):4-5 (1987, Spring)

Dismantling work on the Windscale Advanced Gas-cooled Reactor (WAGR) over the past year has centered around operational waste processing and heat exchanger preparation. The first of these tasks is part of the main reactor dismantling program and is being kept to a tight schedule. The second is on a separate program leading to the disposal of the heat exchangers, and has been arranged so as not to interfere with the reactor work; the lower priority of this heat exchanger work provides a convenient float for resource scheduling.

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Removing the WAGR Coaxial Ducts - An Example of 'Hands-On' Dismantling

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.243-IV.257) (1987)

Descriptions are given of the methods used for dismantling two of the WAGR coaxial gas ducts which connected the reactor pressure vessel to the heat exchangers. Each duct system is 4.5 meters long, 860 mm in diameter, and weighs 1.5 tons. After assessing several cutting techniques the choice of a standard oxy-acetylene gas torch was made (a market survey yielded a semi-remote profile cutter which was used on the second duct). The containment boundaries and provision of ventilation system are detailed. Radiation dose figures included in this paper show that materials with surface radiation levels in the 1-10 mSv per hour range can be safely removed and disposed of at modest cost and with acceptable radiation exposures. In particular, the lessons learned are those of good planning, adequate training, and a high level of team involvement. The successful completion of this work allows the planned manual removal of the reactor pressure vessel top dome to proceed with confidence.

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Boorman, T., and R. Medlock, United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

WAGR Decommissioning - The Processing of Operational Waste

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.379-IV.393) (1987)

In decommissioning the Windscale Advanced Gas-cooled Reactor (WAGR) most of the waste items have to be con-

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ditioned in some way to make them suitable for disposal. This paper describes the techniques used to prepare operational waste, a term applied to all of the WAGR's removable channel items, for disposal. These include plug stringers (the upper part of a fuel stringer), control rods and arrestor mechanisms. A plug stringer is 10 meters in length and includes a 2.5-meter long neutron shield plug (NSP). The plug section is separated from the NSP and cut into convenient lengths by "hands-on" techniques in a ventilated facility. The NSP is cut in a shielded facility using a carborundum disc. Arrestor mechanisms are taken from the core into a modified thimble flask, crushed to a suitable length and returned. The tools and procedures adopted are described. A key feature of this work has been to use simple engineering techniques and to adapt existing facilities.

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Bryan, G.H., Pacific Northwest Laboratory, Richland, WA

Remote Cleanout and Renovation of a Hot Cell

PNL-SA-13809; CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1541-1549) (1987, July)

Obsolete equipment from an entire radioactive cell was demolished, decontaminated, and placed in burial boxes for disposal. Remote handling equipment and techniques were used. Modification of existing equipment for demolition and experimentation with cutting techniques contributed to the successful completion of the year-long effort.

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Charamathieu, A., and J.C. Moreau, Service Technique Mistr'e Industrie, Gif-sur-Yvette, France

Teleoperation in Dismantling Operations

Protection, Handling, Detection and Safety, Proceedings of the P.M.D.S. '86 Meeting, Grenoble, France, March 12, 1986. CEA Commissariat a l'Energie Atomique, Paris, France; (pp. 127-133) (1987)

To select the best appropriate method or equipment for dismantling in a hostile environment, it is necessary to take into account the specificity of dismantling work site. In this paper, the author describes briefly the experience of the Societe des Techniques en Milieu Ionisant (STMI). In conclusion, the examples show that the realization of a polyvalent teleoperator is very difficult.

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Clement, G., G. Graize, P. Antoine, and A. Cregut, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Fontenay-aux-Roses, France

Methodology for Selecting Tooling and Telemanipulated Equipments for a Decommissioning Project

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.1-VI.13) (1987)

Until recently, few decommissioning projects have required a complement of fully remotely controlled equipment to perform all tasks. The situation will change in the future, when more facilities with higher levels of radiation are decommissioned. An effort is being made to prepare for the time when there is a need and a demand for remotely controlled equipment that is easy to transport, has a high degree of maneuverability, and is flexible enough to accommodate the tools necessary for dismantling and removing equipment and structures associated with nuclear power plants, nuclear fuel fabrication and reprocessing plants, and other nuclear facilities. This paper discusses the requirements for such equipment.

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Cregut, A., and R. Lurie, 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

France Proves Techniques in Real Environments

Nuclear Engineering International 32(399):52, 54 (1987, October)

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The Commissariat a L'Energie Atomique (CEA) is decommissioning the G2 gas-cooled reactor at Marcoule in order to perfect the technology needed for the dismantlement of large nuclear reactors. In association with this project, a research and development program has been implemented to cover tooling, equipment and processes. Within the framework of these activities, a variety of areas have been the subject of major developments. These are in the fields of: (1) remote equipment; (2) decontamination; and (3) cutting. The developments in these areas are discussed. The application of some of this equipment to the dismantlement of the reactor is also discussed.

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Da Costa, L., F. de Buck, M. Leconte, R. Goertz, and E. Kirchner

System for Remotely Controlled Decommissioning Operations

System for Remotely Controlled Decommissioning Operations. Graham and Trotman Limited, London, England, 238 pp. (1986)

The aim of the study was to analyze the possibilities of reducing radiation exposure during the decommissioning of nuclear facilities by employing remotely operated systems. All types of nuclear reactors and reprocessing plants that exist in the countries of the European Communities are included. In decommissioning tasks the main fields to be considered for remote control are monitoring by visual inspection and radiation or position measurement, decontamination of assemblies or work space, dismantling of metal or concrete structures and, possibly, treatment and transport of resulting debris. As a result of this study three general purpose robotic systems are proposed in conceptual design form. Most of the technology needed already exists but some further development in hardware and computer software are suggested for greater efficiency.

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Daniel, F., M. Pourprix, J. Vendel, J.Y. Deysson, and J.N. Dumont, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Institut de Protection et de Surete Nucleaire, Gif-sur-Yvette, France; Societe Bertin et Cie, Plaisir, France

Study of an Electrocyclone Working up to 600 Degrees C

Technique Moderne 77(11-12):11-16 (1986, November-December)

An electrocyclone is studied and spectral efficiency is determined as a function of gas temperature and particle velocity for particle sizes ranging from 0.3 to 10 microns. Possible applications include the prefiltration of gaseous effluents during the dismantlement of nuclear facilities or radioactive waste incinerators.

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Davies, I.L., C.C. Fleischer, and A.A. Paton, Taylor Woodrow Construction Limited, Southall, Middlesex, United Kingdom

Developing Techniques for Removing Activated Concrete

Nuclear Engineering International 32(392):45-47 (1987, March)

A variety of optimized techniques may be needed to remove the activated layer of concrete in biological shields and pressure vessels without damaging the external shell of nonactive concrete which will be needed to provide containment. Mechanical systems, chemical techniques, and thermal methods for dismantling radioactive concrete structures are discussed.

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Deichelbohrer, P.R., Rockwell Hanford Operations, Richland, WA

Hot Tests of the Small Portable Arc Saw Using an Electromechanical Manipulator

Alternative Energy Sources VII: Volume 3 - Indirect Solar/Nuclear, Veziroglu, T.N. (ed.), Proceedings of the Seventh International Conference, Miami Beach, FL, December 9, 1985. Hemisphere Publishing, New York, NY; (pp. 485-506) (1985)

A hand-held portable arc saw was demonstrated in 1982. Known as the Small Portable Arc Saw (SPARCS), it

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weighed less than 15-lb and could cut a metal sheet up to 1/2-in thick. From the hand-held SPARCS, a manipulator-handled model was developed for use in decommissioning operations by Pacific Northwest Laboratory (PNL). During cold tests, the SPARCS, which was maneuvered with a mechanical, master-slave manipulator, cut 1-in thick stainless steel plate. The decommissioning method of PNL depended principally on a plasma cutting torch for size reduction. The SPARCS unit was installed in the cell to assist the plasma torch. At present, use of the SPARCS in this project has not been necessary, and it has not been operated in the cell. The plasma cutting torch is a widely used tool for size reduction; the torch can cut stainless steel and heavy material, is lightweight, and is easy to handle with manipulators. Some shortcomings, however, have been reported; for example, cutting pipe, laminates, or forms with hollow cross sections (e.g. unistrut) is sometimes cumbersome. The stand-off spacing required is another constraint. The torch tip must be spaced approximately 1/2-in from the work to achieve proper cutting action. During cutting, this spacing requires accurate control of the torch. The manipulator operator must have significant skill to achieve this control. Test results to date show that the arc saw's ability to cut heavy, hard, and inert metal compares favorably with the performance of the plasma torch. The arc saw offers the further advantages of cutting hollow cross-section forms without special procedures, and of cutting without stand-off spacing.

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Doerge, D.H., R.L. Miller, and K.S. Scotti, UNC Nuclear Industries, Inc., Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects: Summary Status Report Three Mile Island Unit 2, Volume 3 - Reactor Defueling and Disassembly

NUREG/CR-4315 (Vol. 3); 80 pp. (1986, May)

This document summarizes information relating to the preparations for defueling the Three Mile Island Unit 2 (TMI-2) reactor and disassembly activities being performed concurrently with decontamination of the facility. Data have been collected from activity reports, reactor containment entry records, and other sources and entered in a computerized data system which permits extraction/manipulation of specific data which can be used in planning for recovery from a loss of coolant event

similar to that experienced at TMI-2 on March 28, 1979. Included in the report are summaries of man-hours, manpower, and radiation exposures incurred during the period of April 23, 1979 to April 16, 1985, in the completion of activities related to preparation for reactor defueling. Support activities conducted outside of radiation areas are not included within the scope of this report. Computerized reports included in this document are: (1) a chronological summary listing work performed for the period; and (2) summary reports, presented in chronological order for the referenced time period, for each major task undertaken in connection with the specific scope of this report. Manually-assembled table summaries are included for: (1) labor and exposures by department; and (2) labor and exposures by major activity.

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Draulans, J., Belgonucleaire SA, Brussels, Belgium

The Decommissioning of Large Glove Boxes in a Mixed Oxide (MOX) Fuel Fabrication Plant

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1454-1461) (1987, July)

The decommissioning of equipment inside a Mixed Oxide fuel fabrication plant is only part of the task to be performed in such a plant. BELGONUCLEAIRE has successfully performed the decommissioning of a large part of its equipment within the required time limit. A brief description of these tasks is given.

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Dubourg, M., Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), Paris, France

Experience of Partial Dismantling and Design Improvement to Facilitate Decommissioning of French PWR-010

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Pro-

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ceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1512-1522) (1987, July)

This report discusses the feasibility studies of decommissioning that have been undertaken on Framatome PWRs with respect to on-site entombment of PWR units and evaluation of activity and radwaste volume. Several examples of partial dismantling of active components of PWRs are also described. The field experience gained in repairing irradiated components indicates that there is no major obstacle for performing significant repair or modification on irradiated components.

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Dubourg, M., Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), Paris, France

Experience of Partial Dismantling and Large Component Removal of Light Water Reactors

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.121-VI.136) (1987)

Since the operating commercial pressurized water reactors (PWRs) built by FRAMATOME for Electricite de France are relatively young, none are to be decommissioned in the next 20 years. However, decommissioning feasibility studies have been undertaken, and several dismantling scenarios have been considered, including the dismantling of four PWR units and the interim disposal of the active components by entombment in an on-site reactor building. In addition to theoretical evaluation of radwaste volume and activity, FRAMATOME has conducted several operations involving partial dismantlement of active components and decontamination activities of both PWR and BWR units.

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Dubourg, M., Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), Paris, France

Dismantling and Decommissioning Experience of Commercial PWR

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 222-243) (1986, October)

Because the FRAMATOME PWRs in operation are relatively young, none of them need to be decommissioned before 1992. Even though this is the case, studies have been done by FRAMATOME to assess the feasibility of on-site entombment of active components and heavy equipments. In the past, partial dismantling of the CHOOZ reactor [PWR of 320 MW(e)] and complete removal of the thermal shield protecting the reactor vessel were conducted successfully. After repair, the reactor power output was upgraded by 10%. As a result, the reactor has operated satisfactorily since 1970. More recently, the discovery of slight defects in the centering pins of the control guide tube which is located in the upper reactor internals of 900 MW(e) plants has initiated the construction of "Hot stand equipment" for the systematic replacement of these centering pins. At the present time, FRAMATOME is actively studying possible options which will extend the plant life beyond its initial license, or will convert it from a classical PWR to a more advanced, more economical (in terms of uranium consumption) reactor.

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Echert, D.C., M. Hashish, and M.H. Marvin, Flow Research Company, Kent, WA

Abrasive-Waterjet Cutting of Thick Concrete and Waterjet Cleaning for Nuclear Facility Decommissioning and Decontamination

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.80-VI.94) (1987)

Two tools have been developed for use by the nuclear industry: the Deep Kerf tool and the Cleaner/Scarifier tool. The Deep Kerf tool is designed to cut through thick,

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reinforced concrete structures. It employs abrasive-waterjet (AWJ) cutting technology. The system contains a rotary nozzle that cuts a slot in the concrete wide enough to accommodate a cutting tool as it advances. In this program, concrete as thick as 1.5 m was cut through from one side. A shroud and vacuum system which covers the opening of the slot during cutting contains the spoils with greater than 99% efficiency. The Cleaner/Scarifier tool was designed to remove the surface layers of contaminated concrete and decontaminate metal surfaces. It uses ultrahigh-pressure waterjets mounted on a rotating arm to remove or clean the target surface. Spoil recovery with a shroud and vacuum system is over 99% for both horizontal and vertical surfaces.

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Ehlbeck, U., and C.O. Corin

Cutting Metals with a Water Jet

Industrie-Anzeiger 108(97):16-17 (1986)

By the use of solid matter as additives in cutting teeth it is possible to cut metals (steel, high-alloy steel, titanium, aluminum, and lead). The same standard high-pressure elements for the generation of a water jet are used to cut metals, glass, and ceramics. Within the tool, the water jet enters a mixing chamber where a predosed abrasive is added by the action of an injector. At the exit end of the mixing chamber, the jet is concentrated again. New applications of this "Paser" system (particle-stream-erosion cutting process, a registered trade mark), which is also called abrasive jet process, are used in aviation and space travel and in nuclear technology.

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Freund, H.U., S. Schumann, K. Mueller, and H. Wegener, Battelle-Institut eV, Frankfurt am Main, Federal Republic of Germany; Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Test Results of Concrete Demolitioning by Smooth Blasting Inside a Reactor Containment

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.61-VI.79) (1987)

Explosive methods have been demonstrated for dismantling large, radioactively contaminated reinforced concrete structures. In this paper, test results are reported on blasting which has been performed inside the former hot steam reactor HDR, which is now in use as a nuclear safety test facility. The blasting experiments are aimed primarily at: (1) optimizing the method for different types of concrete, in particular, the concrete used in Niederaichbach (KKN) and Biblis (KKB) biological shields; (2) safety measures necessary for handling dust and debris; and (3) quantifying the dynamic loading on the blasted component, the reactor containment, and its vicinity. Efforts invested into characterizing dynamic loading and structural responses should help to increase safety and predictability rates. For this purpose, a variety of measurements have been performed. Responses have also been calculated using finite element models. It is shown that blasting methods can be applied in accordance with safety and regulatory requirements.

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

Removal of Activated Concrete from the Northrop TRIGA Reactor - Operations and Safety Experience

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1088 pp.; (pp. 1417-1428) (1987, July)

The 1 MW Northrop TRIGA reactor was successfully decommissioned and dismantled in March-September, 1985 by Chem-Nuclear Systems, Inc. Approximately 2800 cubic feet of packaged, activated concrete and steel reinforcing bar was removed from the reactor structure. This paper summarizes the decommissioning project and the facility and discusses the safety precautions and operational approach during concrete removal. A discussion of nuclide content of the concrete, personnel safety procedures, control and measurement of airborne dusts and results is included.

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Gardner, F.W., and M.R. Manning, Chem-Nuclear Systems, Inc., Columbia, SC

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Concrete Removal and Disposal from Research Reactor Decommissioning: Waste Management 1986

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 833 pp.; (pp. 465-468) (1987)

Removal and disposal of neutron activated concrete from biological shields is the most significant operational task associated with research reactor decommissioning. During 1985 and 1986 Chem-Nuclear System, Inc. was the prime contractor for complete dismantlement and decommissioning of the Northrop TRIGA Reactor Facility and the Virginia Tech Argonaut Reactor. This paper discusses operational requirements; methods employed, and results of the concrete removal, packaging, transport, and disposal operations for the Northrop TRIGA and Virginia Tech Reactor decommissioning projects. Methods employed for each are compared. Disposal of concrete above and below regulatory limits for unrestricted use are discussed. This study concludes that activated reactor biological shield concrete can be safely removed and buried under current regulations.

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Guittet, J., Commissariat a l'Energie Atomique, Centre de Marcoule, Bagnols-sur-Ceze, France

Advanced Systems for Dismantling

Protection, Handling, Detection and Safety, Proceedings of the P.M.D.S. '86 Meeting, Grenoble, France, March 12, 1986. CEA Commissariat a l'Energie Atomique, Paris, France; (pp. 113-126) (1987)

In this paper the approach used by the UDIN (Unite Centrale de Declassement des Installations Nucleaires) for dismantling is shown. With respect to costs for dismantling, it is necessary to take into consideration the specificity of the work sites and the protection of the environment and workers. Some examples show these points. Protection is made by a good study of the work site, by a preliminary decontamination if possible, by containment of contamination, and by utilization of robots and techniques to reduce radioactive wastes.

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Guittet, J., G. Fraize, and G. Clement, 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; Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Advanced Robotics Unit (UGRA), Gif-sur-Yvette, France

Underwater Dismantling

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1462-1476) (1987, July)

The CEA-UDIN Department in charge of decommissioning nuclear facilities tested various mechanical cutting tools underwater with a MA23M manipulator. The purpose was to learn their main operating features. Underwater thermal cutting processes were also checked to learn the process limits. It appeared that remote underwater cutting of steel plates with a plasma torch was just within the ability of MA23M, due to the difficulty of keeping the gap between the torch nozzle and the surface to be cut constant, without any special device. In order to extend the skill and ability of the MA23M, whose limits and performances are well known, the Advanced Robotic Department of the CEA (UGRA) designed a new generation of servo manipulators RD500 and sensors and computer adapted to remote handling, thus carrying out a real computer assistance.

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

Unitary Torch for Underwater Dismantling of Nuclear Reactor Vessels

Metal Construction 19(11):641-642 (1987, November)

In Japan, it has been suggested that unused nuclear power plants be decommissioned as soon as possible, so that new plants may be constructed in their place. The

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most difficult aspect of decommissioning is dismantling the pressure vessel which is fabricated from thick low alloy steel. The development and testing of a combined gouging and cutting torch for use underwater on commercial reactor components is described.

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Hardy, R.W., General Electric Company, Nuclear Energy Business Operations, San Jose, CA

Experience Using a Plasma Arc Cutting System for Volume Reduction of Irradiated Hardware

CONF-860724; Safe and Reliable Nuclear Power Plants, Proceedings of an American Society of Mechanical Engineers/American Nuclear Society Biannual Nuclear Power Conference, Philadelphia, PA, July 20-23, 1986; (pp. 361-366) (1986)

A Plasma Arc Cutting (PAC) System has been developed for underwater volume reduction of irradiated metallic hardware. This system has recently been used to successfully reduce the volume of over 1200 irradiated BWR fuel channels at two U.S. reactor sites. After cutting, the fuel channels were loaded into burial liners and shipped to a burial site using a shielded transportation system. The total cost to the utilities included the cutting services plus support, transportation, handling and burial. This paper discusses the design of the PAC System, its first use on BWSR fuel channels and other potential uses.

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Harper, J., and J. Warren, Los Alamos National Laboratory, Los Alamos, NM

Los Alamos Transuranic Waste Size Reduction Facility

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.148-III.159) (1987)

The Los Alamos Transuranic (TRU) Waste Size Reduction Facility (SRF) is a production oriented prototype completed in 1981 and later modified during 1986 to enhance production. The facility is operated to remotely

cut (with a plasma arc torch) and repackage TRU contaminated metallic wastes (e.g. gloveboxes, ducting, and pipes) for eventual disposal at the Waste Isolation Plant (WIPP) near Carlsbad, New Mexico. The resulting flat sections are packaged into a tested U.S. Department of Transportation Type 7A metal container. To date, the facility has successfully processed stainless steel gloveboxes (with and without lead shielding construction) and retention tanks. It was found that used gloveboxes generate more cutting fumes than do unused gloveboxes or metal plates - possibly due to deeply embedded chemical residues from years of service. Water used as a secondary fluid with the plasma arc cutting system significantly reduces visible fume generation during the cutting of used gloveboxes and lead-lined gloveboxes.

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Hirayama, T., Nippon Atomic Industry Group Company Limited, Tokyo, Japan

Radiation Shielding Materials

Japanese Patent 61-235799/A; Japanese Patent Application 60-76835; 4 pp. (1986, October, 21)

A simple method for measuring the radioactivation of shielding concretes is described. In a nuclear reactor, thermal shielding is located outside of the reactor pressure vessel, a reactor container is situated outside this, and concrete biological shields are positioned further to the outside. Detachable specimens for measuring the activation occurring during reactor operation are incorporated in the concrete at several predetermined positions. These samples are assembled during construction of the concrete materials. Specimens can be taken out for measuring the activity levels during periodic reactor inspection or during reactor operation. Further, estimation or measurement of activation before dismantling can be easily conducted.

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Ikezawa, Y., J. Onodera, C. Nakamura, Y. Ashikagaya, and H. Matsui, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Radiation Control Technology Applicable to the JPDR Decommissioning

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CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.104-V.113) (1987)

With respect to radiation control, the main features of the Japan Power Demonstration Reactor (JPDR) dismantling are as follows: (1) reactor components in areas of high-level radioactive contamination will be inspected in their underwater position and in air if they are dismantled and removed from the water; (2) new dismantling techniques that have not been previously used in controlled areas will be adopted; and (3) large amounts of materials, tools, and radioactive waste will be removed from the controlled area. To implement these features, the following instruments have been developed: (1) remote high dose rate measuring instruments for radiation monitoring underwater and in air; (2) contamination inspection monitor; (3) respirable dust monitor; (4) extremely low-level waste gamma scanner; and (5) waste package contamination and dose rate monitor.

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Expertise of the Oeko-Institute on the Application to Obtain Permission to Partially Dismantle the Niederaichbach Nuclear Power Plant

INIS-mf-10712; 99 pp. (1985, March)

This report gives an overview of the problems associated with the decommissioning and dismantling of the Niederaichbach nuclear power plant, considering technical and legal aspects. It shows that the dismantling of this reactor cannot serve as evidence to prove the general feasibility of reactor dismantling. Much space is dedicated to the discussion about where the border between radioactive and nonradioactive materials should be drawn so that it is in accord with the ordinance on radiation protection. The reasons for rejecting partial dismantling procedures are given.

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Ishikawa, M., M. Kawasaki, M. Yokota, H. Ezure, T. Hoshi, and M. Tanaka, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Present Status of JPDR Decommissioning Program

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.18-III.30) (1987)

The Japan Atomic Energy Research Institute (JAERI) has been developing decommissioning technologies to dismantle the Japan Power Demonstration Reactor (JPDR) since 1981. The technology development has almost been completed and final check-out of the disassembly and demolition systems such as underwater plasma arc cutting and arc saw cutting were conducted to confirm the required performance. The actual JPDR decommissioning was started on December 4, 1986 according to the detailed decommissioning plan evaluated by the technical design study. The present status of the JPDR decommissioning program and the results of the evaluation study are described in this paper.

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Ishikawa, M., M. Yokota, S. Yanagihara, and H. Nakamura, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Decommissioning Program of the Japan Power Demonstration Reactor by JAERI

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1194-1203) (1987, July)

The decommissioning program of the Japan Power Demonstration Reactor is underway. The detailed procedures for dismantlement and waste management have been studied in consideration of both minimization of personnel radiation exposure and reduction of the waste. The

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features emphasized in the JPDR decommissioning program plan include: (1) all activated components and structures will be removed with remote handling devices to minimize personnel radiation exposure; (2) the components and structures will be further cut into small pieces rather than move them in one piece to reduce the volume of radioactive wastes; and (3) the dismantlement will be carried out using various devices developed by JAERI to demonstrate their performances.

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Progress of JPDR Decommissioning Program: First Progress Report (December 1986-July 1987)

Report; 22 pp. (1987, September)

Japan must be ready in the foreseeable future to begin the dismantlement of large nuclear power plants as their service life ends. In preparation for this, the Science and Technology Agency (STA) commissioned the Japan Atomic Energy Research Institute (JAERI) to undertake a Decommissioning Program for dismantling the Japan Power Demonstration Reactor [JPDR, BWR, 90 MW(t)] which has ended its service life. The program is in accord with the "Long-term Program on Nuclear Energy Development and Utilization" issued by the Japan Atomic Energy Commission (JAEC). The JPDR Decommissioning Program consists of two major phases. Phase 1 began in 1981, aiming to develop a set of techniques needed for reactor dismantling, including an estimate of the radioactive inventory, decontamination, disassembly, waste management, radiation control, and systems engineering, which have now almost been completed. In the process of dismantling JPDR, JAERI will be able to accumulate decommissioning experience in preparation for the decommissioning of large nuclear power plants, which will be necessary in the near future. This is the first progress report. It sets out the present status of the JPDR Decommissioning Program in addition to the preceding phase and presents the outline of the total program with various related topics. The period covered is from December 1986 through July 1987.

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Klimov, Yu.I.

Dismantling and Decommissioning of Nuclear Facilities

Atomnaya Tekhnika za Rubezhom 8:12-15 (1986, August)

Problems of dismantling PWR type nuclear reactor equipment, and the West Valley Processing Plant (WVPP) are considered. Examples of the application of gas burners and electric arc cutting technologies to a reactor vessel wall plated with stainless steel are provided. The use of laser cutting technology on concrete and reinforced concrete structures is also illustrated. Experience in decontamination of equipment and with radioactive wastes produced in the process of equipment dismantlement at WVPP is also discussed.

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Konno, T., T. Narazaki, M. Yokota, H. Yoshida, M. Miura, and Y. Miyazaki, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan; Kajima Corporation, Tokyo, Japan

Abrasive Water Jet Cutting Technique for Biological Shield Concrete Dismantlement

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.270-IV.284) (1987)

The Japan Atomic Energy Research Institute is developing the Abrasive-Water Jet Cutting System to be applied to dismantling the biological shield walls of the Japan Power Demonstration Reactor as a part of the reactor dismantling technology development project. This is a total system for dismantling highly activated concrete. The concrete biological shield wall is cut into blocks by driving the abrasive-water jet nozzle, which is operated with a remote, automated control system. In this system, the concrete blocks are removed to a container, while the slurry and dust/mist which are generated during cutting are both collected and treated automatically. It is a very practical method and will probably be used for dismantling of commercial power reactors in the future because it can: (1) minimize workers' exposure to radioactivity during dismantling; (2) contribute to the prevention of scattering of contaminated dusts and mists; and (3) reduce the volume of contaminated secondary waste.

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Kuypers, J., and A. Spruyt, Keuring van Electrotechnische Materialen, N.V., Arnhem, Netherlands

Decommissioning of the KEMA Suspension Test Reactor

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1502-1511) (1987, July)

During operation of the KEMA Suspension Test Reactor a powdered fuel of $UO_2 - ThO_2$ has been circulated through the primary system of the reactor. Dismantling systems, which have been contaminated with fission products and alpha-emitters and subsequently activated, requires a thorough decommissioning plan, even if the activity levels are low. Disposal of decontaminated steel from this reactor poses another problem because of difficulties in measuring residual alpha-activity. A solution for this problem has been found in remelting the steel.

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Nuclear Decommissioning

Nuclear Energy (British Nuclear Energy Society) 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. 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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Loschhorn, U., U. Birkhold, J. Obst, and W. Stasch,

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Nuclear Power Plant Niederaichbach - Dismantling and Concrete Removal

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1495-1501) (1987, July)

The Niederaichbach Nuclear Power Plant was shut down for good in 1974 and brought into a state of safe enclosure. The following up decommissioning plan is divided into five steps: (1) manual in-place dismantling of the nonradioactive systems within the safety containment; (2) manual removal of the contaminated material; (3) remote controlled dismantling of the activated material; (4) removal of the concrete biological shielding by explosives; and (5) conventional demolishing of the buildings. The steel will be reused after melting or decontamination by scrap dealers or conditioned for final disposal. The rubbish can be reused for road design or disposed of in conventional areas.

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Specific Aspects of Decommissioning

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 108-141) (1986)

This communication depicts the main aspects of decommissioning. Decommissioning covers a sequence of

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operations which must be carefully designed and organized to take into account the environment in which the operations are to be performed. It is important to note that, unless reuse of components and materials is envisaged, destructive processes, which are typical of the dismantling procedures, will be employed. The existence of a hostile environment requires utilization of appropriate methods and specific equipment for gaining access to the equipment to be dismantled. Dismantling results in a significant quantity of active and inactive waste to be sent to disposal. Finally, site work continuously modifies a nuclear plant, due to the dismantling work underway.

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Management of G2 Decommissioning (UNGG Reactor)

CONF-871018; Decommissioning, G.A. Tarzsa (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.34-V.55) (1987)

Technicatome, together with the French Commissariat a l'Energie Atomique (CEA), has developed engineering methodology for the management of nuclear power plant decommissioning. This methodology is being applied to the G2 reactor decommissioning. The French CEA G2 reactor is a graphite moderated carbon dioxide cooled reactor that operated for more than 20 years at a nominal output of 40 MW(e). It was shut down in June 1980. The CEA's Unite Centrale de Declassement des Installations Nucleaires (UDIN) is responsible for its decommissioning. The Societe Technique pour l'Energie Atomique (TECHNICATOME) is in charge of the engineering work, including site work management. This paper describes the reactor and the reactor components and peripherals and summarizes the decommissioning options that the responsible organizations had. It was decided to decommission the reactor to Stage 2, which is presently underway.

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Mangin, D., Commissariat a l'Energie Atomique, Centre d'Etudes de Valduc, Is-sur-Tille, France

Conception of Dismantling Cell for Glove Box with Alpha Contamination

Protection, Handling, Detection and Safety, Proceedings of the P.M.D.S. '86 Meeting, Grenoble, France, March 12, 1986. CEA Commissariat a l'Energie Atomique, Paris, France; (pp. 57-64) (1987)

The new dismantling cell at Valduc treats alpha glove boxes. This cell is designed to reduce the intervention inside for men with ventilated clothes and to reduce the volume of alpha wastes by utilization of manipulators and appropriate tools. The respect of low-level norms (0.1 Ci/ton) for storage of alpha wastes requires us to make a first decontamination, to improve the detection in quantity of plutonium in the wastes, and for wastes with a level above the norm to make studies on decontamination by Freon-113.

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Masuda, M., and H. Furukawa, Hitachi Limited, Tokyo, Japan

Method of Dismantling Reactor Containment Facilities

Japanese Patent 61-142494/A; Japanese Patent Application 59-284473; 3 pp. (1986, June 30)

Purpose: To dismantle and remove the biological shielding blocks accurately by individual radioactivity level, using the through section. Method: Trench excavation is made around the area of the high-radioactive level biological shield, by using a cutting machine, and then, the rear part of the block to be separated from the inside of the through section is cut. The blocks are separated and this process is repeated continuously. Reinforcements and through-section sleeves are also cut out along with dismantling of the biological shield. The block size can be arbitrarily selected within the range of the cut depth and the high-radioactivity level area can be separated efficiently. By using the through-section, the reactor containment facilities can be dismantled easily and accurately from the surface of the biological shield and removed by each radioactivity level. Since the block cut off is of the form of rectangular parallelepiped, the storage space for radioactive waste separated can be minimized.

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Robotic Delivery System for Plasma Cutting of the TMI-2 Lower Core Support Assembly

Transactions of the American Nuclear Society 55:679-681; CONF-871101; Proceedings of an American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (pp. 679-681) (1987)

Attempts to defuel the region of the reactor vessel below the core at Three Mile Island Unit-2 (TMI-2) are described in this article. Access to the region will be aided by the use of a plasma arc cutting tool which will be carried on a robot. A detailed description of the system and the procedures that will be used to reach the fuel is provided. The system was scheduled to be delivered to TMI-2 by mid-June, 1987 and was expected to be working by late 1987.

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McKay, H.S., Virginia Power Company, Glen Allen, VA

Steam Generator Replacement at Surry Power Station: Techniques Applicable to Power Station Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.137-VI.146) (1987)

During the Surry Steam Generator Repair Program, it was necessary to cut the steam generator into two pieces and to remove sections of the reactor coolant piping, feedwater piping, main steam piping, and instrumentation lines. Many of the cutting techniques and measures taken to minimize personnel exposure are directly applicable for use in nuclear power station decommissioning. This paper discusses these techniques as they were used at Surry.

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Mies, H.P., W. Stang, G.V.P. Watzel, W. Schacky, and D. Rittscher, Kernkraftwerke Gundremmingen Betriebsgesellschaft mbH, Gundremmingen, Federal Republic of Germany; Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen, Federal Republic of Germany; Gesellschaft fuer Nuklearservice, Essen, Federal Republic of Germany

Shutdown of Unit A at Gundremmingen Nuclear Power Plant and the Recycling of Steel Scrap

VGB Kraftwerkstechnik 67(6):544-546 (1987, June)

Unit A (KRB A) at the Gundremmingen demonstration nuclear power plant had an electrical output of 250 MW and operated from 1966 to 1977. In 1930 it was decided to shut down the plant. Dismantlement commenced in 1983 following receipt of the necessary license. By the end of 1985 about 1500 tons of steel and concrete had been removed and decontaminated. At the end of 1987 the main dismantling work in the turbine hall will be completed. In compliance with the requirements of the Atomic Energy Act, shutdown provides for the minimization of radioactive waste, and the reuse of as many of the removed components as possible. Basically, unrestricted free or even controlled utilization of steel components is attainable.

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S.T.M.I.: Several Years of Experience in Nuclear Plant Dismantling

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 244-255) (1986)

Since 1977, when the Societe des Techniques en Milieu Ionisant (STMI) performed its first dismantling operation, the Company has attained appreciable

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improvement in that field through performing the following operations: (1) dismantling the calciothermy and fluorination metal Pu preparation facility in the La Hague reprocessing plant; (2) dismantling the slag treatment chain, associated with the calciothermy and fluorination processes in the La Hague reprocessing plant; and (3) cleaning the EL4 cell in Marcoule. To perform these operations, STMI's operating teams developed decontamination and dismantling technologies, worked to improve handling and transportation technologies, and adapted or developed equipment for handling radioactive materials. In order to increase its technical efficiency, STMI signed a cooperative agreement with the Societe Technique pour l'Energie Atomique (TECHNICATOME). The combined expertise of the two organizations (hands-on experience of STMI and design experience of TECHNICATOME) will provide the technology for dismantling any type of nuclear facility.

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Large Scale Fuel Channel Replacement Program

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.106-VI.120) (1987)

The Canadian Deuterium Uranium (CANDU) reactor was designed so that any or all of the components which make up the reactor channels can be removed and replaced. It has always been expected that at least once during the lifetime of a CANDU nuclear power station, the reactor channels would require replacement, and that this feature may allow extension of the life of a CANDU nuclear station far beyond the normal amortization life. This paper describes the planning, decontamination, defueling, safety procedures, and tooling requirements that were necessary for the successful removal and replacement of the reactor fuel channels of the Pickering Units 1 and 2.

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Republic of Germany; Battelle-Institut eV, Safety Technology Department, Frankfurt am Main, Federal Republic of Germany

Testing the Demolition of Concrete and Pipes with Explosive Charges Within a Nuclear Power Plant

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.285-IV.297) (1987)

The demolition of concrete and pipes using explosive charges (ZER) was tested within the HDR, a former nuclear power plant. Using the HDR for these tests ensures results that can be checked under realistic boundary conditions for their validity within a closed containment. When nuclear power plants are decommissioned, it is important to disassemble radioactive plant components (biological shields) in such a way that only the radioactive portions must be put into final storage. Breaking up activated and contaminated concrete structures by blasting seems to be a suitable disassembly technique from the points of view of radiation protection and economy. The possibility of such disassembly without any hazard to adjacent structures and to the reactor containment is to be demonstrated on the HDR in a real, dry containment. Such phenomena as dust emission, shock wave propagation, and activity release as well as necessary protective measures and the time required for this type of decomposition technique are to be analyzed. The mechanical equipment components of decommissioned nuclear power plants must be dismantled and conditioned by the most economical methods while at the same time keeping the radiation exposure to the decommissioning personnel to minimum. Using these criteria as limiting factors, the method of blasting with explosive charges to separate and remove large pipe systems and components was tested.

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Muto, T., Hitachi Shipbuilding and Engineering Company Limited, Osaka, Japan

Method of Dismantling and Withdrawing of Activated Concrete for Reactor

Japanese Patent 61-116698/A; Japanese Patent Application 57-238017; 4 pp. (1986, June 4)

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A flame cutting technique for cutting radioactively contaminated concrete is described. The process allows the cutting to continue without contaminating the environment. A flame cutter is inserted into water inside the reactor cavity to be dismantled. When the flame cutter is operated the activated concrete on the inner surface of the cavity is melted down, from top to bottom, to form blocks of convenient size. Then, the concrete blocks are lifted and moved out of the cavity by conveyor. For less recontamination of the concrete, the water level inside the cavity is lowered in the dismantling process so that the flame cutter is not disposed over the water surface. Radioactive fumes or dusts produced in the cutting process are trapped in water, thus minimizing air pollution.

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Demolition of RC Structures by Applying Electric Current Through Rebars

Semento Konkurito 487:49-55 (1987, September)

Recently, the dismantling of reinforced concrete structures has increased rapidly. In urban districts, there are strict restrictions of noise, vibration, and dust, and the development of no-vibration, no-noise construction methods is desired. The dismantling method by electrically heating reinforcing bars was developed for separating the surface layer of radioactivated and contaminated concrete for the dismantling of nuclear power stations, but it can be applied also to the dismantling of general reinforced concrete structures. Reinforcing bars can be electrified both directly and through induction. The direct electrifying method is discussed here. When a large current is passed directly through reinforcing bars in concrete, they behave like electric resistors, and their temperature rises rapidly to about 450 deg C. As a result, the surrounding concrete cracks and loses the adhesion, due to the dehydration. By striking lightly, the concrete separates, thus dismantling becomes easy. The preparation, types of electrode terminals, and heating temperature used are discussed. Observations on the cracking of the concrete, secondary breaking after heating, dust from dismantling and broken pieces, and the features and the fields of application of this method are reported. (Auth)(PLS)

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Newton, G.J., M.D. Hoover, E.B. Barr, B.A. Wong, and P.D. Ritter, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM

Collection and Characterization of Aerosols from Metal Cutting Techniques Typically Used in Decommissioning Nuclear Facilities

American Industrial Hygiene Association Journal 48(11):922-932 (1987, November)

This study was designed to collect and characterize aerosols released by metal cutting activities during decommissioning of radioactively contaminated facilities. Such information can guide in the selection of appropriate control technologies for these airborne materials. Mechanical cutting tools evaluated included a multi-wheel pipe cutter, reciprocating saw, hand saw, chop saw, and large and small grinding wheels. Melting-vaporization cutting techniques included an oxy-acetylene torch, electric arc cut rod, and plasma torch. With the exception of the multi-wheel pipe cutter, all devices created aerosols in the respirable size range (less than 10 micron aerodynamic diameter). Time required to cut 2-in. (5-cm) Schedule 40, Type 304L, stainless steel ranged from about 0.6 min for the plasma torch to about 3.0 min for the reciprocating saw. Aerosol production rate ranged from less than 10 mg/min for the reciprocating saw to more than 3600 mg/min for the electric arc cut rod. Particles from mechanical tools were irregular in shape, whereas particles from vaporization tools were spheres and ultrafine branched-chain aggregates.

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Onishi, N., A. Kanenari, Y. Futamura, H. Sakurai, S. Suzuki, T. Nagase, A. Iwatani, and F. Otsubo, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan; Shimizu Construction Company Limited, Tokyo, Japan

Investigations Related to a One-Piece Removal of the Reactor Block in the Frame of the JRR-3 Reconstruction Program

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.95-VI.105) (1987)

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An outdated research reactor, Japan Research Reactor No. 3 (JRR-3), was removed to a storage facility on October 14-November 7, 1986. The removal of the 2250-ton reactor block (10 X 10 X 10 m) was performed as part of a program to replace the JRR-3's core [10-MW(t)] with an upgraded research reactor core. The heavy water and fuel elements were taken out of the JRR-3 before removal work began. The reactor block was raised about 3.7 meters, using a 12-cubic meter steel frame and a center-hole jack system. The reactor block was then transported horizontally to a storage facility about 34 meters away using four 100-ton jacks mounted on steel rails. Finally, the reactor block was lowered 14 meters into the storage facility.

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Renc, H.W., and R.C. Schmitt, Idaho National Engineering Laboratory, Idaho Falls, ID; EG&G Idaho, Inc., Idaho Falls, ID

TMI-2 Reactor Fuel Removal, Loading, Transport and Storage

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 1, 1095 pp.; (pp. 688-698) (1987, July)

Preparations and operations are highlighted for loading and transporting the Three Mile Island, Unit 2 (TMI-2) reactor core debris and receiving and storing them at the Idaho National Engineering Laboratory (INEL). The phases of transporting canisters from TMI to INEL are discussed. Lessons learned are indicated and benefits derived are noted.

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Reactor Defueling Gets Under Way: TMI-2 Update

Nuclear Engineering International 31(381):27-29 (1986, April)

With the start of defueling last October, the recovery of TMI-2 entered the most important phase thus far. Planning the defueling has been difficult because the condition of the core below the layer of loose rubble is completely unknown. In order to achieve defueling, a flexible array of tools and procedures has had to be developed. These tools and procedures are described.

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Decommissioning of Nuclear Plants, Examples of Application to Reactors

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 172-206) (1986)

Decommissioning operations are presently underway on two experimental reactors: the Triton, a pool type reactor located at CEN/FAR, and the EL3, a heavy water vessel type reactor located at CEN/SACLAY. The difference in reactor type requires that the decommissioning approaches be adapted for each one. The chosen solution for the EL3 is to dismantle the vessel external equipment immediately and to postpone the dismantlement of the reactor block by reinforcing its containment. Immediate dismantlement of all reactor structures of the Triton Reactor can be performed because of the protection afforded by the pool water.

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Savchenko, V.A., and S.I. Skovorod'ko

Decommissioning of the Otto Hahn Propulsion Reactor

Atomnaya Tekhnika za Rubezhom 9:24-27 (1986, September)

Specifications of the nuclear propulsion reactor at the Otto Hahn ship are presented. Demounting and decontamination of components and equipment of the facility

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on board the ship are described. Measures on determination of control zones, cleanup of a load bilge, spent fuel packing, and transport are considered. Four stages of the reactor decommissioning are analyzed.

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Schumann, S., H.U. Freund, and W. Geiger, Battelle-Institut eV, Safety Technology Department, Frankfurt am Main, Federal Republic of Germany

The Cutting of Steel Tubes by Explosive Techniques: Cutting Performance and Effects on Environment

Propellants, Explosives, Pyrotechnics 11:133-139 (1986)

In the light of special applications, trials were carried out on the separation of steel tubes using commercially obtainable explosive cutting charges in an annular configuration in order to find out their cutting performance and the effects on the environment incurred during separation. Tubes made of St37 steel having a diameter of 220 mm and a wall thickness of 10 mm as well as tubes consisting of high-tensile 15 Mo 3 steel with a diameter of 273 mm and a wall thickness of 12.5 mm were used for this purpose. It was possible to cut the tubes accurately and neatly with the charges used. However, the projectiles formed during the detonation process are not compact. For this reason, the cutting performance of the commercial charges used is not optimal, providing a considerable potential for improvement. Measurements of the environmental effects conducted during the trials (fragmentation, blast wave, projectile impact on the tube line) show that the incidental effects of explosive tube cutting are controllable.

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Investigation of the Development and Optimisation of Cutting Loads for the Cutting of Steel Pipes with Typical Properties and Material Properties for Nuclear Power Stations - Final Report

INIS-mf-11649; 48 pp. (1987, April)

The aim of this project was to develop a type of cutter loading sleeve for the cutting of thick-walled steel pipes by explosive technique. Due to its construction and cutting performance, the cutter is suitable for use when dismantling pipelines in shutdown nuclear power stations. The loading sleeve is built up of individual linear elements and can be placed as a polygon around pipes of different diameters. A steel pipe with dimensions of 610 mm diameter X 36 mm wall thickness (live steam pipe of a German BWR of a new type) was completely and accurately cut using a cutting load sleeve with 1.84 kg of explosive. Tamping of this type of cutting loader minimizes the quantity of explosive required and reduces the air shock or blast wave peak pressure by about 30% compared to a charge without tamping. The distance at which the value of peak pressure of the blast wave of 1 bar (which could cause damage) is exceeded, is reduced to 3.0 meters compared to 5.3 meters for an untamped charge of the same cutting power.

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Explosive Pipe Cutting by Shaped Charges in an Annular Configuration

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.298-IV.310) (1987)

One of the prime objectives in decommissioning of nuclear power stations is the development of dismantling techniques that minimize the radiation exposure of the decommissioning personnel. This paper describes an explosive pipe cutting technique that achieves this objective. In addition, the technique enables the dismantlement of component parts that are not easily accessible for cutting by conventional methods such as sawing or thermal cutting. The explosive pipe cutting technique was developed to separate thick-walled tubes. The simplicity of the arrangement and its easy applicability are the advantages of this dismantling method. Explosive pipe cutting by shaped charges may be carried out in two different ways: from the outside using sleeve charges, or from the inside using catheter charges. The

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cutting of tubes from the outside using sleeve charges and the resulting effects on the environment are discussed.

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TMI-2 Experience with Remote Operations Technology

CONF-871018; Decommissioning, G.A. Tarca (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. VI.14-VI.28) (1987)

The remote operation technology developed for use in the Three Mile Island Unit 2 (TMI-2) cleanup is discussed. Such technology and experience are considered to have applicability for a nuclear plant decommissioning. Specifically, it addresses: (1) mobile, remotely controlled vehicles for surveillance, sampling, light-duty, surface decontamination, and dismantling work; (2) stationary remotely controlled surveillance equipment; and (3) remotely controlled boring, cutting, dismantling, and manipulating tools for damaged reactor defueling and disassembly.

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Scott, D.W., T.L. Moore, G.J. Funnell, and M.A. Schiffhauer, Rockwell Hanford Operations, Richland, WA; West Valley Nuclear Services Company, Inc., West Valley, NY

Remote Installation of a New Riser on an Existing West Valley Site Tank

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 2 - High-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 603 pp.; (pp. 435-440) (1987)

A method of remotely installing new access ports, and risers, on existing high-level radioactive waste tanks has been developed by Rockwell Hanford Operations for use

on two of the storage tanks at the West Valley Demonstration Project, West Valley, New York. The equipment designed includes a semi-remote concrete coring machine and fully remotely operated machines for flame cutting, grinding, and welding.

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Applications of Arc Plasma Technology

Denryoku Chuo Kenkyusho Hokoku 685005:1-39 (1986, June)

This report describes the present situation of research, and the subjects to be studied in plasma technology. The future subjects are summarized as follows: (1) development of control technology and long life electrodes for arc-plasma; (2) volume reduction of noncombustible nuclear solid wastes by plasma furnace and dismantlement of nuclear reactors by plasma cutting; and (3) the valuation technology for arc-proof capability of insulators, horns, towers and so on for distribution and transmission systems.

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WAGR Dismantling Manipulator

WAGR Decommissioning Newsletter 5 (Spring 1987):13-15 (1987, Spring)

Over the years Taylor Hitec has had a continuous involvement in the design and supply of remote handling equipment for the nuclear industry. This has covered elementary manually-controlled manipulators through to very sophisticated computer-controlled manipulators capable of remote welding inside nuclear reactors. This experience has enabled the company to diversify into automation, industrial robot systems, and flexible manufacturing cells for manufacturing industry. The technical interchange of ideas between the two areas of business has enabled Taylor Hitec to respond to the Authority's specification with a sophisticated manipulator design at an economic price. General specifications and design approach for the manipulator are discussed.

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Speer, D.R., Rockwell Hanford Operations, Richland, WA

Decontamination and Decommissioning of a Fuel Reprocessing Pilot Plant, A Progress Report

RHO-WM-SA-81; CONF-871018; Decommissioning, G.A. Tarca (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.44-IV.58) (1987)

The Strontium Semiworks complex on the Hanford Site operated as a pilot plant from 1949 to 1967 to develop two different methods for fuels reprocessing and a method for separating strontium from high-level liquid waste. The complex was maintained in safe storage from 1967 until 1983 when the decision was made to decontaminate and decommission the plant. Alternatives considered were: (1) earthen entombment without demolition; (2) partial dismantlement/entombment; (3) razing of all aboveground structures; (4) total dismantlement; and (5) no action. An Environmental Assessment was prepared for the project in 1984 and a Finding of No Significant Impact was issued on May 15, 1985. The approved method of decommissioning was Alternative 2 based upon stability of the end product, cost of the project, and projected impacts. As of July 1987 three buildings have been decontaminated, two buildings have been completely dismantled, and the main process building has been partially dismantled and entombed. Remaining work includes cleaning out a 190,000-liter (50,000-gal) tank, decontaminating and demolishing a 61-meter (200-ft) stack, entombing an exhaust filter system, and placing an engineered barrier over the entombed facilities.

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Suehtsuna, I.

Decommissioning in Japan

Atomnaya Tekhnika za Rubezhom 3:28-29 (1987, March)

The direction of present research, technology, and techniques, which are being developed and will be used for NPP decommissioning in Japan, are described briefly. Efforts are concentrated on equipment development for cutting radioactive metal and reinforced concrete radiation shield. Some technical data on the equipment being developed are given.

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Tarroni, G., C. Melandri, T. de Zaiacomo, C.C. Lombard, and M. Formignani, Comitato Nazionale per l'Energia Nucleare, PAS-FIBI-Aersol, 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, Proceedings of the 13th Annual Conference of the Association for Aerosol Research (Gesellschaft fuer Aerosolforschung), Garmisch-Partenkirchen, Denmark, September 25, 1985; (pp. 587-591) (1986, June)

The technique of cutting based on the use of a laser beam is studied as a possible method of nuclear plant dismantlement. The main problem with the technique is contamination due to high aerosol production. Tests have been conducted to characterize the aerosol produced in cutting steel and concrete in terms of size spectrum, electric charge, and chemical composition. Aerosol chemical composition has been compared with bulk material composition. 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, occurring in less than 1 sec, and leads to aggregates. Research has been aimed at characterizing the aerosol removed from the cutting zone by ventilation, and at 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 Materials Testing Reactor HFR Petten

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1327-1337) (1987, July)

NUCLEAR FACILITIES DECOMMISSIONING DISMANTLEMENT AND DEMOLITION

The project of replacing the High Flux Reactor (HFR) originated in 1974 when results of several research programs confirmed severe neutron embrittlement of aluminum alloys suggesting a limited life of the existing facility. This paper describes the dismantling philosophy and organization, the design of special underwater equipment, the dismantling of the reactor vessel and the thermal column, and the conditioning and shielding activities resulting in 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 radiation dose of 0.3 manSv.

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Torikai, K., and K. Suzuki, Science University of Tokyo, Department of Mechanical Engineering, Noda, Chiba, Japan

A Study on Treatment of Dust by Dismantling

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.311-IV.325) (1987)

Various kinds of treatment of dust generated by cutting or dismantling concrete structures or reactor components during nuclear power station dismantling are evaluated for safety, cost, and performance. The comparisons are made for work done in air and in water. A method of dust treatment for work in air is discussed in this study. The dry method has the advantage of ease of operation and good equipment performance, but it has problems concerning the dispersion of radioactively contaminated dust in the air. To help prevent this problem, an improved venturi scrubber system for dust collection is proposed for use in dismantling. The system consists of a dust absorber, pipe, a dust collector, a separator for dust and water, and transfer equipment for transferring dust to waste storage. This system is compared with a dust collecting system using HEPA filters with cyclone-type prefilters. The venturi scrubber system would be expected to perform better over long periods of continuous use because it does not have a filter to clog. Since it requires no expensive HEPA filters, the venturi system also would be expected to have a lower operating cost.

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U.S. Nuclear Regulatory Commission, Washington, DC

Memphis State University: Order Authorizing Dismantling of Facility and Disposal of Component Parts

Federal Register 53(25):3646; DOCKET 50-538 (1988, February 8)

Memphis State University has requested authorization to dismantle the AGN-201 reactor facility, License No. R-127, located in Memphis, Shelby County, Tennessee and to dispose of the component parts, in accordance with the plan submitted as part of the application. A notice was published on February 13, 1987. No request for a hearing or petition for leave to intervene was filed following notice of the proposed action. NRC has prepared an Environmental Assessment and Finding of No Significant Impact for the proposed action. Based on the Assessment, NRC has determined that the proposed action will not result in any significant environmental impact and an environmental impact statement is not required. Accordingly, the licensee is hereby authorized to dismantle the AGN-201 reactor facility. After completion of the dismantling and disposal, the licensee will submit a report on the radiation survey it has performed to confirm that radiation and surface contamination levels in the facility area satisfy the values specified in the dismantling plan.

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U.S. Nuclear Regulatory Commission, Washington, DC

Westinghouse Electric Corporation: Order Authorizing Dismantling of Facility and Disposition of Component Parts

Federal Register 53(25):3646-3647; DOCKET 50-87 (1988, February 8)

Westinghouse Electric Corporation has requested authorization to dismantle the Nuclear Training Reactor, Facility Operating License No. R-119, located in Zion, Illinois and to dispose of the component parts, in accordance with the plan submitted as part of the application. A notice was published on September 14, 1987. No request for a hearing or petition for leave to intervene

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was filed following notice of the proposed action. NRC has prepared an Environmental Assessment and Finding of No Significant Impact for the proposed action. Based on the Assessment, NRC has determined that the proposed action will not result in any significant environmental impact and an environmental impact statement is not required. Accordingly, the licensee is hereby authorized to dismantle the reactor facility. After completion of the dismantling and disposal, the licensee will submit a report on the radiation survey it has performed to confirm that radiation and surface contamination levels in the facility area satisfy the values specified in the dismantling plan.

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Vandervort, R.E., and L.W. Wiedemann, Viking Energy Corporation, Pittsburgh, PA

Remote Cutting and Removal of Chemical Processing Cell's Concrete Pedestal Bases

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.31-IV.43) (1987)

As part of the decommissioning of the Chemical Process Cell (CPC) at the West Valley Demonstration Project (WVDP), three 2.24-m (7-ft 4-in) diameter blocks of steel reinforced concrete had to be removed from the floor of the CPC. These blocks, which were cast into the CPC floor and covered with stainless steel as part of the floor liner, had to be cut free from the floor prior to removal in one piece. Tooling was developed to remotely cut the pedestal within 13 mm (1/2 in.) of the floor with a 240-MPa (35,000 psi) abrasive water-jet cutting system. Two of the pedestals weighed 20 Mg (22.5 tons) each with only a 14.5-Mg (16-ton) overhead hoist available for handling. Special fixtures were developed which allowed the pedestals to be tipped over onto a transfer car. The transfer car was also a WVNS design, specifically built for pedestal removal. The pedestals were ultimately transferred into an outer room for placement in metal boxes for disposal.

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Woollam, P.B., Central Electricity Generating Board, London, United Kingdom

Why Not Delay Dismantling the Magnox Reactors?

Atom 380:16-20 (1988, June)

The paper reports on the CEGB's investigation into the consequences of delaying the final dismantling of a magnox nuclear power station for about 130 years. The investigation sets out to determine the radiation exposure which might result from the transfer of radioactive materials from the two magnox reactor structures to the Dungeness aquifer, in the event that final dismantling were to be delayed and the reactor containment to fail. It also assesses the radiological consequences of gaseous discharges from oxidation of the graphite cores. The results reveal negligible radiological consequences. Also the CEGB estimates that a delay of around 100 years would result in potential cost savings for consumers of 800 million Pounds.

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

The Radiological Consequences of Delaying the Final Dismantling of a Magnox Nuclear Power Station

TPRD/B/0871/R87 (1987, April)

When it is no longer economically feasible to maintain the Central Electricity Generating Board's (CEGB's) nuclear power stations at their current high safety standards they will be shutdown and decommissioned. The timing of the final dismantling process will depend on balancing the need to reuse the site against the advantages of allowing residual radioactivity to decay. A delay of 130 years would reduce the dose commitment to dismantling staff as far as practicable and remove the need to depend on robotic systems. This in turn would lead to cost savings of about 800M pounds sterling, at 1986 prices, totaled over all the CEGB's Magnox power stations. However, the possibility must be considered that residual radioactivity from the structure might escape to the environment during the delay period, mainly through rainwater leakage and transport through the groundwater system but also through airborne releases. The principal objective in assessing such safety issues is to examine the engineering standards required of the reactor structure. The Dungeness-A Reactor presents a limiting case since it is the only CEGB nuclear station built on an aquifer from which large quantities of water

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are extracted for a nearby population. This report first attempts to determine the radiological consequences which might result, over a 1500-year period, from the leakage of radioactive materials from the reactor structure in the event that final dismantling were to be delayed. It then discusses any engineering constraints which these radiological consequences might impose.

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Yanagihara, S., H. Gohda, Y. Yamashita, T. Hasegawa, T. Yoshida, and K. Takahashi, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan; Shimizu Construction Company Limited, Tokyo, Japan

Diamond Sawing and Coring Technique for Biological Shield Concrete Dismantlement

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.326-IV.338) (1987)

A diamond sawing and coring technique has been developed to dismantle a biological shield in the Japan Power Demonstration Reactor (JPDR) decommissioning program. Preliminary cutting tests were conducted using a prototype machine equipped with sawing and coring units to obtain the data concerning the characteristics of the cutting machine as well as to confirm the applicability of this technique for reinforced concrete. Many data including cutting rates under various cutting conditions and characteristics of by-products were obtained in the tests. Based on the results of the cutting tests, the cutting system was designed for safe and efficient dismantlement of the JPDR biological shield.

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Yokota, M., T. Hasegawa, and K. Kohyama, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Development of the Cutting Machine for the Biological Shield Wall

FAPIG (First Atomic Power Industry Group, Tokyo) 116:46-51 (1987, July)

Twenty-two years have passed since the first commercial nuclear power plant became operational in Japan. At present, there are 33 commercial nuclear power plants in operation, supplying about 25 percent of the total electricity. Some of them are going to be terminated in the near future and enter into the decommissioning stage. Therefore, it is now necessary to develop decommissioning technologies, including dismantling techniques for these power plants. The development of a concrete cutting machine is one of the most important items applicable to dismantling biological shield walls of the plants. This paper describes the outline of the cutting machine developed for the biological shield wall demolition of the Japan Power Demonstration Reactor (JPDR) including actual decommissioning works tested.

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Zimmermann, W., Kernforschungszentrum Karlsruhe GmbH, Projektbereich Anlagen, Karlsruhe, Federal Republic of Germany

Evaluation of Cutting Techniques

CPD/DOC(88)4; 17 pp. (1988)

This report describes experience in the evaluation of cutting techniques for the decommissioning of the FR2 Research Reactor in Karlsruhe. Topics discussed include boundary conditions, cutting techniques for metals of varying thicknesses, cutting techniques for concrete both in air and under water, and the author's experience with BRISTAR.

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316

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

Closure for a Depleted Uranium and Thorium Waste Pond

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.189-III.200) (1987)

Aerojet Ordnance Tennessee, Inc. completed the closure of an inactive waste evaporation pond at its Jonesboro, Tennessee, facility in September 1985. This paper describes the final closure activities of the comprehensive action program for decommissioning the process waste pond, excavation of associated contaminated soils, and on-site disposal of the contaminated soil. Rogers and Associates Engineering Corporation (RAE) developed remedial action guides and the final designs for the project. RAE, with the assistance of Dames and Moore, managed the remedial action. The project represents one of the first actions of this type by a private company. The closure program was performed under licensing by the State of Tennessee.

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Radioactive Waste Disposal

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 11.1-11.34) (1986)

After an introduction, the following topics are discussed under Radioactive Waste Disposal: (1) waste packaging; (2) waste transportation costs; (3) waste disposal costs; and (4) regional low-level radioactive waste compacts.

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Low-Level Radioactive Waste Criteria

CONF-860422; Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, Proceedings of the American Power Conference, Chicago, IL, April 14-16, 1986, Vol. 1, 289 pp.; (pp. 10.1-10.21) (1986)

After an introduction, the following topics are discussed under Low-Level Radioactive Waste Criteria: (1) types of wastes generated; (2) radioactive waste disposal classification; and (3) radioactive waste transportation classification.

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Alder, J.C., National Cooperative for the Storage of Radioactive Waste, Baden, Switzerland

Waste Packages from Decommissioning: Characterization, Constraints and Disposal Risk

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.368-IV.378) (1987)

Conceptual decommissioning studies, required by the Swiss Nuclear Regulatory Authorities, have been performed for each of the four Swiss nuclear power plants. The purpose of these studies was to demonstrate the technical feasibility and to estimate doses and costs of nuclear power plant decommissioning, and to assess the

quantities of decommissioning wastes. In parallel, a project demonstrating the feasibility of safe final disposal for all types of Swiss nuclear wastes, including decommissioning wastes, was required. Drawing conclusions from these studies, the steps in the management of decommissioning wastes have been fully covered, including the corresponding safety assessments, from the conditioning and packaging of wastes to disposal in a specified repository. The main lessons learned from the links between the different steps are presented and summarized. Emphasis is placed on the heat producing waste packages because they are one of the main concerns.

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Crutchfield, D.M., U.S. Nuclear Regulatory Commission, Washington, DC

General Public Utilities: Availability of Final Supplement 2 to the Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Wastes from March 28, 1979 Accident, Three Mile Island Nuclear Station Unit 2

Federal Register 52(137):27091-27092; DOCKET 50-320 (1987, July 17)

The Nuclear Regulatory Commission has published its final report, Supplement 2, to the Programmatic Environmental Impact Statement (PEIS) related to decontamination and disposal of radioactive wastes resulting from the March 28, 1979 accident at Three Mile Island Nuclear Station, Unit-2. Supplement 2 to the PEIS addresses environmental impacts associated with the licensee's proposal and various alternatives for the disposal of slightly contaminated water presently stored on the Three Mile Island site

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Doerge, D.H., R.L. Miller, and K.S. Scotti, UNC Nuclear Industries, Inc., Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects: Summary Status Report - Three Mile Island Unit 2 Radioactive Waste and Laundry Shipments (Technical rept. 5 Apr 79-19 Dec 84)

NUREG/CR-4315 (Vol. 9); 40 pp. (1986, May)

NUCLEAR FACILITIES DECOMMISSIONING WASTE DISPOSAL

This document summarizes information concerning radioactive waste and laundry shipments from the Three Mile Island Nuclear Station Unit 2 to radioactive waste disposal sites and to protective clothing decontamination facilities (laundries) since the loss of coolant accident experienced on March 28, 1979. Data were collected from radioactive shipment records, summarized, and placed in a computerized information retrieval/manipulation system which permits extraction of specific information as required. Information contained in the report includes: waste disposal site locations, dose rates, curie content, waste description, container type and number, volumes and weights.

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Grant, I.M., and W. Dicks, Atomic Energy of Canada Limited, Mississauga, Ontario, Canada

On-Site Dry Concrete Canister Storage of Spent Fuel at Gentilly-1

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1715-1722) (1987, July)

Gentilly-1 is a 250 MW(e) CANDU reactor which is being decommissioned by Atomic Energy of Canada Limited. Putting the fuel into safe and low maintenance longer-term storage was one of the objectives of the decommissioning work. This paper gives an overview of the Dry Concrete Canister Storage (DCCS) system chosen for the Gentilly-1 fuel, and describes the processes and tooling employed during the spent fuel handling operations.

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

Treatment of Waste Metals from Decommissioning

CONF-871018; Decommissioning, G.A. Tarzsa (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.90-III.99) (1987)

Decommissioning and demolishing nuclear installations produces, not only rubbish and secondary waste but, metal components. All these types of waste are treated so that a maximum in volume reduction is achieved. In the first instance, this objective can be met by safe recycling or reusing waste material in nuclear facilities. The guidelines and standards under which this is possible in the Federal Republic of Germany (FRG), and the techniques employed, are outlined. Another method applied successfully is melting of the waste metals for reuse or waste minimization. All waste for which neither technique can be applied is compacted under high pressure or stored in a repository without previous treatment, but solidified in cement mortar or other fillers. A survey of the waste arising is given in the FRG from decommissioning and repair of nuclear reactors. The methods of treatment and the quantities of individual waste streams are indicated as far as possible. The types of treatment available can be evaluated only in the light of existing legal guidelines and standards. These conditions are likely to become tighter in the FRG. The expected impact of tighter regulations on the work at Kernforschungszentrum Karlsruhe is discussed.

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Hoshi, T., Y. Seiki, and K. Kato, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Management of Waste from the JPDR Decommissioning

CONF-871018; Decommissioning, G.A. Tarzsa (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.77-III.89) (1987)

Management of waste from the dismantlement of a nuclear facility is a great concern because a large amount of radioactive waste is produced in a short period. Radioactive solid waste of 4000 tons is estimated to be generated by the dismantlement of the Japan Power Demonstration Reactor (JPDR) facilities. The waste disposal methods used will be storage or burial in accordance with the kinds of waste materials and the activity levels. Radioactive waste shall be managed under the regulatory laws. The regulation for the radioactive waste in Japan and the concepts of waste management of the JPDR decommissioning are described in this paper.

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Jayawardene, N.D., and P.J. Armstrong, Ontario Hydro, Toronto, Ontario, Canada

One-Piece On-Site Burial of CANDU Reactors for Decommissioning

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1234-1243) (1987, July)

An alternate concept for decommissioning of Ontario Hydro's Bruce Nuclear Generating Station (A) has been identified. In this concept all four CANDU-type reactor assemblies would be packaged in their own biological shield tanks, removed in one piece and buried in the underlying bedrock using conventional equipment and methods. The description of the one-piece removal and burial method, its merits and a preliminary estimate of the potential public dose from this method of burial is presented.

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McConnell, J.W., Jr., and R.C. Schmitt, EG&G Idaho, Inc., Idaho Falls, ID

Commercial Disposal of High Integrity Containers (HICs) Containing EPICOR-II Prefilters from Three Mile Island: Reflections and Projections

EGG-M-02886; Low, Intermediate and High Level Waste Management - Decontamination and Decommissioning, Proceedings of an International Meeting, Niagara Falls, NY, September 14, 1986; (10 pp.) (1986, September)

The processes of loading, transporting, and commercially disposing of 46 EPICOR-II prefilters, each contained in a High Integrity Container (HIC), are described. Also described is participation of the regulatory agencies and industrial organizations in combining their efforts to accomplish this task. The significant aspect of the task was that the commercial disposal involved the first-of-its-kind production use of a reinforced concrete HIC at the US Ecology, Inc., facility in the State of Washington. The same type of container probably can be used in below- or above-ground disposal of other types of high specific activity, low-level nuclear wastes.

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Price, M.S.T., and I. Lafontaine, United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Winfrith, Dorchester, Dorset, United Kingdom; Department of the Environment, London, United Kingdom

System of Large Transport Containers for Waste from Dismantling Light Water and Gas-Cooled Nuclear Reactors, Volume 1

AEEW-R-1706 (Vol. 1); 129 pp. (1986, September)

The main types of reactors in the European Economic Community are described, and a series of reference plants are selected for further study. Estimates of the quantities of radioactive wastes, including both neutron-activated and contaminated materials, that would be produced by decommissioning activities are given for each. Regulations governing the transport of radioactive materials, both international and national, are reviewed.

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System of Large Transport Containers for Waste from Dismantling Light Water and Gas-Cooled Nuclear Reactors, Volume 2

AEEW-R-1706 (Vol. 2); 123 pp. (1986, September)

This report covers the operational, radiological and economic aspects of radioactive waste transport as well as conceptual designs of large containers for the transport of radioactive wastes from the decommissioning of nuclear power plants within the member states of the European Economic Community. The means of transport, the costs, and radiological detriment are considered, and conceptual designs of containers are described. Recommendations are made for further studies.

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Rajan, J.B., R. Kumar, and D.R. Viessers, Argonne National Laboratory, Chemical Technology Division, Argonne, IL

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Improved Treatment/Disposal of Reactive Metals - Annual Report

DOE/HWP-29; ANL-87-39; 15 pp. (1987, October)

This study was conducted in Argonne National Laboratory's Chemical Technology Division to develop improved treatment/disposal techniques for reactive metals. The basic approach used was to convert the reactive metal (primarily sodium, with small quantities of radioactive and nonradioactive contaminants) to a glass form by reacting it with silica sand. Some additives might be used to impart the desired mechanical and chemical integrity to the waste form. A high soda silicate glass was selected as the most desirable glass form for waste sodium disposal; however, it was found that small quantities of other additives would be necessary to impart acceptable resistance to leaching by groundwaters and other environmental stresses. Differential thermal analysis (DTA) with varying compositions of sodium oxide, silicon dioxide, calcium oxide, and magnesium oxide showed that the primary glass-forming reactions occur at less than 300 deg C; for the well mixed samples used in DTA tests, there were no additional thermal effects as the temperature was raised to 1260 deg C, indicating that the glass-forming reaction was essentially completed in a very short time. Glass samples were produced in a laboratory furnace to determine qualitative glass characteristics. Samples of sodium di-silicate glass were tested for leachability of sodium from them into aqueous solutions; this particular glass had a relatively high sodium leach rate of $0.73 \times 10(E-2)$ micrograms per square millimeter per minute at room temperature in pure water. A conceptual process for waste sodium conversion was designed, incorporating a low-g, low-pressure drop, high-temperature cyclone. Mine Safety Appliances, Inc. has expressed interest and willingness to build and test a prototype demonstration system to convert sodium to glass.

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Roux, P., Societe Generale pour les Techniques Nouvelles, Saint-Quentin-en-Yvelines, France

Dismantling of Alpha Emitters Contaminated Facilities

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dis-

mantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 206-221) (1986)

The dismantling of transuranic contaminated facilities raises specific problems. A large part of these problems relates to the management of the waste resulting from dismantling. From the experience gained in the different centers, Commissariat a l'Energie Atomique (CEA) and Compagnie Generale des Matieres Nucleaires (COGEMA), it appears that there are industrial solutions in the group CEA and that an engineering company such as Societe Generale pour les Techniques Nouvelles (SGN) can export them.

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Salisbury, M.F., D.J. Harward, and R.F. Gessner

Training West Valley Operators to Stabilize High-Level Waste

Transactions of the American Nuclear Society 52:82; Proceedings of the American Nuclear Society 1986 Annual Meeting, Reno, NV, June 15, 1986; (p. 82) 82 (1986)

The West Valley Demonstration Project (WVDP) was formed to solidify 2271 cubic meters (560,000 gal) of high-level waste (HLW) generated during commercial fuel reprocessing operations in the 1960s and early 1970s. The process selected involves vitrifying the waste with glass formers to produce borosilicate glass encapsulated in steel canisters 61 cm in diameter by 305 cm (2 ft in diameter by 10 ft long). The canisters will ultimately be sent to a federal HLW repository for disposal. The vitrification system is being installed and simultaneously undergoing extensive testing at West Valley using nonradioactive materials simulating the waste composition. Operating personnel are being trained to operate the glass melter concurrent with the installation and test program. Some operators have experience in chemical plants while others are inexperienced. The challenge accepted at West Valley is to provide a full scope of training and qualification to ensure that they can perform their duties safely, efficiently, and correctly to produce the required quality glass and to assure that when HLW processing is initiated in 1988 both operators and equipment will be ready.

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Transporting TMI-2 Core Debris to INEL: Public Safety and Public Response

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 2 - High-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 603 pp.; (pp. 489-494) (1987)

This paper describes the approach taken by the U.S. Department of Energy (DOE) to ensure that public safety is maintained during transport of core debris from the Three Mile Island Unit 2 (TMI-2) reactor located near Harrisburg, Pennsylvania, to the Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho. It provides up-to-date information about public response to the transport action and discusses DOE's position on several institutional issues. The authors advise that planners of future transport operations be prepared for a multitude of comments from all levels of federal, state, and local governments, special interest groups, and private citizens. They also advise planners to keep meticulous records concerning all informational transactions.

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Thomas, P.J., and J.R. Wakefield, United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

The Development of a Large Container for WAGR Decommissioning Wastes

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.128-III.141) (1987)

The Windscale Advanced Gas-cooled Reactor (WAGR) was built as a 100 MW prototype for the projected commercial nuclear power plants that came onstream in the 1970s. After 18 years operation at high load factor, the

reactor was shut down, and the decision was made to decommission the plant to Stage 3, involving complete dismantling and return of the site to a "green field." This has involved the United Kingdom Atomic Energy Agency (UKAEA) in an extensive program of development work. One of the key elements in this program is the production of an acceptable container for the intermediate-level waste formed by the irradiation of reactor materials. The container is required to meet a number of national and international regulatory standards. These cover handling and storage on the Windscale site, transport to the depository by road or rail, and ultimately the engineering needs of the depository itself. Experimental tests and mathematical analyses have been carried out to meet these needs. The final documentation which is almost complete will cover all aspects of design, testing and performance of the container. This paper is a report on the current status of the program.

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Thomas, P.J., and J.R. Wakefield

The Development of a Large Container for WAGR Decommissioning Wastes

ND-R-1540(W); CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.128-III.147) (1987)

The Windscale Advanced Gas-cooled Reactor (WAGR) was built as a 100 MW prototype for the projected commercial nuclear power plants that came on line in the 1970s. After 18 years of operation at high load factors, the reactor was shut down and the decision was made to decommission the plant to Stage 3, i.e. complete dismantling and return of the site to a "green field". This has involved the United Kingdom Atomic Energy Authority in an extensive program of development work. One of the key elements in this program is the production of an acceptable container for Intermediate Level Waste formed by the irradiation of reactor materials. The container is required to meet a number of regulatory standards both national and international. These cover handling and storage on the Windscale site, transport to the depository by road or rail and ultimately the engineering needs of the depository itself. Experimental tests and mathematical analyses have been carried out to meet these needs. The final documentation will cover all aspects of design, testing and performance of the container. This paper is a report on the current status of the program.

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Tuite, P.T., Waste Management Group, Inc.,
Crompond, NY

RADCOR - A Computer Code to Characterize and Document Irradiated Hardware for Disposal

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1314-1326) (1987, July)

The U.S. nuclear power industry currently uses several different methodologies to characterize the radionuclide content and distribution in irradiated hardware, and classify these components according to 10 CFR Part 61 criteria. RADCOR is a computer program to characterize, classify, track, ship, and document radwaste in the form of irradiated hardware. The code has been reviewed and approved by the CNSI regulatory group as a methodology to document irradiated hardware shipments to the Barnwell, South Carolina disposal site. This paper discusses the RADCOR methodology and describes typical results for PWR and BWR projects. It also compares RADCOR to another characterization method being used in the U.S.

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U.S. Nuclear Regulatory Commission, Washington, DC

GPU Nuclear Corporation: Availability of Draft Supplement to the Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Wastes from March 28, 1979 Accident, Three Mile Island Nuclear Station, Unit 2

Federal Register 53(81):15160; DOCKET 50-320 (1988, April 27)

Pursuant to the National Environmental Policy Act of 1969 and the U.S. Nuclear Regulatory Commission's reg-

ulations in 10 CFR Part 51, notice is hereby given that a Draft Supplement to the Programmatic Environmental Impact Statement (NUREG-0683, Supplement 3) related to post-defueling monitored storage and subsequent cleanup of Three Mile Island Nuclear Station, Unit 2 is available for inspection by the public. Interested persons may submit comments on the draft supplement for NRC's consideration.

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Yoshida, Y., Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Treatment and Disposal of Low-Level Solid Wastes Accompanying Dismantling of Nuclear Facilities

Radiation and Radioisotopes, Proceedings of the 17th Japan Conference, Tokyo, Japan, September 2, 1985; (pp. 226-234); Nippon Aisotopu Hoshasen Sogo Kaigi Hobunshu 17:226-234 (1986)

More than 30 years have elapsed since the beginning of the development and utilization of atomic energy. It has become necessary to decommission and dismantle some nuclear reactors and some facilities used for processing radioactive substances either because of the facilities' age or the completion of the mission or project. This is especially true for nuclear power reactors which have come to the end of their useful life. The management of the radioactive wastes accompanying the decommissioning and dismantlement of these reactors has become an important problem for the future. This paper discusses: (1) the characterization of the wastes generated from the dismantling of nuclear reactors; (2) the technology for reactor dismantlement and radioactive waste management that has been developed by the Japan Atomic Energy Research Institute for the JPDR; and (3) the planning for and experience gained from the waste management program accompanying the dismantling and reconstruction of the facilities at the Japan Atomic Energy Research Institute. Also, the investigation of safety concerning the rational disposal of very low level radioactive solid wastes is discussed.

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Hermes Decommissioning

Nuclear Engineering International 32(391):10
(1987, February)

Work on decommissioning Hermes, an experimental electromagnetic facility for the separation of heavy metal isotopes, has been completed at Harwell in England. The work, carried out by BBNG Nuclear Technology, involved the removal of equipment and decontamination of the room so that it could revert to use as a laboratory. Ultimately the room was cleaned such that it was declared a nonrestricted area and free access was possible for the first time since the 1950s.

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Adkisson, R.J., Sequoyah Fuels Corporation, Oklahoma City, OK

Fuel Fabrication Facility Decommissioning Experience

CONF-871018; Decommissioning, G.A. Tarca (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.50-III.54) (1987)

For the past several years, Sequoyah Fuels Corporation has been decommissioning its Cimarron Facility located in north central Oklahoma. The facility contained separate plutonium and enriched uranium fuel fabrication plants. The site also contained small settling lagoons and a small shallow burial area used to dispose of uranium- and thorium-contaminated wastes. The objective of the decommissioning activity is to decontaminate the facilities so that there are no restrictions on future use of the property. The decommissioning work has involved: (1) decontamination of the plutonium fuel fabrication plant; (2) decontamination of the enriched uranium fuel fabrication plant; (3) excavation, packaging and shipment of the lagoon sediments and associated underground piping; and (4) excavation, repackaging and shipment of the low-level radioactive wastes in the burial ground.

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Institut de Protection et de Surete Nucleaire/Unite Centrale de Declassement des Installations Nucleaires, Marcoule, France; Societe Technique pour l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France

French Decommissioning Experience

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1204-1212) (1987, July)

French decommissioning experience spreads over a large field including the dismantlement of power reactor circuits, pool type and material test reactors, hot cells, pilot plants or small capacity fuel reprocessing facilities. Therefore, one might think that a large range of tools, equipment and processes are ready to meet the numerous and various requirements of dismantling work. If this experience is to be useful in making technical choices when studying new facility decommissioning projects, it will be necessary to improve existing equipment or create new ones. The following examples give an idea of the pragmatic approach that is necessary to achieve the best solution in each case: (1) explosive cutting of primary circuit bellows on the EL3 reactor, (2) embedding ELAN IIB waste with thermosetting resins, (3) cutting and decontaminating large pipes on G2 reactor, (4) cutting of the RAPSODIE heat exchangers, and (5) handling equipment and tools to cut and remove the AT1 waste.

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Demonie, M., L. Geens, and J. Claes, Belgoprocess, Dessel, Belgium

Recent Practical Experience with the Cleaning and Decontamination of an Intermediate-Level Liquid Waste Storage Facility at the Former Eurochem Reprocessing Plant

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1689-1700) (1987, July)

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Between 1978 and 1983, an important bituminization program was carried out at EUROCHEMIC. The amount of waste was about 2,200 cubic meters of ILLW, generated during reprocessing campaigns and the subsequent plant decontamination. The shielded tank farm, in which these ILLW were temporarily stored, has been rinsed and partially decontaminated, pending the decisions on future reprocessing or decommissioning. The present paper describes the cleaning operations, the applied techniques and procedures, as well as the obtained results.

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Denault, P., LN Technologies Corporation, Columbia, SC

A Study in Nuclear Decommissioning

Civil Engineering 53(2):74-77 (1988, February)

The Gentilly-1 nuclear power plant was the first commercial sized plant in the world to be decommissioned. The decommissioning methods, equipment, and systems (including an innovative on-site dry fuel storage method) are described. The Gentilly-1 decommissioning program included: isolation of the circular post tensioned concrete containment reactor building, as well as the service and turbine buildings; dry storage of the spent fuel in concrete canisters; decontamination of the service building and fuel pool; and removal, disposal, and/or storage of all contaminated service building equipment and systems. Today's static state is expected to last for 50 to 100 years during which time radiation levels will have decreased enough to allow the next decommissioning phase to proceed with reduced radiation exposure to workers.

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Devell, L., S. Karker, T. Dahlgren, and L. Anderson, Studsvik Energiteknik AB, Nyköping, Sweden

Decommissioning of Research Reactors and Associated Laboratories in Sweden

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1184-1193) (1987, July)

The decommissioning of the first research reactors and some associated laboratories was completed during the period 1981-1986. A prestudy of the decommissioning of the 60 MW PHWR Agesta was also performed. Prior to the start of each project, radiological surveys and detailed plans for the dismantling were done. Criteria and levels for classifying waste, measurement methods and acceptable levels of residual contamination on-site are briefly discussed in the paper. Occupational radiation doses, costs and some experience obtained are also treated.

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Decommissioning of Gentilly-1 - Canada

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.1-IV.7) (1987)

Canada's 250 MW(e) Gentilly-1 station went into service in 1971 in the Province of Quebec, Canada, and produced electricity intermittently until 1979. Since April 1986, the station has been decommissioned to a "Static State" following a two-year, 25 million dollars (Canadian) project. Access to the reactor building has been permanently shut off except for one airlock that can be made operable for periodic inspection. Systems inside the reactor building have been isolated and sealed. All radioactive materials and components inside the service building have been removed, and the area has been decontaminated, and released to the local utility Hydro-Quebec for a full scale simulator training center. Spent fuel has been put in interim on-site storage inside concrete canisters. The spent fuel bay has been decontaminated, and a slab has been poured on top of it.

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Research Reactor and Fuel Development Facility: Decommissioning Experience and Technology

NUCLEAR FACILITIES DECOMMISSIONING REMEDIAL ACTION EXPERIENCE

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 1 - General Interest, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 711 pp.; (pp. 539-545) (1987)

This paper discusses the technology and experience gained in research reactor and fuels development facility decommissioning programs carried out by Babcock & Wilcox (B&W) at one of its NRC-licensed sites in Lynchburg, Virginia. The projects included two buildings that housed plutonium/uranium fuels development laboratories, four low-power critical experiment facilities, and two (megawatt-level) research reactors. However, this paper concentrates on the experiences with the plutonium/uranium fuels development laboratories and critical experiment facilities. These were comprehensive projects that included: (1) developing the decommissioning and quality assurance plans; (2) interfacing with the U.S. Nuclear Regulatory Commission; (3) performing the actual decontamination/dismantling work; (4) performing decontamination and final radiological surveys; and (5) volume reducing, packaging, certifying, classifying, and shipping the radioactive waste for disposal. This broad experience has involved handling radioactive contamination from the following sources: low- and high-enriched U-235 fuel; depleted uranium; mixed oxide fuel (Pu/UO); thorium fuel; U/Al alloy fuel; and fission/activation products beta-gamma. Areas of generic application to future projects are highlighted.

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Decommissioning of Nuclear Power Plant Gundremmingen Unit A

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.31-III.49) (1987)

Several first generation nuclear power plants have reached the end of their operating life and have been retired to the status of decommissioning. The nuclear power station KRB A (Gundremmingen Unit A) falls in this category. After having operated successfully from

1966 to 1977, the facility was shut down due to an accident. Repairing and backfitting would have incurred considerable cost and would have required several years of shutdown. Therefore, in 1980 the decision was made to decommission KRB A. Decommissioning planning was initiated in 1980, and in 1982 a feasibility study was issued. Actual decommissioning work began in 1983 and has continued to the present time. Approximately 3000 tons mainly of steel scrap and concrete parts have been removed from the turbine building. This paper describes the current status of decommissioning at Unit A.

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Decommissioning Experience of the Reprocessing Facility AT-1

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.55-III.67) (1987)

AT-1 was a pilot plant in France for reprocessing the mixed oxide fuel elements from the FBR program. It was successfully operated for ten years and shut down in 1979. After two years of fissile material recovery and decontamination of the process line it was decided to decommission the unit to stage 3. Even though the plant is small in reprocessing capacity, it contains all the difficulties and specific problems encountered in any of this type of facility. Decommissioning technology and equipment development are needed for: (1) a remote controlled machine for dismantling the main cells; (2) a modular workshop that will not allow the escape of alpha contamination while gloveboxes and alpha cells are dismantled; and (3) an alpha-activity measurement station for monitoring decommissioning wastes to make sure that the alpha activity levels are in compliance with disposal site regulations. Design, engineering, and performance concepts for these equipment requirements are discussed.

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Rhoades, W.A., EG&G Idaho, Inc., Idaho Falls, ID

Final Report - Decontamination and Decommissioning of the Auxiliary Reactor Area IV Facility

EGG-2518; 51 pp. (1988, March)

This report describes the decontamination and decommissioning (D&D) performed at Auxiliary Reactor Area IV (ARA IV) during the summer and fall of 1987. The report documents the conditions existing at ARA IV upon completion of these activities. The primary objectives of this project were to remove all radiological and hazardous materials contaminants from the ARA IV area and to eliminate the personnel safety hazard imposed by the partially dismantled ARA-616 building. Meeting these objectives required demolition of the building remains, removal of the building slabs and foundation, removal of asbestos-containing materials (ACM) left in the area, and exhumation of the contaminated waste system piping, sump, and leach pit. A post-D&D radiological survey of the area showed that the only radionuclides present were those naturally occurring in this area and their activities were limited to background levels. A post-D&D hazardous materials survey was deemed unnecessary.

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Schmak, R.F., Pennsylvania State University, University Park, PA

Bathtub Primer - Lessons from West Valley, New York

Environmental Consequences of Energy Production: Problems and Prospects, Majumdar, S.K., F.J. Brenner, and E.W. Miller (eds.). Pennsylvania Academy of Science, Phillipsburg, NJ; (pp. 349-368) (1987)

Future nuclear and radioactive waste management practices can benefit from a thorough understanding of problems encountered at unsuccessful disposal facilities in the past. The commercial low-level radioactive waste disposal operation at West Valley, New York, is one of three such failed facilities in the United States. This paper discusses the history and background of this and other sites. It reviews their environmental characteristics

and site geology. The paper also addresses the design of the West Valley operation and the hydrologic problems which resulted in the ultimate contamination and closure of the facility.

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Warren, G.A., Rolls-Royce and Associates Limited, Derby, England, United Kingdom

Decommissioning of Redundant Radioactive Working Area at HM Dockyard, Chatham, Kent

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.254-III.268) (1987)

The Royal Navy Dockyard was closed in 1981, including the Nuclear Submarine Refitting facility. Decommissioning of the radioactive facilities was scheduled to take place in 1985, and the methods of planning, estimating, and executing the work are described. A full review and analysis of the problem was carried out, showing that a variety of buildings, plant and equipment were radioactively contaminated with beta and gamma emitters. A timescale of 12 months for full decommissioning was estimated and, with the degree of contamination expected, a cumulative dose burden of 66 mSv was expected. Cost was estimated at 1 million pounds sterling. Although the task was recognized as of relatively minor radiological significance, estimated activity 200-250 GBq, methods of work control would be identical to any adopted for more heavily contaminated facilities. The decommissioning site included workshops, laboratories, offices, and outdoor facilities comprising pipework, trenches, ductwork, and ventilation equipment. In the workshop areas were heavy machine tools, refueling equipment, and miscellaneous minor pieces of equipments. The decommissioning operation was judged to be successful, allowing the owner to enter the complex free from restrictions to carry out the necessary follow-up work for the site. The cumulative dose burden was close to the estimated value, and the task was completed within the financial budget and in approximately the predicted timescale. This work was carried out with the support of the Procurement Executive, Ministry of Defense.

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One Piece Removal of JRR-3

FAPIG (First Atomic Power Industry Group, Tokyo) 115:32-37 (1987, March)

The JRR-3 is a research reactor owned by the Japan Atomic Energy Research Institute. It has a thermal out-

put of 10 megawatts, and reached criticality in 1962. In order to match an increase in power demands due to more versatile and advanced research, it was decided to remove the existing reactor, and the equipment and pipings pertaining to it, and to install a new reactor on the same spot. A method to remove the reactor as one block without disassembling it was developed and used to decommission the JRR-3 reactor. Reactor removal was successfully completed on November 7, 1986. This paper describes the planning, execution and results of the one piece removal of JRR-3.

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Decommissioning of Radioactive Facilities

Decommissioning of Radioactive Facilities. Mechanical Engineering Publications Limited, Edmunds, Suffolk, United Kingdom, 34 pp. (1986)

The papers in this book present current engineering research on the decommissioning of nuclear reactors and radioactively contaminated power plants.

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Decommissioning Nuclear Facilities - An Overview

Energy Digest 15(3):23-26 (1986)

Currently (1986) three nuclear power plants are being decommissioned but many more will soon be past their useful operating lifetime and will require decommissioning. Other facilities which may require decommissioning include sites used for processing of mine tailing and radiopharmaceutical laboratories. Although there are no serious technical problems, further work is needed to improve equipment and techniques. The major decommissioning steps are listed. The importance of a national strategy and the IAEA's efforts in decommissioning, especially the data base it is assembling, are mentioned.

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Demonstrating the Solution to a Problem for the Next Century

Nuclear Engineering International 32(399):48 (1987, October)

Considerable progress has been made in the development of decommissioning techniques and equipment in the past two years. Several demonstration projects are now under way to show that reactors can be safely and economically dismantled using today's technology; however, decommissioning of a large nuclear reactor remains some distance in the future. Since decommissioning has remained important, the nuclear industry is now setting about demonstrating that decommissioning does not pose any major problems.

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Bertini, A., H. Lawton, O. Ilari, and S. Menon, Ente Nazionale per l'Energia Elettrica, Latina, Italy; United Kingdom Atomic Energy Authority, London, United Kingdom; Organization for Economic Cooperation and Development, Nuclear Energy Agency, Paris, France

The OECD/NEA Cooperative Programme Concerning Nuclear Installation Decommissioning Projects

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1859-1869) (1987, July)

A primary objective of the Nuclear Energy Agency of the OECD is to promote co-operation between its member countries on the safety and regulatory aspects of nuclear development. This paper describes the background of the program, its proposed scope and executive procedures. It also briefly describes the projects that are included in the program at present and the current program of work.

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International Cooperation on Decommissioning Within the OECD/NEA

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. 1.1-1.15) (1987)

The OECD/NEA Cooperative Programme on Decommissioning was established to share the technologies and know-how resulting from a number of major decommissioning projects. It started in 1985 with nine participating countries and ten ongoing projects. Since then, the Cooperative Programme has been expanded to cover twelve decommissioning projects. These projects

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are: (1) Gentilly-1, Canada; (2) Rapsodie, France; (3) G2, France; (4) AT1, France; (5) Kernkraftwerk Niederaichbach (KKN), Federal Republic of Germany; (6) Kernkraftwerk Lingen, Federal Republic of Germany; (7) Garigliano, Italy; (8) Japan Power Demonstration Reactor (JPDR), Japan; (9) Windscale Advanced Gas Cooled Reactor, United Kingdom; (10) BNFL Coprecipitation Plant; (11) Shippingport, United States of America; and (12) West Valley Demonstration Project, United States of America. This paper gives an overview of the projects in the Programme and a critical appraisal of the development and benefits resulting from it.

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Commission of the European Communities, Directorate-General for Science, Research and Development, Brussels, Belgium

The Community's Research and Development Programme on Decommissioning of Nuclear Installations - Second Annual Progress Report (Year 1986)

EUR-11112; 264 pp. (1987)

The second Annual Progress Report of the European Community's 1984-1988 program of research on the decommissioning of nuclear installations covers the year 1986. The 1984-1988 program has three major parts. The first part consists of the research and development projects concerning the following subjects: (1) long-term integrity of building and systems; (2) decontamination for decommissioning purposes; (3) dismantling techniques; (4) treatment of specific waste materials, namely, 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. The second part of the program is the identification of guiding principles: (1) in the design and operation of nuclear installations with a view to simplifying their subsequent decommissioning; and (2) in the decommissioning of nuclear installations, which could form the initial elements of a Community policy in this field. The third part of the program is the testing of new techniques under real conditions, within the framework of large-scale decommissioning operations undertaken in Member States.

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Robotics, Remote Handling Techniques, and Decommissioning

CPD/DOC(88)5; DT/DgD-88/007; 11 pp. (1988)

This paper is an introduction to the use of robotics in decommissioning and how its use changes the design of decommissioning projects. Discussed in this paper are: the definition of a robot, the applicability of robotics to decommissioning, and the types of robots presently being used for this purpose. An assessment of the current use of robots in decommissioning and suggestions for future development are presented.

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Investigations on Decommissioning of Nuclear Facilities (Phase 2)

BMU-1987-171; 503 pp. (1987)

Information on recent developments with the decommissioning of nuclear facilities, including planning and actual experiences, is collected and evaluated. The progress in the field of decommissioning techniques and their remote applications are studied. The application of existing decommissioning concepts for light water reactors (LWR) on high-temperature reactors is discussed together with necessary modifications. A statistical model that will assess the radiological consequences of the recycling of ferrous metals arising during decommissioning is developed. This model adequately takes into account the wide variety of possible recycling pathways. On this basis, the distribution of individual doses to the general public is calculated. Finally, a rough estimate of the risk of decommissioned nuclear facilities is provided.

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Fulfilling Information Needs of Environmental Groups: The Current West Valley Experience

DOE/NE-44139-18 (1986, July 15)

The West Valley Demonstration Project (WVDP) located south of Buffalo, New York, was chosen to exhibit the solidification of high-level nuclear waste. The project is also charged with the cleanup of low-level and transuranic wastes. The closed door communication policy of the former reprocessing operator, along with the current promise new waste management technology, fostered suspicion from environmental groups. Consequently, the WVDP public information department organized regular program meetings with three diverse environmental organizations: the Coalition on West Valley Nuclear Wastes, the Sierra Club Radioactive Waste Campaign, and the Springville (New York) Field and Stream Club. Members of these groups and project management express great satisfaction with the results of this unique open communications approach.

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Hulot, M., A.M. Chapuis, H. Garbay, W. Jager, and J. Kroeger, Commission of the European Communities, Luxembourg

State-of-the-Art Review on Technology for Measuring and Controlling Very Low-Level Radioactivity in Relation to the Decommissioning of Nuclear Power Plants

EUR-10643; 134 pp. (1986)

Information on measurement devices for very low radioactivity, applied in the decommissioning of electronuclear power plants, is scarce; however, some information can be obtained from the specialists working at nuclear plant dismantling sites. In practice, the in situ measurements deal with two or three radionuclides only. Samples must be collected so that the other contaminants may be determined in laboratories by means of radioanalysis and spectrometry technologies. These technologies are briefly described. One of the problems with these methods concerns the detection threshold of

the measuring instruments. This threshold varies in relation to the detector efficiency, the background noise and the measurement duration. The application of the concept of a threshold to various types of instruments is studied. Tables and graphs are presented to summarize the various possibilities of detection depending on the effective areas of the usual detectors. The possibility of reducing the number of monitoring points using statistical methods is presented.

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Decommissioning of Nuclear Plants, Examples of Application to Workshops

Radioactive Waste Management, Decommissioning, Spent Fuel Storage, Volume 1 - Waste Management Principles, Decommissioning, Dismantling, Operations in Hot Environment. Commissariat a l'Energie Atomique, Paris, France, 3rd edition, 389 pp.; (pp. 142-171) (1986)

The Societe Technique pour l'Energie Atomique (TECHNICATOME), on behalf of Unite Centrale de Declassement des Installations Nucleaires (UDIN) as prime contractor, is involved in the decommissioning of the La Hague AT1 and ELAN 2B workshops. ELAN 2B was a workshop for fabrication in shielded cells of Cesium-137 and Strontium-90 sources. The AT1 workshop was the pilot plant for reprocessing the fuels of the French fast breeder reactor system. General decommissioning plans, specific decommissioning tactics, and principal equipment developed for performing the tasks are described for each of the workshops. The equipment includes, for ELAN 2B, the PIADÉ machine and system for waste conditioning by epoxy painting, then embedding in thermosetting resins; for AT1, the intervention workshop, waste transfer system and intervention machine.

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A Multicriteria Decision Aid for Evaluating Nuclear Power Plant Decommissioning

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.314-III.323) (1987)

Electric utilities and public service commissions have not taken full advantage of the many proven techniques available for evaluating complex technological issues. A case in point involves the selection of a specific method for decommissioning of nuclear power plants. A multicriteria decision-aiding technique, decision analysis, is introduced and applied to the decommissioning issue.

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Nannicini, R., H. Dworschak, and F. Daniele, European Nuclear Energy Agency, Rome, Italy

The R & D Activities Carried Out in Ispra, According to a Cooperative Between ENEA COMB and JRC-Ispra in the Field of Radioactive Waste Management

ENEA-RT/COMB-87-7; 20 pp. (1987, July)

The research and development activities carried out in Ispra since 1984, concerned high-level waste vitrification under working conditions at the ESTER minipilot plant. The paper discusses the decommissioning of this plant and the characterization of the active glasses produced. The paper reports on the start-up of the PETRA plant including design and construction, which is more complete than the ESTER plant.

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Co-Operative Programme for the Exchange of Scientific and Technical Information Covering Nuclear Installations Decommissioning Projects: Format for Information on Decommissioning Projects

Report; 4 pp. (1988, February 8)

This reply to a questionnaire put out by the Co-Operative Programme for the Exchange of Scientific and Technical Information Covering Nuclear Installations Decommissioning Projects is for the Canadian Nuclear Power Demonstration Generating Station. The facility description, operating history, decommissioning project data and the decommissioning technical data are summarized. The radioactive waste produced by the facility are described.

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Pentek, Inc., Sacramento, CA

Decommissioning U.S. Reactors: Current Status and Developing Issues

EPRI-NP-5494; 144 pp. (1988, January)

This report describes the decommissioning status of reactors in the U.S. The reactors are statistically presented based upon the following criteria: (1) reactors that are involved in active decommissioning operations; (2) reactors that are shutdown and pending operational recovery or decommissioning alternatives; and (3) reactors currently operating and their projected shutdown and decommissioning schedules. Precedent setting decommissioning projects are presented to illustrate the technological experiences and issues being addressed by the industry. These projects include the smaller prototype reactors such as: Shippingport Station, Peach Bottom - Unit 1, Humbolt Bay - Unit 3, Dresden - Unit 1, Indian Point - Unit 1, and Saxton. The following decommissioning issues were derived from literature reviews and utility surveys and are considered indicative of the major concerns of the utilities and other industry organizations: (1) How is decommissioning going to be defined in NRC's final rule making? (2) What new guidelines, requirements and regulations will ultimately be adopted? (3) How will decommissioning wastes be classified, quantified, and where will they be buried? (4) What constitutes de-minimus waste quantities for decommissioning and how will residual radioactivity limits be set for a decommissioned site? (5) What other federal and state entities will set policy affecting decommissioning? (6) Will the uncertainty over decommissioning cost and financial management subside?

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Sanders, M.J., United Kingdom Atomic Energy

NUCLEAR FACILITIES DECOMMISSIONING GENERAL STUDIES

Authority, Atomic Energy Research Establishment, Winfrith, Dorchester, Dorset, United Kingdom

A Re-Usable Modular Containment System for Use in the Decommissioning of Plutonium Active Plant

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1477-1494) (1987, July)

Operations are described in which three glove boxes contaminated with a total of 20 g of Plutonium, were reduced in size by the Winfrith Modular Containment System (MCS), a portable demountable pressurized suit area which has its own HEPA Filtered Extract System and Shower entry tunnel. Contamination of the internal surface is prevented by use of strippable coating. The testing of a new design of drum bagging system which results in good waste packing fraction is described, and data is given on surface contamination levels, airborne contamination levels, and radiation dose uptake. Details of waste arising, man-hours expended and testing of hand tools including a pneumatic hand saw and hydraulic cutter are also given.

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Savchenko, V.A.

NPP Decommissioning in Europe

Energeticheskoe Stroitel'stvo za Rubezhom 4:17-20 (1986, August)

Problems of NPP decommissioning in West Europe are considered. Data on decommissioned small reactors operated in Great Britain, Italy, France, BDR, Switzerland and Sweden are given. In 1979-1983 the European Community Commission performed the first five-year program of investigation into problems arising from NPP decommissioning. During this program, implementation of new methods of subdivision of different radioactive units using remote equipment are to be considered. It is expected that in the near future basic principles of licensing, dismantling and dismantling inspection will be determined, the technology of nonradioactive material recovery from radioactive wastes will be developed, and the methods of nuclear facility decommissioning will be tested on a large scale.

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Schaller, K.H., and B. Huber, Commission of the European Communities, Brussels, Belgium

The Commissioning of the European Communities' Programme on Decommissioning of Nuclear Facilities

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 1174-1183) (1987, July)

The Nuclear Regulatory Commission's cost-sharing research program on decommissioning of nuclear facilities has supported development of a number of techniques and processes applicable in decommissioning activities, aimed at providing efficient procedures taking into account radiation protection, minimization of waste arisings and cost-effectiveness. After a short description of the program, the main results of the already performed contractual work are summarized. Special attention is given to the remote handling aspect and to management of large quantities of very low-level activity waste. In the currently running program, a large part of the effort is devoted to the testing of new techniques under real conditions in the frame of large-scale decommissioning operations.

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Spence, S.T., UNC Nuclear Industries, Inc., Richland, WA

Data Submittal to the DOE Integrated Data Base

UNI-SA-172 (Rev. 1); 6 pp. (1987, May 22)

The Defense D&D Program includes approximately 220 radioactively contaminated, DOE-owned facilities remaining in the inventory that have been declared surplus to government needs. These facilities are concentrated in seven locations throughout the United States. Defense D&D facilities include such installations as production reactors, fuel reprocessing plants, laboratories, storage tanks, stacks, pipelines, waste treatment systems, solid waste disposal facilities, ponds, cribs,

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ditches, and areas contaminated by uranium and thorium from mill tailings. The objectives of the Defense D&D Program are to decontaminate these facilities and to eliminate any potential hazards to public health and the environment. The Defense D&D Program was formally established in 1978, and the projected schedule for its current projects is given in this report. The predominant wastes in Defense D&D sites are LLW and mill tailings. Some TRU wastes are also involved. The projected waste volumes of these wastes are summarized. The principal Defense D&D projects are listed. Initial characterization of many of the sites has identified waste types (soil, building rubble, metal, and miscellaneous materials). Projections for Defense D&D Program waste are updated annually according to the most recent information available. Long-range decommissioning plans were prepared for each Defense D&D site in 1985. The data listed have been updated with new estimated waste volumes.

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Thomas, P.J., United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

Update on Decommissioning

Atom 376:24-26 (1988, February)

The paper reports on the 1987 International Decommissioning Symposium, organized by the U.S. Department of Energy and held in Pittsburgh, Pennsylvania. Reactor decommissioning projects are described, including progress at the Shippingport Atomic Power Station decommissioning project, the United Kingdom Atomic Energy Authority's Windscale Advanced Gas-cooled Reactor (WAGR) decommissioning project, and the Japanese power demonstration reactor decommissioning project. The application of remote and robotic technology in WAGR decommissioning activities is outlined. Decommissioning work on the West Valley reprocessing plant is described. The recycling of nonradioactive material from decommissioned facilities is also discussed. The costs of nuclear power station decommissioning are briefly reviewed.

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Thomas, P.J., United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

WAGR Decommissioning Project Overview

WAGR Decommissioning Newsletter 5 (Spring 1987):2-3 (1987, Spring)

Good progress has been maintained with the Windscale Advanced Gas-cooled Reactor (WAGR) Decommissioning Project over the last year. A landmark in dealing with the operational waste was reached when the last of the 230 upper plug stringers was severed and dispatched to Drigg in August 1986. Construction of the main part of the Waste Packaging Building has now been completed, and work is ongoing to install the mechanical and electrical equipment. Meanwhile two important new contracts were given during the year: supply of the Remote Dismantling Machine was awarded to Strachan and Henshaw in October 1986, while the contract for the supply of the Manipulator to be deployed by the Remote Machine was awarded to Taylor Hitec in February.

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Thomas, P.J., and J. Williams, United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom; United Kingdom Atomic Energy Authority, Authority Fuel Processing Directorate, Harwell, Didcot, Oxon, United Kingdom

UKAEA Research Programme for the Decommissioning of WAGR and Other Radioactive Facilities in the UK

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. III.1-III.17) (1987)

The United Kingdom Atomic Energy Authority (UKAEA) was involved in the early development of nuclear power, and accordingly has a number of prototype plants that require decommissioning in the near future. It is appropriate that it should now take a leading role in the development of the technology needed to decommission nuclear facilities, and apply that technology to prototype decommissioning projects. The paper outlines the development program ongoing within the UKAEA.

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

Defense Decontamination and Decommissioning (D&D) Program Overview

DOE/RL/88-02; 51 pp. (1988, January 1)

In 1978, the U.S. Department of Energy (DOE) established several national programs to provide for the control, maintenance and eventual decommissioning of hundreds of shutdown, radioactively contaminated facilities that were part of government defense and energy development projects. DOE-owned facilities declared surplus after use in national defense programs, and with no current program sponsor, become the responsibility of the Defense Decontamination and Decommissioning (D&D) Program. The current program inventory includes 218 shutdown nuclear reactors, chemical processing plants, waste treatment systems, laboratories, and support facilities located throughout the United States. A brief description of each site and the major decommissioning projects are given for: the Mound Site in Miamisburg, Ohio; the New Brunswick Laboratory (NBL) Site in Middlesex County, New Jersey; the Grand Junction Projects Office Site located along the Gunnison River in western Colorado; the Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho; the Oak Ridge National Laboratory (ORNL) at Oak Ridge, Tennessee; the Hanford Site near Richland, Washington; and the Knolls Atomic Power Laboratory, Knolls Site near Schenectady, New York. The paper provides an overview of the program's facility acceptance and transfer requirements, surveillance and maintenance

functions, and project planning approach. The D&D Program participates in technology development and exchange activities with other U.S. government agencies and many foreign countries and also maintains a timely public information policy.

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Weiss, A.J., U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC

Decontamination and Decommissioning, Accident Management, TMI-2

CONF-8710111; Water Reactor Safety, Proceedings of the 15th U.S. Nuclear Regulatory Commission Information Meeting, Gaithersburg, MD, October 26-29, 1987, Vol. 6, 259 pp. (1988, February)

The six-volume report contains 140 papers out of the 164 that were presented. The papers are printed in the order of their presentation in each session and describe progress and results of programs in nuclear safety research conducted in the country and abroad. Foreign participation in the meeting included twenty-two different papers presented by researchers from Belgium, Czechoslovakia, Germany, Italy, Japan, Russia, Spain, Sweden, The Netherlands, and the United Kingdom. The titles of the papers and the names of the authors have been updated and may differ from those that appeared in the final program of the meeting.

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

Environmental Monitoring Plan for the Maywood Site, Maywood, New Jersey

DOE/OR/20722-25; 38 pp. (1984, September)

The Maywood Interim Storage Site (MISS) is located in Maywood, New Jersey, a highly urbanized area 8 km east of Paterson, New Jersey. The MISS is on the Stepan Company property bounded by State Route 17 on the west, and the New York, Susquehanna and Western railroad line on the north and east. The U.S. Department of Energy will acquire 3.5 ha (8.7 acres) of the Stepan property for development of the MISS for interim storage of low-level radioactive materials. This document describes the surveillance monitoring program, which consists of monitoring at routine intervals for contaminants in air, surface water, sediments, and groundwater. External gamma radiation monitoring will also be conducted. The monitoring results will be compared with applicable regulatory guidelines. If there is evidence of new or increased off-site migration of contaminants, additional remedial action and sampling may be warranted.

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

Environmental Monitoring Plan for the Wayne Site, Wayne, New Jersey

DOE/OR/20722-26; 35 pp. (1984, August)

The Wayne Interim Storage Site (WISS) is located at 868 Black Oak Ridge Road in Wayne Township, New Jersey. The property, formerly used by W.R. Grace and Company, will be acquired by DOE to serve as an interim storage site for contaminated materials removed from off-site locations. Remedial actions at the WISS are designed and will be implemented to control radioactive and nonradioactive contaminants at the site. This document describes the surveillance monitoring program, which consists of monitoring at routine intervals for contaminants in air, surface water, sediments, and groundwater. External gamma radiation monitoring will also be conducted. The monitoring results will be compared with applicable regulatory guidelines. If there is evidence of new or increased off-site migration of contaminants, additional remedial action and sampling may be warranted.

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

Saint Louis Airport Storage Site (SLAPSS) Environmental Monitoring Summary - Calendar Year 1983, St. Louis, Missouri

DOE/OR/20722-30; 10 pp. (1985, February)

The St. Louis Airport Storage Site (SLAPSS) is an 8.8-ha (21.7-acre) area located north of the St. Louis, Missouri airport. Radiological surveys conducted in 1976 and 1978 determined that SLAPSS and the drainage ditches north and south of McDonnell Boulevard were radioactively contaminated above remedial action guidelines. The ditches have been designated for remedial action consideration under the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). The SLAPSS property has not yet been designated for consideration for remedial action under FUSRAP; however, limited radiological monitoring of the site has been authorized. Results of the 1983 sampling analysis show that concentrations of radium-226 ranged from 0.1 pCi/l to 0.2 pCi/l in samples taken from Coldwater Creek. Total uranium concentrations ranged from 3.3 pCi/l to 45 pCi/l. During the first sampling period, the radium-226 concentrations in water and uranium concentrations in sediment showed higher levels upstream of SLAPSS than downstream. This occurrence will be monitored and evaluated in future sampling. Radium-226 concentrations in groundwater ranged from 0.1 pCi/l to 0.5 pCi/l. Total uranium concentrations ranged from 13 pCi/l to 3740 pCi/l. The 1983 results are consistent with concentrations identified during previous sampling.

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

Survey Plan for the Radiological Characterization of Residential Properties in Lodi, New Jersey

DOE/OR/20722-49; 13 pp. (1984, November)

Based on designation survey data collected by Oak Ridge National Laboratory, the Department of Energy has designated four residential properties in Lodi, New Jersey, for remedial action. The major objective of this survey is

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to locate the horizontal and vertical boundaries of radioactive contamination exceeding remedial action criteria. An important secondary objective is to identify and evaluate any pathways by which contamination could migrate from the properties. This report includes the planning data relevant to radiological survey instrumentation, radiological survey measurements, soil sampling analysis, water and sediment sampling analysis, measurement structures, and background measurements and samples. The survey will be conducted from November 1984 through January 1985.

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

Survey Plan for the Radiological Characterization of the Ballod and Associates Property, Rochelle Park, New Jersey

DOE/OR/20722-50; 13 pp. (1984, December)

A characterization survey of the Ballod and Associates property, located in Rochelle Park, New Jersey, is required to complete remedial action engineering. The major objective of this survey is to locate the horizontal and vertical boundaries of radioactive contamination exceeding remedial action criteria. An important secondary objective is to identify and evaluate any pathways by which contamination could migrate from the properties. This report includes the planning data relevant to radiological survey instrumentation, radiological survey measurements, soil sampling analysis, water and sediment sampling analysis, and background measurements and samples. The survey will be conducted from November 1984 through January 1985.

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

Report on Drilling and Observation Well Installation at the Colonie Interim Storage Site, Colonie, New York

DOE/OR/20722-61; 82 pp. (1985, October)

This report documents the procedures used and the results obtained during a subsurface investigation con-

ducted as a part of the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program activities at the Colonie Interim Storage Site. The program included overburden sampling, permeability testing, installation of groundwater monitoring wells, and measurement of groundwater levels. A total of 7 new groundwater monitoring wells were installed and five geologic boreholes were drilled. The results of the investigation indicate that four continuous overburden units were identified on the site: Upper sand, Upper clay, Lower sand, and Lower clay. The measured range of permeability values for each of these units is: (1) Upper sand, $3.8 \times 10(E-2)$ to $8.95 \times 10(E-4)$ cm/s; (2) Upper clay, $1.7 \times 10(E-4)$ to $1.0 \times 10(E-4)$ cm/s; (3) Lower sand, $2.6 \times 10(E-4)$ to $1.0 \times 10(E-4)$ cm/s, and (4) Lower clay, $1.8 \times 10(E-4)$ to $6.0 \times 10(E-5)$ cm/s. The groundwater in both the upper and lower sands flows generally from the north to the south.

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

Report on Observation Well Installation, Hazelwood Interim Storage Site, St. Louis County, Missouri

DOE/OR/20722-62; 42 pp. (1985, July)

This report presents the results of the observation well installation program conducted at the Hazelwood Interim Storage Site near St. Louis, Missouri, as part of DOE's FUSRAP activities. Eight holes were drilled and seven observation wells were installed at the site between December 11 and 18, 1984. The drilling and well installation was performed by John Mathes and Associates, Inc. of Columbia, Illinois, under the supervision of a Bechtel geologist.

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

Post Remedial Action Report for the Colonie Interim Storage Site Vicinity Properties - 1984, Colonie, New York

DOE/OR/20722-72; 41 pp. (1986, March)

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The purpose of this report is to document Bechtel National, Inc.'s (BNI) post-remedial action sampling of certain properties in the vicinity of the former National Lead (NL) Industries plant in Colonie, New York. 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 and data on the current radiological status of the properties.

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

Closure Plan for the Colonie Interim Storage Site - Colonie, New York

DOE/OR/20722-74 (Rev. 2); 17 pp. (1986, November)

The Colonie Interim Storage Site (CISS) contains both radioactive contamination and hazardous chemical wastes. Because of the hazardous wastes on-site, the Department of Energy (DOE) submitted a Resource Conservation and Recovery Act (RCRA) Part A Application and a closure plan to the Environmental Protection Agency (EPA). The original closure plan was submitted in September 1985 to fulfill the DOE's obligation to the EPA. Included with this closure plan are future work plans and an inventory list of the chemicals found in the CISS facility.

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

Report on Drilling and Well Installations at the Maywood Interim Storage Site

DOE/OR/20722-75; 32 pp. (1985, October)

This report documents the procedures used and the results obtained during a subsurface investigation conducted as a part of the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program activities at the Maywood Interim Storage Site. The program included overburden and bedrock sampling, permeability testing, installation of groundwater monitoring wells, and measurement of groundwater levels. A total of 15

groundwater monitoring wells were installed and two geologic boreholes were drilled. The results of the investigation indicate that: (1) overburden materials range in thickness from 1.8 to 21.5 ft in the site area; (2) no consistent permeability values can be demonstrated for the overburden due to the reworked nature of the materials; (3) bedrock permeabilities ranged from 10(E-3) to 10(E-5) cm/s. The groundwater in both the overburden and bedrock aquifers flows generally southwest.

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

Post-Remedial Action Report for the Hazelwood Site - 1984

DOE/OR/20722-76 (1984, September)

The purpose of this report is to document the post-remedial action sampling conducted at 9200 Latty Avenue and along the shoulders of Latty Avenue from Coldwater Creek to Interstate Highway 170 in Hazelwood, Missouri. This report briefly describes the origin of the radioactive contamination in this area and the remedial action performed. It also provides the guidelines used in performing the remedial action and data on the current radiological status of the decontaminated areas.

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

Post-Remedial Action Report for the Residential Properties on Davison and Latham Streets, Maywood, New Jersey

DOE/OR/20722-77; 53 pp. (1986, February)

The purpose of the assessment was to verify the data that supports the adequacy of the remedial actions performed at the site and to confirm the site's compliance with remedial action criteria. Two types of gamma radiation scans were conducted to determine whether all of the radioactively contaminated soil was removed. Soil samples were analyzed at a laboratory to determine the concentrations of Ra-226, Th-232, and U-238. Measured gamma radiation exposure rates were used to calculate

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annual "doses" assuming continuous exposure at the point of measurement. Radon and radon daughter monitoring was performed within some of the homes on Davison and Latham. Based on all the data collected, these parcels conform to all applicable DOE radiological guidelines established for release of the properties for unrestricted use.

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

Characterization Plan for Sears and Adjacent Properties, Maywood, New Jersey - Revision 1

DOE/OR/20722-81 (Rev. 1); 22 pp. (1986, July)

Characterization of Sears and adjacent properties is necessary to determine the magnitude and nature of the radioactive contamination present. Limited chemical characterization of radiological waste will be performed at two adjacent properties. This report documents the scope of the characterization effort and the procedures to be used. In addition to background information and schedules, the report details specific personnel.

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

Survey Plan for the Radiological Characterization of the Sears and Scanel Properties

DOE/OR/20722-81; 13 pp. (1985, August)

Two areas near the Stepan Company plant known as the Sears and Scanel properties were shown to be radioactively contaminated by NUS Corporation during radiological surveys conducted in July 1983. Further characterization of these properties is necessary to confirm the NUS finding and to better define the boundaries of the contamination. The major objective of this survey is to locate the horizontal and vertical boundaries of radioactive contamination where remedial action criteria are exceeded. An important secondary objective is to identify and evaluate any pathways by which contamination could migrate from the properties. This plan details survey instrumentation, radiological survey measurements, and soil, water and sediment sampling procedures.

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

Post-Remedial Action Report for the Residential Properties on Grove Avenue and Parkway: Rochelle Park, New Jersey

DOE/OR/20722-83; 56 pp. (1986, March)

Bechtel National, Inc. (BNI) removed radioactive contamination from residential properties on Grove Avenue and Parkway in Rochelle Park, New Jersey, as part of the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). The purpose of this report is to document BNI post-remedial action sampling of properties in the vicinity of the Stepan Company plant which is in Maywood, New Jersey. 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 provides the guidelines used in performing the remedial action and data on the current radiological status of the properties.

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

Characterization Plan for the St. Louis Airport Site

DOE/OR/20722-87; 41 pp. (1986, July)

This report describes the characterization procedures used in evaluating the St. Louis Airport Site (SLAPS). The hydrogeologic properties and magnitude and nature of the chemical and radioactive contamination included in this characterization. This has been done as a prelude to developing the property as a permanent disposal site for low-level radioactive waste. For each topic of study the scope and purpose, characterization activities, and documentation are listed. More detailed reports from this study are planned to follow.

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Bechtel National, Inc., Oak Ridge, TN

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Characterization Plan for the Vicinity Properties in Lodi, Lodi, New Jersey

DOE/OR/20722-120; 19 pp. (1987, January)

Based on designation survey data collected by the Oak Ridge National Laboratory (ORNL), the Department of Energy (DOE) has designated nine properties in Lodi, New Jersey for remedial action. Bechtel National, Inc., (BNI) has been tasked by the DOE to conduct comprehensive characterization surveys to determine the extent of contamination on these properties. Additional Lodi properties may be characterized based on preliminary data from ORNL designation surveys. Although the contamination at these properties did not result directly from the atomic energy program, Congress assigned the Maywood Interim Storage Site (MISS) and its vicinity properties to DOE with the 1984 Energy and Water Appropriations Act to expedite the decontamination process. This report includes an overview of the project, the planned radiological characterization, documentation, and schedule of reporting of the data collected.

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Bechtel National, Inc., Oak Ridge, TN

Characterization Plan for the National Guard Armory, Chicago, Illinois

DOE/OR/20722-138; 22 pp. (1987, February)

A characterization survey of the National Guard Armory is necessary to determine the horizontal and vertical boundaries of radioactive contamination exceeding remedial action criteria and to determine the magnitude and nature of the contamination. These factors will effect design engineering for remedial action at the site. This report documents the scope of the characterization effort and the procedures to be used.

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Bechtel National, Inc., Oak Ridge, TN

Colonie Interim Storage Site Annual Site Environmental Report, Colonie, New York - Calendar Year 1987

DOE/OR/20722-194; 52 pp. (1988, April)

The environmental monitoring program was continued during 1987 at the Colonie Interim Storage Site (CISS), a U.S. Department of Energy (DOE) facility located in Colonie, New York. The monitoring program at the CISS measures external gamma radiation levels and uranium and radium-226 concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with DOE radiation protection standards 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 this report, the maximally exposed individual would receive an annual external exposure approximately equivalent to 2 percent of DOE radiation protection standard of 100 mrem/yr. This exposure is also approximately equivalent to the exposure 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 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 the population would receive from naturally occurring radioactive sources. Results of 1987 monitoring show that the CISS is in compliance with DOE radiation protection standards.

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Bechtel National, Inc., Oak Ridge, TN

Maywood Interim Storage Site Annual Site Environmental Report, Maywood, New Jersey - Calendar Year 1987

DOE/OR/20722-195; 65 pp. (1988, April)

The environmental monitoring program was continued during 1987 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 soils contaminated with low-level radioactivity. 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, groundwater, and sediment. To verify that the site is in compliance with DOE radiation protection standard (100 mrem/yr) 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

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scenario described in this report, the maximally exposed individual would receive an annual external exposure approximately equivalent to 1 percent of DOE radiation protection standard of 100 mrem/yr. This exposure is less than the exposure 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 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 population would receive from naturally occurring radioactive sources. Results of 1987 monitoring show that the MISS is in compliance with DOE radiation protection standards.

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Bechtel National, Inc., Oak Ridge, TN

Wayne Interim Storage Site Annual Site Environmental Report, Wayne, New Jersey - Calendar Year 1987

DOE/OR/20722-196; 67 pp. (1988, April)

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 monitoring program at the WISS measures thoron and 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 DOE radiation protection standard (100 mrem/yr) 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 this report, the maximally exposed individual would receive an annual external exposure approximately equivalent to 1 percent of DOE radiation protection standard of 100 mrem/yr. By comparison, the average American receives a dose of 1 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 the same population would receive from naturally occurring radioactive sources. Results of 1987 monitoring show that the WISS is in compliance with DOE radiation protection standards.

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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 1987

DOE/OR/20722-198; 74 pp. (1988, April)

During 1987, 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 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, groundwater, and sediment. To verify that the sites are in compliance with 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, this individual, at the MSP, would receive an annual external exposure approximately equivalent to 10 percent of DOE radiation protection standard. By comparison, the incremental dose received from living in a brick house as opposed to 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 an 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 1987 monitoring show that the MSP and MML are in compliance with DOE radiation protection standards.

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Bechtel National, Inc., Oak Ridge, TN

St. Louis Airport Site Annual Site Environmental Report, St. Louis, Missouri - Calendar Year 1987

DOE/OR/20722-199; 58 pp. (1988, April)

The environmental monitoring program was continued during 1987 at the St. Louis Airport Site (SLAPS) in St.

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Louis County, Missouri. The monitoring program at the SLAPS measures radon gas concentrations in air; external gamma dose rates; and uranium, thorium, and radium concentrations in surface water, groundwater, and sediment. To assess the potential effect of the SLAPS 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 5.5 percent of U.S. Department of Energy (DOE) radiation protection standard of 100 mrem/yr. This exposure is approximately the same as a person would receive from increased cosmic radiation during six round-trip flights from New York to Los Angeles (due to greater amounts of cosmic radiation at higher altitudes). The dose to the population within an 80-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 1987 monitoring show that the SLAPS is in compliance with DOE radiation protection standards.

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Bechtel National, Inc., Oak Ridge, TN

Hazelwood Interim Storage Site Annual Site Environmental Report, Hazelwood, Missouri - Calendar Year 1987

DOE/OR/20722-200; 58 pp. (1988, April)

The environmental monitoring program was continued during 1987 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, the HISS is presently used for the storage of soils contaminated with residual radioactive material. The monitoring program at the HISS measures radon 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 DOE radiation protection standard (100 mrem/yr) 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 this report, the maximally exposed individual at the HISS would receive an annual external exposure approximately equivalent to 1 percent of DOE radiation protection standard of 100 mrem/yr.

This exposure is less than the exposure 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 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 the population would receive from naturally occurring radioactive sources. The results of 1987 monitoring show that the HISS is in compliance with DOE radiation protection standards.

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Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the Niagara Falls Storage Site Vicinity Properties - 1983 and 1984, Lewiston, New York

DOE/OR/20722-84; 167 pp. (1986, December)

The Niagara Falls Storage Site (NFSS) is a U.S. Department of Energy (DOE) facility. The site covers approximately 191 acres and is used for the storage of radioactive residues and contaminated soils and rubble. Water and wind erosion have aided the migration of contaminants to adjacent vicinity properties. Bechtel National, Inc. (BNI) removed radioactively contaminated soil from the vicinity properties in its capacity as DOE's Project Management Contractor for the NFSS. This report documents BNI's post-remedial action sampling of the properties cleaned up and 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 provides guidelines used in performing the remedial action and data on the current radiological status of the properties.

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Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for 826 Black Oak Ridge Road, Wayne, New Jersey

DOE/OR/20722-90; 25 pp. (1987, March)

As part of work being conducted under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), during 1986 Bechtel

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National, Inc. (BNI) removed radioactive contamination from the school bus maintenance facility at 826 Black Oak Ridge Road in Wayne, New Jersey. The purpose of this report is to document post-remedial action sampling performed by BNI on the property, which lies adjacent to the Wayne Interim Storage Site (WISS). This report briefly describes the origin of the radioactive contamination at the maintenance facility, the methods used to determine the extent of it, and the type 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 the property.

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Cottrell, W.D., and R.F. Carrier, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN; Oak Ridge National Laboratory, Biology Division, Oak Ridge, TN

Radiological Survey of Latty Avenue in the Vicinity of the Former Cotter Site, Hazelwood/Berkeley, Missouri (LM001)

ORNL/TM-10006; 262 pp. (1987, May)

A radiological survey was conducted over a proposed construction corridor along Latty Avenue, Hazelwood/Berkeley, Missouri, in the vicinity of the former Cotter site at 9200 Latty Avenue. The survey included measurement of gamma exposure rates at the ground surface and at 1 meter 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 subsurface water. The results of the survey demonstrated some degree of radioactive contamination in all areas of the construction corridor, extending north and south in some regions onto adjacent private properties. Redistribution of the contamination by flooding, surface runoff, and road and utility line activities was evident. The pattern of contamination ranged from widespread to isolated spots and was found to occur from near the surface to depths of about 1.8 m. The most highly contaminated region was noted on both sides of Latty Avenue adjacent to the former Cotter site. Concentrations of thorium-230 in soil from that region were as high as 16,000 pCi/g.

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Cottrell, W.D., and R.F. Carrier, Oak Ridge National Laboratory, Oak Ridge, TN

Results of the Radiological Survey at the Ventron Site, Beverly, Massachusetts

ORNL/TM-10053; 106 pp. (1988, May)

The results of a radiological survey of the Ventron site in Beverly, Massachusetts, are presented in this report. From 1942 through 1948, the site was used for various projects involving the production of uranium metal powder from uranium oxide and the recovery of uranium from scrap metal. After 1948, the Atomic Energy Commission surveyed the facility and performed decontamination and decommissioning activities in accordance with current procedural policies. In 1980 and 1982, a comprehensive radiological survey of the site was conducted by the Oak Ridge National Laboratory. Included were measurements of the following: residual alpha and beta-gamma contamination levels inside the buildings; external gamma radiation levels at 1 m above the surface in the buildings and outdoors; and uranium, radium, and thorium concentrations in surface and subsurface soil outdoors and beneath the buildings. The results show the presence of residual radioactive contamination, largely uranium with lesser amounts of thorium and radium, in outdoor soil and in fill material beneath Buildings B-1, B-2, and C-1. The spotty contamination found in Buildings A and A-1, and the Alfa Building on floors, walls, and overhead surfaces, and equipment included beta-gamma dose rates exceeding the limits set by current guidelines applicable to the release of property for unrestricted use. Surface contamination dose rates on the roof of Building A were comparable to those inside the buildings. In summary, concentrations of residual radioactive material found in buildings and soils at the site are in excess of concentration guidelines established by the Department of Energy to determine if a site needs to be considered for remedial action. These guidelines are typically derived to ensure that unrestricted use of the facility (including residential use) will not result in above-guideline doses to the general public. An examination of work/occupancy scenarios for this site suggests that the annual radiation exposures to personnel from any credible current use scenario would be well below dose limits which would be applied to protect members of the general public from exposure to radiation.

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Davis, K.A., C.P. Leichtweis, M.E. Kaye, and A.M. Feldman, Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the Middlesex Municipal Landfill Site, Middlesex, New Jersey

DOE/OR/20722-135; 45 pp. (1987, February)

The purpose of this report is to document post-remedial action sampling performed by Bechtel National, Inc. (BNI) on the Middlesex Municipal Landfill (MML) in Middlesex, New Jersey. The MML site is located in the Borough of Middlesex, Middlesex county, New Jersey, approximately 18 miles southwest of Newark. The Middlesex Sampling Plant (MSP) is located about 0.5 miles southeast of the landfill. Remedial action was conducted at the MML from 1984 through 1986 under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S. Department of Energy (DOE) effort to identify, decontaminate, or otherwise control sites where low-level radioactive contamination that exceeds current guidelines remains from the early days of the nation's atomic energy program. This report briefly describes the origin of the radioactive contamination on the MML property, the method used to determine its extent, and the type of remedial action performed. It also provides the guidelines used in performing the remedial action, summarizes the data on the current radiological status of the property, and presents final excavation limits and depths.

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Golchert, N.W., Argonne National Laboratory, Argonne, IL

Site Surveillance and Maintenance Program for Palos Park - Report for 1987

ANL-88-12; 40 pp. (1988, April)

The results of the environmental monitoring program conducted at Site A/Plot M in the Palos Park Forest Preserve area for CY 1987 are presented. The monitoring program is the ongoing remedial action that resulted from the original radiological characterization of the site. This study had determined that hydrogen-3 (as tritiated water) migrated from the burial ground and was present in two nearby hand pumped picnic wells. The current program consists of sample collection and analysis of air,

surface and subsurface water, and bottom sediment. The results of the analyses are used to: (1) determine the migration pathway of water from the burial ground (Plot M) to hand-pumped picnic wells; (2) establish if buried radionuclides other than hydrogen-3 have migrated; and (3) generally characterize the radiological environment of the area. The program was designed to study the migration of nonradiological hazardous waste constituents that may have been buried with the radioactive waste. This was done by analyzing borehole water samples for selected heavy metals and organic compounds and analyzing quarterly water samples from the Red Gate Woods picnic well for inorganic constituents. 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 current winter peak was significantly less than in earlier years. Tritiated water continues to be detected in a number of wells, boreholes, dolomite holes, and a surface stream. For many years it was the only radionuclide found to have migrated in measurable quantities. Recent measurements indicate the presence of strontium-90 and technetium-99 in borehole water next to Plot M. The present data does not allow a conclusion as to whether these nuclides represent recent migration or movement that occurred before the Plot was capped. 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.

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Hunt, C.D., Rhode Island University, Marine Ecosystems Research Laboratory, Narragansett, RI

Fate and Bioaccumulation of Soil-Associated Low-Level Naturally Occurring Radioactivity Following Disposal into a Marine Ecosystem - Final Report

PB-87-204-822; 169 pp. (1986, October 1)

The fate of radium (Ra) and other naturally occurring uranium-series isotopes associated with soils disposed in seawater was examined using the Marine Ecosystem Research Laboratory (MERL) controlled marine ecosystems. Thirty-seven kilograms of a soil containing approximately 400 pCi Ra-226/g from an inactive uranium ore processing plant site in Middlesex, New Jersey were added to each of two mesocosms over five days in mid-September 1984. Radionuclide activity in these and

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two control mesocosms was observed for three months after the soil additions. Radioactivity in the soil appeared to be confined to discrete soil particles rather than being distributed equally on the soil particles, suggesting the source of the radioactivity was remnant ore particles.

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Kannard, J.R., Bechtel National, Inc., Oak Ridge, TN

Case Study: FUSRAP in New Jersey 1980-1987

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 151-167) (1987)

Formerly Utilized Site Remedial Action Program (FUSRAP) activities in New Jersey consists of five sites, representing 17% of all sites in the FUSRAP program. Three of these, one in Middlesex, one in Wayne, and one in Maywood, are discussed. Each is being used as an interim storage site for contaminated material from vicinity properties. They also represent three distinct stages of completion of interim remedial action also having been accomplished. Contrasts range from drastically different attitudes in the public and local government sector to significant differences in quantities of contaminated materials, and the mechanisms by which they migrated to vicinity properties. In each case, the main concern of the public is the lack of a location for permanent disposal. The history, objectives, and accomplishments for each site will be discussed; and, in keeping with the overall theme of the conference, those activities which were undertaken during FY 1986 to enhance productivity will be described. Several areas demonstrating improved cost effectiveness are also discussed.

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Kannard, J.R., and T.M. Dravecky, Bechtel National, Inc., Oak Ridge, TN

Case Study: FUSRAP in New Jersey (1980-1987)

CONF-871075; Waste Problems, Proceedings of the Third Oak Ridge Model Conference, Oak Ridge, TN, October 13-16, 1987; (pp. 185-201) (1988)

The five U.S. Department of Energy Formerly Utilized Sites Remedial Action Program (FUSRAP) sites in New Jersey represent 17% of all FUSRAP sites. Two of these sites, Kellex in Jersey City and DuPont in Deepwater, have not been included in recent program activities. This case study concentrates on the other three sites - Middlesex, Wayne, and Maywood. Each of these is currently being used as an interim storage site for contaminated material from vicinity properties. Each also represents a distinct stage of completion of interim remedial action. Middlesex is complete, Wayne is nearing completion, and Maywood is still in the characterization stage with some remedial action also having been accomplished. The sites differ drastically. In each case, the main concern of the public is the location of permanent waste disposal. These issues, along with the history, objectives, and accomplishments at each site, are discussed.

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Kuhaida, A.J., and P.R. Cotten, Bechtel National, Inc., Oak Ridge, TN

Environmental Monitoring of the Middlesex Sites, Middlesex, NJ, Under the Department of Energy Formerly Utilized Sites Remedial Action Program

CONF-850106; Environmental Radiation '85, Proceedings of the Health Physics Society 18th Midyear Topical Symposium, Colorado Springs, CO, January 6-10, 1985; (Preprint) (1985)

An environmental monitoring program has been maintained at the Middlesex Sampling Plant since 1980 and at the former Middlesex Municipal Landfill since 1981. The sites, located in New Jersey, are part of the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) and contain uranium- and radium-bearing low-level radioactive waste. During remedial action activities conducted in 1980 and 1981, monitoring of air, water, and sediments was conducted to verify the adequacy of contamination control and compliance with applicable standards. Analytical results show that, with few exceptions, remedial action activities were conducted within applicable DOE guidelines. The surveillance monitoring program was initiated in 1982 to measure uranium and radium concentrations in surface and groundwater, radon concentrations in air, and external gamma exposure levels. Radiation doses to the public are also calculated. Measured radioactivity in air and water and radiation doses to the public during 1982 and 1983 were within DOE radiological guidelines.

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Leichtweis, C.P., and M.E. Kaye, Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the Wayne Site - 1986, Wayne, New Jersey

DOE/OR/20722-142; 42 pp. (1987, April)

As part of work conducted during 1986 under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), Bechtel National, Inc. (BNI) removed radioactive contamination from three areas in Wayne, New Jersey. These areas were: a portion of Sheffield Brook; the front yard of the former W.R. Grace and Company property, which is now the Wayne Interim Storage Site (WISS) owned by the DOE; and a small area on the right-of-way of Pomton Plains Cross Road adjacent to Lot 4A of Block 614. The purpose of this report is to document post-remedial action sampling performed by BNI on these properties. This report briefly describes the origin of the radioactive contamination at the properties, the methods used to determine the extent of contamination, and the type of remedial action performed. The report 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.

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Leichtweis, C.P., J.A. Liberatore, and T.M. Dravecky, Bechtel National, Inc., Oak Ridge, TN

Characterization Report for the Maywood Interim Storage Site, Maywood, New Jersey

DOE/OR/20722-139; 284 pp. (1987, June)

This report describes the procedures used to conduct the radiological and limited chemical characterization of the Maywood Interim Storage Site (MISS) from May through August 1986, and summarizes the results of the characterization. The radiological characterization was performed to identify the extent of contamination exceeding Department of Energy (DOE) radiological guidelines. The limited chemical characterization was performed to assist with developing health and safety requirements for the protection of personnel during remedial action to be conducted at the site in the future.

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Lord, J.P., J.A. Blanke, and A.M. Feldman, Bechtel National, Inc., Oak Ridge, TN

Preliminary Geological and Hydrogeological Characterization Report for the Southern Portion of the Ashland 2 Site

DOE/OR/20722-181; 186 pp. (1987, December)

Based on several technical considerations and on its proximity to several other FUSRAP sites, the southern portion of the Ashland Oil Company property, located in the Town of Tonawanda, New York, has been identified by the DOE as a potential location for a disposal cell. This portion of the property is referred to as Ashland 2 South. A preliminary geological and hydrological characterization of Ashland 2 South was conducted to provide information to be used in evaluating its suitability to serve as a disposal site. The geological and hydrogeological investigation consisted of a literature search, a shallow seismic refraction survey, the installation of geologic boreholes and groundwater monitoring wells, and the performance of an in situ field permeability test. Limited chemical and radiological characterizations were performed concurrently with the geological and hydrogeological characterization. Based on these characterizations, there are no indications that Ashland 2 South should be withdrawn from further consideration as a disposal site. Phase II geological and hydrological characterization of Ashland 2 South should be performed to provide a basis for further evaluation of its suitability for this purpose.

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Nemec, J.F., and J.M. Hoffman, Bechtel National, Inc., Oak Ridge, TN

The Formerly Utilized Sites Remedial Action Program

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 2017-2029) (1987, July)

The Formerly Utilized Sites Remedial Action Program (FUSRAP) is a U.S. Department of Energy (DOE) pro-

FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

gram to evaluate and remedy radiological conditions at privately and institutionally owned sites across the nation where low-activity radioactive contamination exceeds levels permitted by current DOE guidelines. FUSRAP was initiated in 1974 and now includes 29 sites in 12 states. From the start of field work in 1979 through the 1985 work season, 170,000 cubic meters of contaminated material have been removed during remedial action on 129 properties. By current estimates, the program will be completed in 2001 at a cost of approximately \$700 million. Of prime importance in the immediate future will be the development of permanent disposal sites to replace the interim storage sites currently used by the program. An overview of the program's origin, administration, scope, and governing guidelines precedes an explanation of the remedial action process. Major program accomplishments are described, and the paper concludes with an assessment of issues affecting the future of FUSRAP.

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Noey, K.C., C.R. Hickey, and A.M. Feldman, Bechtel National, Inc., Oak Ridge, TN

Characterization Report for the Hazelwood Interim Storage Site, Hazelwood, Missouri

DOE/OR/20722-141; 63 pp. (1987, June)

During October and November 1986, a radiological survey was conducted at the Hazelwood Interim Storage Site (HISS) in Hazelwood, Missouri. The survey was performed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S. Department of Energy (DOE) program to identify, clean up, or otherwise control sites where residual radioactive contamination exceeds current guidelines. These are remains from the early years of the nation's atomic energy program or conditions that Congress has mandated DOE to remedy. Although sampling for chemical contamination was not within the scope of this effort, chemical characterization of the site will be performed before remedial action commences.

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Oak Ridge National Laboratory, Oak Ridge, TN

Environmental Impact Assessment of the Former Airport Storage Site of the Atomic Energy Commission, St. Louis County, Missouri

DOE/EA-0078; 161 pp. (1979, July)

The primary purpose of this Environmental Assessment is to evaluate the adequacy of the Quit-Claim Deed, used to protect public health, safety and environmental quality. The assessment evaluates two proposed actions: (1) the use of this deed to control present radiation exposure from the site, and (2) the use of the deed to control anticipated radiation exposure from the site after the burial of approximately 18,300 to 50,000 cu yd of contaminated material from a former AEC/NRC licensed site (the Latty Avenue site) located about 3/4 mile northeast of the airport storage site. Four alternatives to the proposed actions are also evaluated: (1) complete site decontamination with removal of radioactive material to an unidentified location; (2) release of the site for "unrestricted use" with no further action; (3) release of the site for "unrestricted use" after burial of contaminated material from the Latty Avenue site; and (4) continued restriction of the site with no development of the site permitted.

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Schlatter, J.F., Bechtel National, Inc., Oak Ridge, TN

Effective Applications of Public and Media Relations for the DOE Formerly Utilized Sites Remedial Action Program

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning, Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vol. 2, 1098 pp.; (pp. 2030-2035) (1987, July)

A community relations program is an integral part of the U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a DOE initiative to clean up sites where low-level radioactive contamination remains from the early years of the Nation's atomic energy programs. Objectives of the FUSRAP community relations programs and techniques used to meet those objectives are described. The community relations program is a joint effort by DOE and its management contractor, Bechtel National, Inc.

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

Formerly Utilized MED/AEC Sites Remedial Action Program, Bayo Canyon, New Mexico: Environmental Assessment

DOE/EA-0197; 35 pp. (1982, July)

The U.S. Department of Energy (DOE) has determined that strontium-90, in excess of its proposed remedial action criteria, exists in materials underlying an area of about 0.6 ha (1.5 acres) at the Bayo Canyon site. The proposed action is to demarcate this area and restrict its use to activities that will not disturb this subsurface contamination. The proposed action would allow unrestricted use of the rest of the formerly utilized site. The proposed remedial action will be minor and, thus, will cause negligible disruption of the socioeconomic or environmental systems in which the site exists. The action will not threaten any legally protected species of flora or fauna, nor will it threaten any legally protected cultural or historical resources. Because the local community is well informed about radiation and has expressed no concern to date, it is expected that future public concern will be low. DOE is ensuring that county authorities remain aware of all proposed remedial activities in the area.

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U.S. Department of Energy, Washington, DC

Environmental Assessment of Remedial Action, Acid/Middle Pueblo Canyon, Los Alamos, New Mexico

DOE/EA-0184; 104 pp. (1982, August)

The radiological survey of the former radioactive waste treatment plant site (TA-45), Acid Canyon, and Pueblo Canyon found residual radioactivity at the site itself and in the channel and banks of Acid, Pueblo, and lower Los Alamos Canyons, all the way to the Rio Grande. The largest reservoir of radioactive material is in lower Pueblo Canyon, which is on DOE property. The only areas where residual radioactivity exceeds the proposed cleanup criteria are at the former vehicle decontamination facility. This is located between the former treatment plant

site and Acid Canyon, around the former untreated waste outfall to a short distance below, and in two small areas farther down in Acid Canyon. The three alternatives proposed are: (1) to take no action; (2) to fence the areas where the residual radioactivity exceeds the proposed criteria (minimal action); and (3) to clean up the former vehicle decontamination facility and around the former untreated waste outfall. Calculations based on actual measurements taken at the location having the greatest residual radioactivity indicate that the annual dose would be about 12% of the amount designated as an applicable guideline. Most doses are much smaller. No environmental impacts are associated with either the no-action or minimal action alternatives. The impact associated with the cleanup alternative is very small. The preferred alternative is to clean up the areas around the former vehicle decontamination facility and the untreated waste outfall. This course of action is recommended not because of any real danger associated with the residual radioactivity, but rather because the cleanup operation is a minor effort and would conform with the ALARA (as low as reasonably achievable) philosophy.

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Vaughn, J.W., Jr., U.S. Department of Energy, Office of the Assistant Secretary for Nuclear Energy, Washington, DC

Floodplain/Wetlands Statement of Findings: Decontamination Research and Development Project Actions for Properties Located in Wayne, NJ

Federal Register 52(170):33265 (1987, September 2)

DOE has determined that there is no practical alternative to the proposed remedial action for the areas of the Pompton River/Sheffield Brook that are near the FUSRAP site in Wayne, New Jersey. After presentation of a brief history of the Wayne site, the need for remedial action is discussed. A summary of the impact that remedial action would have on the area is provided. The mitigative procedures have been designed so as to minimize damage to the floodplain/wetland area during remedial action.

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FACILITIES CONTAMINATED WITH NATURAL RADIOACTIVITY

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Brink, J.M., and S.F. Tarlton, U.S. Environmental Protection Agency, Region VIII, Denver, CO

Management of Uncontrolled Hazardous Waste Sites Cleanup of Radium Processing Residues in a Highly Urbanized Area

Management of Uncontrolled Hazardous Waste Sites, Proceedings of the Fifth National Conference, Washington, DC, November 7, 1984. Hazardous Materials Control Research Institute, Silver Spring, MD; (pp. 445-448) (1984)

The Denver Radium Site, with its numerous and diverse contaminated properties, presents interesting challenges to the planners of remedial actions. The radioactive wastes are difficult to quantify due to the complexity of field investigation techniques and the degree to which the wastes have been disturbed by normal urban activities during the decades the wastes were forgotten or ignored. In addition to the radioactive wastes, the remedial planning for the Denver Radium Site must address the problems posed by nonradioactive hazardous materials present in the contaminated soils. Some of the properties involved have a history of as much as 100 years of mixed industrial uses. The presence of such nonradioactive hazards may have a significant bearing on the health and safety procedures used during site cleanup and the selection and design of disposal sites. The diversity of properties involved and the uniqueness of each property's history also present great challenges in the investigation of potentially responsible parties. Finally, because of the long lead time required to address all of the issues in a study of this nature, prompt actions should be considered in order to reduce the exposure of occupants of contaminated properties.

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Czapor, J.V., K. Gigliello, and J. Eng, U.S. Environmental Protection Agency, Region II, New York, NY

Radon Contamination in Montclair and Glen Ridge, New Jersey: Investigation and Emergency Response

Management of Uncontrolled Hazardous Waste Sites, Proceedings of the Fifth National Conference, Washington, DC, November 7, 1984. Hazardous Materials Control Research Institute, Silver Spring, MD; (pp. 457-464) (1984)

In 1979, the New Jersey Department of Environmental Protection (NJDEP) initiated a program to identify and investigate those locations in the state which were once the site of radium processing facilities. Chief among those sites investigated was a facility in Orange, New Jersey, which had ceased operation in the 1920s. Concern over the possibility of off-site disposal of processing waste prompted an aerial gamma radiation survey of surrounding areas of Essex County. This survey identified a number of areas having high gamma radiation; the level and extent of several of the gamma anomalies suggested the possibility of waste disposal. In July 1983, NJDEP began to investigate two areas of high gamma readings in the towns of Montclair and Glen Ridge. The results of this investigation became available in late November 1983, and identified a number of homes having unacceptably high levels of radon gas. On December 6, 1983, the U.S. Environmental Protection Agency (EPA), acting under the mandates of CERCLA, began immediate removal actions at both the Glen Ridge and Montclair sites. Response actions were taken to reduce the residents' exposure to radon gas and radon progeny. Concurrent with the response action, the EPA and NJDEP developed and implemented an extensive field investigation to totally assess the extent of the problem. While radon problems have been identified and addressed in several areas of the country (e.g. uranium mill tailings in the west and phosphate tailings in the southeast), the potential threat posed by radioactive processing material disposed of in densely populated, urban residential communities poses unique problems. In this paper, the authors discuss both the immediate removal actions and the field investigation initiated in response to the problems in Montclair and Glen Ridge.

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Herzenberg, C.L., and R.C. Winter, Argonne National Laboratory, Argonne, IL

Review of Radiological Surveys of the General Services Administration's Raritan Depot in Edison, New Jersey

ANL/EES-TM-331; 14 pp. (1986, October)

This report reviews two recent radiological surveys of the General Services Administration (GSA) Raritan Depot in Edison, New Jersey. The surveys were conducted after somewhat elevated levels of radiation were detected within a depot building. The first survey indicated gamma radiation levels were higher than natural back-

FACILITIES CONTAMINATED WITH NATURAL RADIOACTIVITY

ground levels in some buildings and identified the probable source of the radiation as gypsum-like building tiles that contained natural uranium-chain radionuclides at a level 20 times higher than other materials. Elevated levels of radon and radon decay products also were detected in some buildings. A follow-up survey was conducted to confirm the January measurements and to measure radiation levels at other locations including: additional buildings at the depot, buildings on the Middlesex County College campus, and a possible outdoor disposal site. Measurements established that ceiling material is the primary source of the radiation. Radioisotope analysis of the ceiling tile material from buildings with elevated radiation levels showed the presence of radium-226 at levels of approximately 25 picocuries per gram (pCi/g); this material would thus have to be treated as hazardous waste should it be removed. This report critiques the methodology and results of the two surveys and recommends further action.

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Ohio Department of Health, Radiological Health Program, Columbus, OH

Cleveland Radium Decontamination Project

Report; 23 pp. (1984)

This report summarizes the steps taken to decontaminate two sites in the Cleveland area that had been contaminated by radium. The sites described are the back yard of a private residence on Nottingham Road and the Dial Service Manufacturing Company site on Rockwell Avenue.

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Robinet, M.J., G.D. Mosho, and R.A. Wynveen, Argonne National Laboratory, Argonne, IL

Removal of Radium Contaminated Soil at the Luminous Processes, Inc. Site, Ottawa, Illinois: April-June 1986

ANL-OHS/HP-87-101; 121 pp. (1987, November)

The radium and tritium contaminated site formerly occupied by Luminous Processes, Inc. (LPI), a radium dial painting factory, was decontaminated during April-

June 1986. The site is located in Ottawa, Illinois. Decontamination of the site consisted of removal of contaminated soil, removal of contaminated foundation and basement walls of a previously demolished building, removal of contaminated sidewalks, and removal of drain lines. The purpose of this report is to describe the site decontamination process and to document that the final radiological condition of the site is acceptable for public use. The principal criterion for acceptability was that the exposure rate everywhere on the site must be no more than 20 μ R/hr at 1 meter above the soil surface. An addendum is included in this report. The addendum gives the results of a leach test done on contaminated bricks from the exterior of the former Luminous Processes, Inc. building. The leach test was begun in June 1985.

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Robinet, M.J., and R.A. Wynveen, Argonne National Laboratory, Argonne, IL

Estimating Volume of Contaminated Soil for Excavation - A Quick and Simple Method

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.1-V.15) (1987)

Estimates of the volume of radionuclide contaminated soil which must be excavated require data on the depth distribution of the contamination. Using a novel uncomplicated approach, vertical activity distribution data were obtained on a 1400 square meter site. The volume of contaminated soil which had to be excavated was estimated to be 227 to 425 cubic meters. When the site cleanup was done, 312 cubic meters of contaminated soil had to be removed to satisfy the cleanup criteria. The basic approach was to drill 193 holes over the entire site and to make measurements in each hole using a detector with a side-looking collimator. Soil samples from the holes were analyzed only to the extent necessary to obtain sufficient data for demonstrating a correlation between count rate and activity concentration in the soil. The site was then conceptually sliced into vertical strips of contamination concern. The product of the contamination depths which exceeded cleanup criteria and the areas of the slices gave the volume of excavation required.

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Smith, W.H., and R.A. Wynveen. Argonne National Laboratory. Radiological Survey Group, Argonne, IL

Radiological Assessment and Remedial Action for the "Son of Lansdowne" Property, 186 North Lansdowne Avenue, Lansdowne, Pennsylvania

ANL-SSD/HP-86-102; 160 pp. (1987, August)

Results of a radiological assessment and remedial action program conducted by Argonne National Laboratory at a radioactively contaminated private residence in Lansdowne, Pennsylvania are reported. The residence had become contaminated from furniture which had been moved from another residence where a person had been engaged in the commercial production of radium sources. Further investigation and remedial action operations revealed that the contamination present could not have been solely from the contaminated furniture. The entire house was found to be contaminated to some extent. It was apparent that some form of radium solutions were involved, a portion of which had been disposed of in the backyard area. Parts of the backyard and the subsurface of the driveway were contaminated. In the house, some of the solutions had dripped from upper floors through the flooring, subflooring, and to the ceilings below. Spots of contamination were found on all floors and the basement of the residence. Contamination was found on carpeting, walls, floors, woodwork, and ceilings. Remedial action undertaken to remove the contamination ranged from scrubbing, to scraping, to shaving of wood, to removal and disposal of items and material that could not be adequately decontaminated. Outdoors, contaminated soil was removed from the backyard, and the driveway was dug up so the contaminated subsurface could be removed. Waste volumes generated by the remedial action included four 55-gallon drums and one M-III bin (120 cu ft) containing floor tile, concrete, personal items, furniture, floor scrapings, vermiculite absorbed scrub water, and other items. In addition, there were 24 M-III bins containing about 112 tons of contaminated soil and rock from the contaminated areas in the backyard and the subsurface of the driveway.

427

Solow, A.J., and D.R. Phoenix, Weston (Roy F.), Inc., West Chester, PA

Characterization Investigation Study - Volume 2: Chemical and Radiological Analysis of Waste Pits

FMPC/Sub-008 (Vol. 2); 422 pp. (1987, November)

The Feed Materials Production Center (FMPC) was constructed to produce high purity uranium metal for use at various Department of Energy facilities. The waste products from these operations include: general uncontaminated scrap and refuse; contaminated and uncontaminated metal scrap; waste oils; low-level radioactive waste, co-contaminated waste, mixed waste, and toxic waste; sludges from water treatment; and fly ash from the steam plant. This material has been stored in designated areas and is estimated to total more than 350,000 cubic meters. Most of the process waste is contained in pit nos. 1 through 6. Specific alternatives are being developed and evaluated for the final disposition of the wastes currently stored at the site. Selective investigations were conducted to characterize the material contained within the approximate 100-acre Waste Storage Area. This report presents the methodology used to sample and analyze the waste materials. A total of 790 samples was obtained for the various types of analyses. A portion of each sample was immediately sealed for volatile organic analysis for later compositing in the laboratory, a portion of each sample was saved for gamma ray spectral analysis, and a composite was made of samples from each borehole for nonvolatile chemical and radiochemical analysis. Chain-of-custody forms were completed for each sample.

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Solow, A.J., and D.R. Phoenix, Weston (Roy F.), Inc., West Chester, PA

Characterization Investigation Study - Volume 3: Radiological Survey of Surface Soils

FMPC/Sub-008 (Vol. 3); 372 pp. (1987, December)

The Feed Materials Production Center was constructed to produce high purity uranium metal for use at various Department of Energy facilities. The waste products from these operations include general uncontaminated scrap and refuse, contaminated and uncontaminated metal scrap, waste oils, low-level radioactive waste, co-contaminated wastes, mixed waste, toxic waste, sludges from water treatment, and fly ash from the steam plant.

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This material is estimated to total more than 350,000 cubic meters. Other wastes stored in this area include laboratory chemicals and other combustible materials in the burn pit; fine waste stream sediments in the clear well; fly ash and waste oils in the two fly ash areas; lime-alum sludges and boiler plant blowdown in the lime sludge ponds; and nonradioactive sanitary waste, construction rubble, and asbestos in the sanitary landfill. A systematic survey of the surface soils throughout the Waste Storage Area, associated on-site drainages, and the fly ash piles was conducted using a Field Instrument for Detecting Low-Energy Radiation (FIDLER). Uranium is the most prevalent radioactive element in surface soil; U-238 is the principal radionuclide, ranging from 2.2 to 1790 pCi/g in the general Waste Storage Area. The maximum values for activity concentrations in the same area were 972 pCi/g for Th-230 and 298 pCi/g for U-234. Activity concentrations of Th-230, as high as 3010 pCi/g, were found along the K-65 slurry line. U-238 had a value of 761 pCi/g in the drainage area just south of pit no. 5. The upper fly ash area had the highest radionuclide activity concentrations in surface soils with maximum values for U-238 of 8600 pCi/g, U-235 of 2190 pCi/g, U-234 of 11,400 pCi/g, Tc-99 of 594 pCi/g, Ra-226 of 279 pCi/g, and Th-230 of 164 pCi/g.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium Site, 12th and Quivas Properties, Colorado (Selected Remedial Action), September 1987

EPA/ROD/R08-87/013; 43 pp. (1987, September 29)

The decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 12th and Quivas properties, Operable Unit I of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium Site, Open Space Properties, Colorado (Selected Remedial Action), September 1987

EPA/ROD/R08-87/014; 61 pp. (1987, September 29)

This decision document presents the selected remedial actions for the properties included in Operable Units VI, IX, and XI of the Denver Radium Site, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the Open Space properties, Operable Units VI, IX, and XI of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial actions was based.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium Site, 11th and Umatilla Properties, Colorado (Selected Remedial Action), September 1987

EPA/ROD/R08-87/015; 46 pp. (1987, September 29)

The decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium Site, 1000 West Louisiana Properties, Colorado (Selected Remedial Action), September 1987

EPA/ROD/R08-87/017; 44 pp. (1987, September 29)

The decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 1000 West Louisiana properties, Operable Unit III of the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 3): Lansdowne Radiation Site, Lansdowne, Pennsylvania (Second Remedial Action), September 1986 - Final Report

PB-87-189-031; 21 pp. (1986, September 22)

The Lansdowne Radiation site consists of two attached residences located at 105/107 East Stratford Avenue, Lansdowne, Pennsylvania. The building is located in a residential area, approximately two miles from Philadelphia. The dwellings were contaminated with radium and other radionuclides between 1924 and 1944 as a result of refining radium and producing medical devices. A decontamination effort in 1964 consisted of removing as much radium as practical by sanding, scraping, vacuuming, and washing the house walls, floors and ceilings. Some concrete floor and wooden floor boards were also removed. It is postulated that the acid fumes from the radium purification procedure used, as well as spills, carried the radium contamination deep into the wood and plaster of

the home. The remedial action includes dismantling of the house. All radioactive materials above established permissible levels will be packed and sealed in approved containers, and disposed of at an approved off-site disposal facility; contaminated soil located in and around the house will be excavated and removed to established permissible levels. The sewer lateral leading from the contaminated house to Stratford Avenue will be removed and replaced. The capital cost has been estimated at \$4,000,000-\$4,500,000.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium/ROBCO, Colorado (Second Remedial Action), September 1986 - Final Report

PB-87-190-070; 38 pp. (1986, September 30)

The Denver Radium/ROBCO site is located on the site of the former National Radium Institute (NRI) facility, a private corporation operating between 1914 and 1920 which produced radium under an agreement with the U.S. Bureau of Mines. Research revealed the ROBCO property as one of thirty-one radioactive sites in the Denver metropolitan area. There is no serious public health risk at present from the radon gas and its decay products found on-site. However, since radium has a half-life of 1600 years, there is a long-term potential for increased public health risk if the radium-contaminated materials were misused or inadvertently spread. An EPA preferred alternative, full removal and permanent off-site disposal, is proposed but is very costly. Therefore, the EPA is actively pursuing a temporary off-site storage remedy.

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U.S. Environmental Protection Agency, Washington, DC

Superfund Record of Decision (EPA Region 8): Denver Radium/Card Corporation Property, Colorado (Third Remedial Action), June 1987 - Final Report

PB-88-126-461; 39 pp. (1987, June 30)

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The Denver Radium/Card Corporation property is a 17.2-acre site located in Denver, Colorado. In 1979, the U.S. Environmental Protection Agency (EPA) discovered a reference to the National Radium Institute in a 1916 U.S. Bureau of Mines report. Subsequent field research revealed the presence of thirty-one radioactive sites in the Denver Metropolitan area, one of these being Card property, the location of the original Pittsburgh Radium Company processing facility. The site consists of five buildings and an oil and waste water pond at the eastern boundary. There is no serious public health risk at present from radium or its decay products, most notably radon gas. However, there is the potential for increased public health risk if the radium contaminated materials are misused or inadvertently spread. Currently, radium has been detected in the soil, sediment, and underneath the True Truss building. EPA's preferred remedial action for the Card property is permanent off-site disposal. However, the alternative can not be implemented until a suitable off-site facility is designated.

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U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Industrial and Medical Nuclear Safety, Washington, DC

Radioactive Material in the West Lake Landfill

NUREG-1308; 16 pp. (1988, April)

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for disposal of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. This report summarizes the circumstances of the radioactive material found in the West Lake Landfill. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material.

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U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management, Washington, DC

Draft Supplement to the Final Environmental Statement Related to the Decommissioning of the Rare Earths Facility, West Chicago, Illinois

NUREG-0904 (Suppl. 1); DOCKET 40-2061 (1987, June)

This Draft Supplemental Environmental Statement (DSES) assesses the impacts of permanent disposal of wastes located at the Kerr-McGee Rare Earths Facility in West Chicago, Illinois. The assessments presented in the DSES augment and update those described in the Final Environmental Statement (FES) that was issued by the U.S. Nuclear Regulatory Commission (NRC) in May 1983. In this DSES, additional alternative sites are analyzed, the analysis is more detailed, and the NRC expressly considers the suitability of these sites for permanent waste disposal. The analysis describes the Proposed Action, which is permanent disposal of the wastes in an above-grade disposal cell at the West Chicago site, and four alternatives for permanent disposal at other sites in Illinois. The four alternatives are: Alternative A, disposal at an active surface coal mine in a deep-trench disposal cell; Alternative B, disposal in a reclaimed surface coal mine in a deep-trench disposal cell; Alternative C, disposal in an underground coal mine in a worked-out panel; and Alternative D, disposal on a farmland site in a partially above-grade disposal cell. The environmental issues considered in the impact assessment are topography, air quality, socioeconomics, land resources, archeology, mineral resources, water resources, ecology and radiation exposure. A cost-benefit analysis of the Proposed Action and its alternatives is also presented. Based on the information and analysis given within this DSES, the NRC concluded that the Proposed Action is the preferred action of course.

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U.S. Nuclear Regulatory Commission, Washington, DC

Radioactive Material in the West Lake Landfill - Summary Report

NUREG-1308 (Rev. 1); 21 pp. (1988, June)

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for the disposal of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. This report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from uranium ore processing activities and the subsequent sale of the processing residues by the Atomic Energy

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Commission. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is necessary.

URANIUM MILL TAILINGS REMEDIAL ACTION 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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Dubois, D., and K.S. Scotti, Jacobs Engineering Group, Inc., Albuquerque, NM; UNC Geotech Inc., Grand Junction, CO

Working with the Public

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 1, 550 pp.; (pp. II.132-II.144) (1987)

This paper discusses the public and community relations programs associated with the U.S. Department of Energy Uranium Mill Tailings Remedial Action Project processing sites and vicinity properties. Emphasis is placed on the importance of early establishment of clear-cut public relations policies, early dissemination of information, and use of public relations professionals to monitor and coordinate public response to cleanup activities. Case studies of three processing site and vicinity property communities are presented.

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Gilbert, R.O., M.L. Miller, and H.R. Meyer, Pacific Northwest Laboratory, Richland, WA; Weston (Roy F.), Inc., Albuquerque, NM; Chem-Nuclear Systems, Inc., Albuquerque, NM

On the Design of a Sampling Plan to Verify Compliance with EPA Standards for Radium-226 in Soil at Uranium Mill Tailings Remedial Action Sites

PNL-SA-15256; CONF-8710245; Proceedings of the ASA/EPA Conference on Compliance Sampling, Washington, DC, October 5, 1987; (35 pp.) (1987, September)

This paper discusses design aspects of a two-stage compliance sampling program which is being developed to verify that removal of soil at windblown uranium mill tailings sites results in Ra-226 concentrations that meet Environmental Protection Agency (EPA) standards. In the first stage, gamma scans of surface soil would be conducted over the entire remediated area. This scan would be accomplished through the use of a tractor-mounted gamma-ray counting system (RTRAK) to measure Bismuth-214 (an indicator of Ra-226 in soil). In the second

stage, composite soil samples would be collected from a systematic sampling grid of 10-m by 10-m plots. The number of plots is determined using a compliance acceptance sampling plan. These soil samples are analyzed for Ra-226 and compared with the EPA standard of 5 pCi/g above background to determine their regulatory status.

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Hazle, A.J., Colorado Department of Health, Radiation and Hazardous Wastes Control Division, Denver, CO

Comments on Rn Emanation from Natural Deposits of U and Remedial Actions

Health Physics 53(1):93 (1987, July)

A letter is presented which corrects several recent publications that improperly reported the remedial action levels required by the State of Colorado with respect to uranium mill tailings.

442

Nelson, R.A., K.R. Baker, R.P. Schoenfelder, and P.W. Zelle, Jacobs Engineering Group, Inc., Albuquerque, NM; Weston (Roy F.), Inc., Albuquerque, NM

Soil Excavation Criteria for Use at the UMTRA Project Site in Canonsburg, PA

Health Physics 47(1):139-140 (1984)

Work is presently underway at the Uranium Mill Tailings Remedial Action (UMTRA) Project site in Canonsburg, Pennsylvania. The major portion of the residual contamination from the processing site is being excavated and recontoured for encapsulation on the site. Most of the remaining excavation is being covered with approximately two feet of uncontaminated soil for radon control and stabilization purposes. Portions of the site are also being decontaminated to meet the EPA standards for unrestricted use. The application of these multiple excavation criteria across the site complicates the remedial action. The criteria and monitoring procedures for excavating the soils to achieve the remedial action are further complicated by the varying and sometimes high Th-230 to Ra-226 concentration ratios. Average Th-230 to Ra-226 ratios for various portions of

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the site range from 0.9 to 11.0. Site characterization data were used to develop excavation criteria, based on the ingrowth of Ra-226 from the decay of Th-230 over the next 1000 years. Site characterization data and the various soil excavation criteria will be presented.

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Reith, C.C., H.R. Meyer, and J.E. Till, Jacobs Engineering Group, Inc., Albuquerque, NM; Chem-Nuclear Systems, Inc., Albuquerque, NM; Radiological Assessments Corporation, Neeses, SC

DECHEM: A Program for Characterizing and Mitigating Chemical Contamination Associated with Uranium Mill Tailings

Proceedings of the Oak Ridge National Laboratory Technical Workshop, Oak Ridge, Tennessee, June 21, 1988; (11 pp.) (1988, June 21)

Remedial investigations have indicated that waste composition at contaminated sites is frequently complex, with radioactive and hazardous chemical wastes occurring in close association. It is important in such cases that the full range of potential hazards be addressed during remedial planning, because the mitigation of one type of hazard may not assure that a site is being cleaned up of all hazards. This paper describes an approach to the combined hazards of radioactivity and chemical contamination at inactive uranium mill tailings sites, where potentially toxic metals and metalloids occur in close association with radionuclides such as uranium, radium, and thorium. A program, called DECHEMA (for DEcontamination of CHEMicals), will add a new dimension to site characterization and remedial planning that addresses the potential nonradiological hazards at each mill tailings site. The principal activities in the development of the DECHEMA procedure are: (1) regulatory analysis, (2) toxicology review, (3) site characterization, (4) database development, (5) DECHEMA code development, and (6) trial implementation. At the heart of the procedure is a pathway analysis model for determining the acceptable residual levels of chemical contaminants that may remain in the soil after a tailings pile has been relocated. The DECHEMA program is being developed for the Uranium Mill Tailings Remedial Action (UMTRA) project, although it has elements of potential utility at any site where radioactive and hazardous chemical wastes occur in close association.

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Thomas, L.M., U.S. Environmental Protection Agency, Washington, DC

Standards for Remedial Actions at Inactive Uranium Processing Sites (40 CFR Part 192)

Federal Register 52(185):36000-36008 (1987, September 24)

The Environmental Protection Agency is proposing health and environmental regulations to correct and prevent contamination of groundwater beneath and in the vicinity of inactive uranium sites by uranium tailings. EPA issued regulations (40 CFR Part 192 Subparts A,B,C) for cleanup and disposal of tailings from these sites on January 5, 1983. These new regulations would replace existing provisions at 40 CFR 192.20(a)(2) and (3) that were remanded by the Tenth Circuit Court of Appeals on September 3, 1985. They are proposed pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2002), as amended by Section 206 of the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604, [UMTRCA]). The regulations would apply to tailings at the 24 locations that qualify for remedial actions under Title I of Public Law 95-604. They provide that tailings must be stabilized and controlled in a manner that permanently eliminates or minimizes contamination of groundwater beneath stabilized tailings so as to protect human health and the environment. They also provide for cleanup of contamination that existed before the tailings are stabilized.

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Timm, C.M., Jacobs Engineering Group, Inc., Albuquerque, NM

Design of Radioactive Tailings Disposal Sites to Last 1,000 Years

EPA/600/9-85-025; New Frontiers for Hazardous Waste Management, Proceedings of an International Conference, Pittsburgh, PA, September 15, 1985; (pp. 441-449) (1985)

Cleanup and stabilization is currently being conducted by the Department of Energy at 24 inactive uranium mill sites. These sites contain as much as 3,000,000 cubic yards of radioactive tailings and other contaminated

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materials. The majority were built on the banks of, or very close to, rivers so that most of the tailings piles are in floodplains and are vulnerable to flood erosion. Another common problem is groundwater contamination. This paper discusses the selection of design criteria sufficiently conservative to assure a high probability that the embankment will last 1,000 years or more essentially intact. Among the criteria utilized in the designs are the application of Maximum Credible Earthquake, Probable Maximum Precipitation, Probable Maximum Flood to the location, and configuration of the proposed disposal site.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meetings on Tailings Cleanup at Falls City

DOE News (871016):1 (1987, October 16)

The U.S. Department of Energy (DOE) held a public meeting in Falls City, Texas, November 5, 1987, to discuss plans for eventual cleanup of the old Susquehanna Western uranium processing site near Falls City. Representatives from DOE's Uranium Mill Tailings Remedial Action Project (UMTRAP) Office in Albuquerque, New Mexico, Jacobs Engineering Group Inc. (Technical Assistance contractor to DOE), and the Texas Department of Health presented updated plans, schedules and a progress report regarding the cleanup activities. The U.S. Congress has authorized DOE to clean up 24 inactive uranium mill tailings sites nationwide including the site near Falls City. The DOE's UMTRAP Office in Albuquerque will carry out the remedial actions.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Tailings Cleanup at Gunnison

DOE News (871028):1 (1987, October 28)

The U.S. Department of Energy (DOE), in cooperation with the State of Colorado, held a public meeting in Gunnison, Colorado, November 12, 1987, to present progress

on the alternate uranium tailings site selection process. For several months prior to the meeting, DOE had been conducting a drilling program at five locations outside Gunnison to determine a suitable site to accept the tailings should relocation be necessary. Results from the drilling effort were made available at the meeting. The meeting also served as an informal public scoping session for production by DOE of an Environmental Assessment (EA). The scoping session was intended to provide citizens with the opportunity to present issues of local concern for analysis in the EA. Cleanup of the inactive uranium mill tailings site in Gunnison is being conducted under the DOE's Uranium Mill Tailings Remedial Action Project.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Reviewing Mesa County Conditional Use Permit Resolution

DOE News (880404):1-2 (1988, April 4)

The U.S. Department of Energy (DOE) is reviewing the resolution of the Mesa County Board of Commissioners regarding a Conditional Use Permit application for permanent disposal of the Grand Junction tailings under the Uranium Mill Tailings Remedial Action (UMTRA) Project. The permit application presented the DOE's plan for stabilizing the Grand Junction tailings at the Cheney Reservoir disposal site located in Mesa County, 18 miles southeast of Grand Junction. Two options for tailings transport were proposed. The Commissioners approved use of the Cheney Reservoir disposal site for permanent disposal of the tailings. Transportation of the tailings to the Cheney site using a combination train/truck option was also approved. Use of trucks only to transport the tailings was denied. Approval was requested for either transportation method to enable selection of the most cost-effective approach through a competitive procurement process. During the permit review process, the DOE recommended mitigation measures for both the rail/truck and truck only transport options and deemed both to be technically viable, environmentally sound, and safe. Under Public Law 95-604, DOE is obligated to select the most cost-effective approach to tailings cleanup. Federal budget constraints initiated under the Gramm-Rudman-Hollings amendments have resulted in increasing pressure to control costs on the \$960 million UMTRA Project. The UMTRA Project at Grand Junction

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tion is being administered by the DOE's Albuquerque, New Mexico UMTRA Project Office in cooperation with the State of Colorado.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Tailings Cleanup at Falls City

DOE News (880525):1 (1988, May 25)

Representatives from the U.S. Department of Energy (DOE), Jacobs Engineering Group Inc. (Technical Assistance Contractor to DOE), and the Texas Department of Health will hold a public meeting in Falls City, Texas on June 1, 1988. Updated plans, schedule, and a progress report on the remedial action for the former Susquehanna Western uranium processing site near Falls City will be presented. The DOE's UMTRA Project Office in Albuquerque, New Mexico will carry out the remedial actions.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Remedial Actions at the Former Union Carbide Corporation Uranium Mill Sites, Rifle, Garfield County, Colorado

DOE/EIS-0132-D; EIS-87-0207 (Draft) (1987, May)

Cleanup of the contaminated materials at the mill sites and associated vicinity properties at Rifle in Garfield County, Colorado, is proposed. The Rifle tailings sites consist of the separate Old and New Rifle tailings sites. Together, the Old and New Rifle sites cover 164 acres of private land and contain approximately 3.5 million cubic yards of tailings and associated contaminated soils. The tailings were produced by the Union Carbide Corporation when it processed vanadium and uranium ores from 1924 to 1932 and from 1942 to 1973. If the tailings are properly stabilized, erosion or human removal of the contaminated materials cannot spread the contamination over a much wider area and increase potential public health hazards. Approximately 164 acres of land would

be released for other uses. Primary impacts of the preferred alternative would be the temporary exceeding of federal and state air quality standards; disturbance of residents-near and between the Rifle, Estes Gulch, and borrow sites during the daytime from noise generated by construction and transportation activities; and increased traffic on U.S. Highway 6 and State Highway 13, with associated increases in accidents, congestion, and highway maintenance.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Finding of No Significant Impact and Floodplain Statement of Findings of the Remedial Action at the Green River Uranium Mill Tailings Site, Green River, Utah

Billing Code 6450.01; 17 pp. (1988, July)

The U.S. Department of Energy (DOE) has prepared an environmental assessment (EA) (DOE/EA-0343) on the proposed remedial action at the inactive uranium mill tailings site near Green River, Utah. Based on the analyses in the EA, DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment, as defined by the National Environmental Policy Act (NEPA) of 1969. Therefore, the preparation of an environmental impact statement (EIS) is not required. DOE has also prepared a Floodplain Assessment as part of the EA. Under authority granted by the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, DOE proposes to clean up the residual radioactive wastes and other contaminated materials at the inactive uranium mill tailings site located at Green River, Utah. The proposed action will move and stabilize the radioactive wastes according to a plan to be determined by the U.S. Nuclear Regulatory Commission (NRC) and the State of Utah.

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U.S. Department of Energy, Washington, DC

Final Decision on Inclusion of a Private Property Near Naturita, Colorado, for Remedial Action Under the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604)

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DESIGN, PLANNING, AND REGULATIONS

Federal Register 53(138):27332-27334 (1988, July 19)

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) authorized the U.S. Department of Energy (DOE) to conduct, in cooperation with interested states, Indian Tribes, and persons who own or control certain inactive mill tailings sites, a program of assessment and remedial action to stabilize and control the tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards at these sites and at nearby vicinity properties. DOE has been requested by Hecla Mining Company to include Hecla's Durita property as a designated property for remedial action under the Act. The Durita property is located approximately nine miles west of Naturita off Colorado Highway 90S. After consideration, DOE has decided that the Durita property is not a proper candidate for inclusion in the remedial action program under UMTRCA.

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U.S. Department of Energy, Washington, DC

Uranium Mill Tailings, Naturita, Colorado

Federal Register 53(48):7964 (1988, March 11)

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) authorized the U.S. Department of Energy (DOE) to conduct, in cooperation with interested states, Indian Tribes, and persons who own or control certain inactive mill tailings sites, a program of assessment and remedial action to stabilize and control the tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards at these sites and at nearby vicinity properties. DOE has been requested by Hecla Mining Company to include Hecla's Durita property as a designated property for remedial action under the Act. The Durita property is located approximately nine miles west of Naturita off Colorado Highway 90S. This advance notice is to alert interested parties that DOE will be soliciting the views of interested parties on its proposed decision regarding the inclusion of the Durita property within 30 days.

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U.S. Department of Energy, Washington, DC

Proposed Decision on Inclusion of a Private Property Near Naturita, Colorado, for Remedial Action Under the Uranium Mill Tailings Radiation Control Act of 1978

Federal Register 53(82):15273-15274 (1988, April 28)

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) authorized the U.S. Department of Energy (DOE) to conduct, in cooperation with interested states, Indian Tribes, and persons who own or control certain inactive mill tailings sites, a program of assessment and remedial action to stabilize and control the tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards at these sites and at nearby vicinity properties. DOE has been requested by Hecla Mining Company to include Hecla's Durita property as a designated property for remedial action under the Act. The Durita property is located approximately nine miles west of Naturita off Colorado Highway 90S. DOE proposed not to include Durita property as either a production site or vicinity property for the purposes of remedial action under UMTRCA. The purpose of this notice is to solicit comments on this proposed decision.

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U.S. Nuclear Regulatory Commission, Low-Level Waste and Uranium Recovery Branch, Washington, DC

Staff Technical Position on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailing Sites

WM-39/DCG/85/5/23/0 (Rev. 1) (1987, March)

Title I of the Uranium Mill Tailings Radiation Control Act of 1978, as amended (UMTRCA), requires the Nuclear Regulatory Commission (NRC) to concur in with the U.S. Department of Energy's selection and performance of remedial actions at inactive uranium mill tailings sites. The NRC provides reviews, concurrences, and licensing actions during the remedial process. Among the specific technical aspects of the remedial action performance is field control, including testing and inspection. This staff technical position describes the engineering practices, testing, inspection, record keep-

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ing, nonconformance corrective action, and "stop work order" controls considered satisfactory for the implementation of remedial action programs. These criteria reflect the approaches and state-of-the-art methods that are considered to be adequate to protect public health

and safety, and as such to be acceptable to the NRC staff. If alternative methods are proposed, they will be considered on a case-by-case basis.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

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Berven, B.A., M.S. Blair, and C.A. Little, Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN; Oak Ridge National Laboratory, Instrumentation and Controls Division, Oak Ridge, TN

Automation of the Radiological Survey Process: USRADS Ultrasonic Ranging and Data System

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.129-V.134) (1987)

The Radiological Survey Activities (RSA) program at Oak Ridge National Laboratory serves as the Inclusion Survey Contractor (ISC) in the U.S. Department of Energy's Uranium Mill Tailings Remedial Action project. The ISC is required to identify properties in the vicinity of 24 inactive uranium mill sites where presence of uranium mill tailings is suspected. These tailings are the by-products of uranium ore processing, and they contain radium-226. Mobile gamma scanning is the primary method used to identify the vicinity properties. Once identified, the ISC conducts an inclusion survey on the property. The objective of this survey is to perform sufficient radiological measurements to determine if uranium mill tailing contamination is present, and if so, if it exceeds relevant U.S. Environmental Protection Agency (EPA) criteria. Radon gas emanating from Ra-226 is the primary component of exposure to human occupants at these sites. EPA criteria focus on controlling Ra-226 concentrations in soil. The concentration of Ra-226 in soil can be measured directly by soil sampling and subsequent gamma spectrometric analysis of the sample, or can be estimated by direct measurement of the gamma exposure rate at the soil surface using portable instrumentation in the field. In both methods, the concentration of Ra-226 is inferred by examining the frequency of gamma emissions of Bi-214/Pb-214, radioactive decay products in the U-238 decay chain.

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Caldwell, J.A., and A.M. Robertson, Jacobs Engineering Group, Inc., Albuquerque, NM; Steffen, Robertson and Kirsten, Inc., Vancouver, British Columbia, Canada

An Evaluation of Geotechnical and Hydrologic Aspects of Uranium Mill Tailings Reclamation in the USA and Canada

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 833 pp.; (pp. 145-150) (1987)

Reclamation of inactive uranium mill tailings piles in the United States is currently in progress as part of a federal remedial action program. Remediation is done according to standards established by the Environmental Protection Agency (EPA). Implementing the standards involves relocating the piles, if necessary, to suitable sites, and covering them with a radon and infiltration control barrier and erosion resistant rock. A recent study in Canada defines appropriate approaches to stabilize Canadian inactive uranium mill tailings piles. There are no legal standards governing such work in Canada. Generally the Canadian approach involves reduction of steep slopes, water control, sometimes a cover, and the establishment of a stable vegetative cover. Differences of approach to remediation in the two countries reflect the differences in climate, population densities, vegetation, and the regulatory framework in each country. A recent evaluation of a less conservative approach to remedial action in the U.S. indicates that considerably increased probabilities of failure of the remediation need to be accepted before a significant cost savings can be affected. Therefore, the more conservative U.S. approach is generally reasonable and justifiable.

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Gilbert, R.O., H.R. Meyer, M.L. Miller, and C. Begley, Pacific Northwest Laboratory, Richland, WA

Estimating Calibration Equations for Predicting Ra-226 Soil Concentrations Using RTRAK In-Situ Detectors at the Ambrosia Lake, New Mexico, UMTRA Site

PNL-6555; 34 pp. (1988, June)

This report describes a field study conducted at the Ambrosia Lake, New Mexico, UMTRA site to obtain data for calibrating the RTRAK Sodium Iodide (NaI) detectors for estimating concentrations of Ra-226 in sur-

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face soil. The statistical analyses indicate that the data are useful for estimating the calibration equations. Several statistical models are used to evaluate which model is best as a basis for the calibration equations. A procedure is provided for using the estimated calibration equations and extensive RTRAK measurements to estimate the average Ra-226 concentrations on 100 sq m land areas to determine whether additional remedial action is needed. The UMTRA Project office proposes to use the RTRAK for cleanup verification of surface Ra-226 contamination. The system enables 100% coverage of areas having undergone remedial action. The sensitivity of the system enables verification at less than 5 pCi/g averaged over 100 sq m, as specified by the Environmental Protection Agency (EPA) standards (40 CFR Part 192). This analysis demonstrates RTRAK's ability to meet reasonable standards of statistical accuracy, using commonly accepted procedures.

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Gilbert, R.O., R.H. Miller, K.R. Baker, M.L. Miller, and R.A. Nelson, Pacific Northwest Laboratory, Richland, WA

Sampling Errors Associated with Soil Composites Used to Estimate Mean Ra-226 Concentrations at an UMTRA Remedial Action Site

PNL-6262; 63 pp. (1987, July)

The decision of whether to take additional remedial action on regions contaminated by uranium mill tailings involves collecting 20 plugs of soil from each 10-m by 10-m plot in the region and analyzing a 500-g portion of the mixed soil for Ra-226. Due to the high cost of collecting 20 soil plugs in each plot, a soil sampling study was conducted in the windblown mill-tailings flood plain area at Shiprock, New Mexico, to evaluate whether reducing the number of soil plugs to 9 would have any appreciable impact on remedial action decisions. The results of the Shiprock study are described and used in this paper to develop a simple model of the standard deviation of Ra-226 measurements on composite samples formed from 21 or fewer plugs. This model is then used to predict as a function of the number of soil plugs per composite: (1) the percent accuracy with which the mean Ra-226 concentration in surface soil can be estimated; and (2) the probability of making incorrect remedial action decisions on the basis of statistical tests.

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Little, C.A., B.A. Berven, M.S. Blair, K.S. Dickerson, and D.A. Pickering, Oak Ridge National Laboratory, Oak Ridge, TN

The Ultrasonic Ranging and Data System for Radiological Surveys in the UMTRA [Uranium Mill Tailings Remedial Action] Project

CONF-880568; Nuclear Facility Decommissioning: Environmental Effects of Decommissioning Nuclear Facilities, Proceedings of a Conference, Nashville, TN, May 9, 1988; (10 pp.) (1988)

The Ultrasonic Ranging and Data System (USRADS) was developed to allow radiation exposure data and positional information to be collected, stored, and analyzed in a more efficient manner than currently employed on the Uranium Mill Tailings Remedial Action (UMTRA) project. USRADS is a portable unit which employs ultrasonics, radio frequency transmissions, and a personal computer. Operational experience indicates that the system results in increased information about the property with decreased data analysis and transcription effort and only slightly more field effort.

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Meyer, H.R., C. Begley, and C. Daily, Chem-Nuclear Systems, Inc., Albuquerque, NM; MK-Ferguson Company, St. Charles, MO

Field Instruments Developed for Radiation Measurements on the UMTRA Project

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 2 - High-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 603 pp.; (pp. 585-589) (1987)

The Uranium Mill Tailings Remedial Action Project (UMTRAP) requires cost-effective field instrumentation to implement standards under diverse conditions at 24 different sites. Numerous formal U.S. Department of Energy (DOE) audits are performed annually to ensure that these requirements are met. Chem-Nuclear Systems, Inc. (CNSI) and MK-Ferguson Company

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(MK-FC) have responded by developing or adapting unique systems for rapid and auditable analysis of Ra-226, Th-230 and other radionuclides, under difficult field conditions. The resulting calibrated and traceable field measurements (backed by DOE-prescribed, independent vendor quality control analysis), have been accepted by federal, state and tribal authorities for official certification of UMTRAP results. The instruments developed include: (1) the opposed crystal system, a semi-portable, shielded, high-efficiency gamma spectrometer which was developed at Argonne National Laboratory and modified by CNSI/MK-FC with assistance from the DOE and the Jacobs-Weston UMTRAP team; (2) MK-FC's Delta System, a portable, interference-correlated scintillation counter; and (3) the field analysis system for Th-230 (FAST), a gross-alpha counting system. Under development are additional systems to improve UMTRAP data collection efficiency and accuracy, while reducing costs. The results of application of these devices are summarized in this paper. The results demonstrate that UMTRAP standards can be accurately verified through the use of these devices. Some 10,000 certification-quality measurements have been made to date at completed UMTRAP sites, using this equipment.

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Nelson, R.A., Jacobs Engineering Group, Inc., Albuquerque, NM

Measurement Uncertainties of Long-Term Rn-222 Averages at Environmental Levels Using Alpha Track Detectors

Health Physics 53(5):447-453 (1987, November)

More than 250 replicate measurements of outdoor Rn concentrations integrated over quarterly periods were made to estimate the random component of the measurement uncertainty of Track Etch detectors (type F) under outdoor conditions. The measurements were performed around three uranium mill tailings piles to provide a range of environmental concentrations. The measurement uncertainty was typically greater than could be accounted for by Poisson counting statistics. Average coefficients of variation on the order of 20% for all measured concentrations were found. It is concluded that alpha track detectors can be successfully used to determine annual average outdoor Rn concentrations through the use of careful quality control procedures. These include rapid deployment and collection of detectors and careful and secure mounting of all detectors in as similar

a manner as possible. The use of multiple (at least duplicate) detectors at each monitoring location and an exposure period of no less than one quarter are suggested.

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Smuin, D.R., M.J. Wilson, and J.W. Crutcher, Oak Ridge National Laboratory, Grand Junction Office, Grand Junction, CO

Investigation of Background Radiation and Associated Anomalies in Rifle, Colorado

ORNL/TM-10592; 63 pp. (1988, February)

Oak Ridge National Laboratory (ORNL) assisted the Department of Energy as the Inclusion Survey Contractor (ISC) for the Uranium Mill Tailings Remedial Action (UMTRA) Project at Rifle, Colorado. In determining the background gamma exposure rate range versus elevated gamma exposure rates due to the presence of uranium mill tailings, several anomalies were encountered. The combination of the Wasatch Formation, radioactive coal clinkers, and windblown tailings accounts for many of the anomalous gamma exposure rates observed by the radiological survey teams. The Wasatch Formation outcrops extensively in the Rifle area. Varying potassium concentrations and naturally occurring uranium in the rock unit result in fluctuating gamma exposure rates and thus influence background radiation. Radioactive coal clinkers were used as fill material throughout the Rifle region and have been determined to be a product of the mill and subject to remediation. Mill tailings redistributed from the Rifle uranium mill tailings piles by prevailing winds were detected extensively on vicinity properties in Rifle. The study also presents a formula to convert thousand counts per minute from a gamma scintillator to microrentgen per hour for the Rifle region. Examining Ra/Th ratios from laboratory analysis of soil samples or use of Ra/Th ratios from GR-410 gamma spectrometer readings on-site allows discrimination between mill-related contamination and naturally occurring radioactivity. This method is suggested to be applied to all property surveys in the Rifle area.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

DOE Releases Environmental Assessment on Remedial Actions for Ambrosia Lake Site

DOE News (870714):1 (1987, July 14)

The U.S. Department of Energy (DOE) has published and distributed an Environmental Assessment regarding remedial actions on the Phillips/United Nuclear uranium mill tailings site located near Ambrosia Lake, New Mexico. A brief summary of the Environmental Assessment is provided in this document. Cleanup of the Ambrosia Lake tailings site is being conducted as part of the DOE Uranium Mill Tailings Remedial Action Project. The Ambrosia Lake Environmental Assessment and the Finding of No Significant Impact were published on July 13, 1987. The Finding of No Significant Impact documents the DOE remedial action decision and states that the environmental impacts of the project do not warrant preparation of an Environmental Impact Statement.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Releases Environmental Assessment on Remedial Actions for Mexican Hat Site

DOE News (871103):1 (1987, November 3)

DOE has published and distributed an Environmental Assessment regarding remedial actions at the inactive uranium mill tailings site located near Mexican Hat, Utah at the Navajo Nation community of Halchita. The Environmental Assessment outlines the various options that are considered for disposal of the residual radioactive material and discusses the environmental consequences of the DOE's preferred option. That option is to stabilize the tailings at their present location by consolidating the tailings and associated contaminated materials into a recontoured pile. A compacted soil 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. Cleanup of the Mexican Hat tailings site is being conducted under DOE's UMTRAP program. The Mexican Hat Environmental Assessment and the Finding of No Significant Impact were published on November 2, 1987. The Finding of No Significant Impact documents the DOE remedial action decision and states that the environmental impacts of the project do not warrant preparation of an Environmental Impact Statement.

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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 Mexican Hat Uranium Mill Tailings Site, Mexican Hat, Utah

DOE/EA-0332; 275 pp. (1987, October)

This document assesses the environmental impacts of the proposed remedial action at the Mexican Hat uranium mill tailings site located on the Navajo Reservation in southern Utah. The site covers 235 acres and contains 69 acres of tailings and several of the original mill structures. Remedial action must be performed in accordance with standards and with the concurrence of the U.S. Nuclear Regulatory Commission and the Navajo Nation. The proposed action is to stabilize the tailings within the present site by consolidating them and associated contaminated soils into a recontoured pile. A radon barrier of compacted earth would be constructed over the pile, and various erosion control measures would be taken to assure the long-term stability of the pile. The no action alternative is also assessed in this document.

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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 Green River Uranium Mill Tailings Site - Green River, Utah

DOE/EA-0343; 565 pp. (1988, July)

The inactive Green River uranium mill tailings site is one mile southeast of Green River, Utah. The existing tailings pile is within the floodplain boundaries of the 100-year and 500-year flood events. The 48-acre designated site contains eight acres of tailings, the mill yard and ore storage area, four main buildings, a water tower, and several small buildings. Dispersion of the tailings has contaminated an additional 24 acres surrounding the designated site. The proposed action is to relocate the tailings and associated contaminated materials to an area 600 feet south of the existing tailings pile where they would be consolidated into one, below-grade disposal cell. A radon infiltration barrier would be constructed to

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cover the stabilized pile and various erosion control measures would be taken to ensure its long-term stability. The environmental impacts presented in this environmental assessment are for the proposed action, no action, and stabilization in place alternatives. The assessment has demonstrated that the proposed action would not significantly affect the quality of the human environment and would be performed in compliance with applicable environmental laws. No action would not be consistent with the intent of Public Law 95-604 and would not result in compliance with EPA standards. Although the impacts associated with the stabilization in place alternative are similar to those associated with the proposed action, additional construction requirements would be needed to protect the disposal cell from flooding, thereby adding to the costs.

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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 (FONSI), Remedial Action at the Mexican Hat Uranium Mill Tailings Site, Mexican Hat, Utah

Federal Register 52(216):43098-43100 (1987, September 18; 1987, November 9)

The U.S. Department of Energy (DOE) has prepared an environmental assessment (EA) on the proposed remedial action at the inactive uranium milling site in Mexican Hat, Utah. Based on the analyses in the EA, DOE has determined that the proposed action does not significantly affect 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 is not required.

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U.S. Department of Energy, Washington, DC

Preliminary Cleanup Activities at Vicinity Properties Near Salt Lake City, Utah: Environmental Assessment

DOE/EA-0186; 53 pp. (1982, August)

This document describes the preliminary cleanup activities and their impacts for approximately 100 properties in Salt Lake Valley that have been contaminated by radioactive tailings from the site of the inactive Vitro uranium mill. The 23 properties already included on the official list for cleanup have been used as the basis for estimating impacts at all 100 sites.

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U.S. Department of Energy, Washington, DC

Floodplain and Wetland Involvement Notification for Remedial Action at Various Inactive Uranium Mill Tailings Sites

Federal Register 53(33):5033-5034 (1988)

The U.S. Department of Energy (DOE) proposes to conduct remedial actions involving the stabilization and control of uranium mill tailings at various sites located in Colorado, Idaho, North Dakota, Texas, and Utah. Remedial actions must comply with the standards promulgated by the Environmental Protection Agency (40 CFR 192) as required by the Uranium Mill Tailings Radiation Control Act of 1978 (Public Law 95-604). Remedial actions would involve the removal of tailings, contaminated soils, and/or vegetation from floodplains for the sites located in Maybell, Slick Rock and Naturita, Colorado; Lowman, Idaho; Belfield, North Dakota; and Green River, Utah; and from wetlands for the sites located in Bowman, North Dakota and Falls City, Texas. In accordance with DOE regulations for compliance with floodplain/wetland environmental review requirements (10 CFR Part 1022), DOE will prepare a floodplain or wetland assessment for each site, to be incorporated in the environmental assessment of these proposed sites. Any comments should be made on or before March 7, 1988.

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U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Groundwater Protection Standards for Inactive Uranium-Tailings Sites: Background Information for Proposed Rule - Final report

PR-87-226-767; 266 pp. (1987, July)

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

The report summarizes the information and data considered by EPA in developing the proposed groundwater protection standards. It gives a description of the 24 designated uranium tailings sites and their current status in the DOE remedial action program. It also presents a detailed analysis of the available data on the groundwater in the vicinity of 12 of the 24 sites and describes different methods that can be used for the restoration of groundwater.

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Voigt, W.R., Jr., U.S. Department of Energy, Office of the Assistant Secretary for Nuclear Energy, Washington, DC

Availability of Environmental Assessment and Finding of No Significant Impact: Remedial Action at the Inactive Riverton Uranium Mill Tailings Site, Riverton, Wyoming

Federal Register 52(132):26065-26066 (1987, July 10)

The U.S. Department of Energy (DOE) has published an Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming (DOE/EA-0254), for the proposed remedial action for residual radioactive materials at the inactive uranium mill site near Riverton, Wyoming. On the basis of the analyses in the EA, the DOE has made a Finding of No Significant Impact.

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Voigt, W.R., Jr., U.S. Department of Energy, Office of the Assistant Secretary for Nuclear Energy, Washington, DC

Availability of Environmental Assessment and Finding of No Significant Impact: Remedial Action at the Ambrosia Lake Uranium Mill Tailings Site, Ambrosia Lake, New Mexico

Federal Register 52(135):26549-26550 (1987, July 15)

The U.S. Department of Energy (DOE) has published an Environmental Assessment (EA) of Remedial Action at

the Ambrosia Lake Uranium Mill Tailings Site, Ambrosia Lake, New Mexico (DOE/EA-0322), for the proposed remedial action on residual radioactive materials at the inactive United Nuclear uranium mill site near Ambrosia Lake, New Mexico. On the basis of the analysis 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 and has issued a finding of no significant impact (FONSI). The EA is available for public review.

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Voigt, W.R., Jr., U.S. Department of Energy, Office of the Assistant Secretary for Nuclear Energy, Washington, DC

Availability of Environmental Assessment and Finding of No Significant Impact: Remedial Action at the Mexican Hat Uranium Mill Tailings Site, Mexican Hat, UT

Federal Register 52(216):43100-43101 (1987, November 9)

The U.S. Department of Energy (DOE) has published an Environmental Assessment (EA) of Remedial Action at the Mexican Hat Uranium Mill Tailings Site, Mexican Hat, Utah (DOE-EA-0332) for the proposed remedial action on residual radioactive materials at the inactive mill site. On the basis of the analysis 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 and has issued a Finding of No Significant Impact (FONSI). The EA is available for public review.

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Williams, L.R., R.W. Leggett, M.L. Espegren, and C.A. Little, Indiana University at South Bend, South Bend, IN; Oak Ridge National Laboratory, Grand Junction Office, Grand Junction, CO; Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Optimization of Sampling for the Determination of the Mean Radium-226 Concentration in Surface Soil

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM ENVIRONMENTAL STUDIES AND SITE SURVEYS

ORNL/TM-10255; 40 pp. (1987, August)

The authors discuss the results of a field experiment designed to help identify an optimal method for determination of compliance with the U.S. Environmental Protection Agency's Ra-226 guidelines for soil. The primary goals of the study were: (1) to establish practical levels of accuracy and precision that can be obtained in estimating the mean Ra-226 concentration of surface soil in a small contaminated region; (2) to obtain empirical information on composite versus individual soil sampling and on random versus uniformly spaced sampling; and (3) to examine the practicality of using gamma measurements in predicting the average surface radium

concentration, and in estimating the number of soil samples required to obtain a given level of accuracy and precision. Numerous soil samples were collected on each of six sites known to be contaminated with uranium mill tailings. Three types of samples were collected on each site: 10-composite samples, 20-composite samples, and individual or post hole samples. It was found that 10-composite sampling is the method of choice among these three approaches, in that it yields a given level of accuracy and precision for the least cost. It was also found that gamma measurements can be used to reduce surface soil sampling on some sites.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM HEALTH, SAFETY, AND BIOMEDICAL STUDIES

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Meyer, H.R.

Hazardous and Radioactive Waste: Public Health Issues and Concerns

CONF-870323; Proceedings of the American Institute of Chemical Engineers Spring National Meeting, Houston, TX, March 29-April 2, 1987; (10 pp.) (1987)

The Uranium Mill Tailings Remedial Action Project (UMTRAP), managed by the U.S. Department of Energy, requires radioactive materials cleanup at numerous private properties and mill sites throughout the United States. To enhance public relations, Chem-Nuclear Systems (CNSI) and MK-Ferguson Company present a unique training and information program, allowing local individuals to understand and evaluate the relative hazards of the work. This paper describes the radioactive waste and other hazardous materials and the control programs concerned with these wastes.

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Tschaeché, A.N.

Bioassay for Uranium Mill Tailings

CONF-861022; Bioassay, Analytical and Environmental Chemistry, Proceedings of the 32nd Annual Conference, Gaithersburg, MD, October 21-23, 1986; (p. 5.1) (1986)

Uranium mill tailings are composed of uranium bearing (U-238 primarily) fine grained sands that contain most of the uranium decay products including Th-230. These decay products are left behind after the usable uranium is removed in the milling process. Millions of pounds of tailings are generated at uranium mills around the United States. Discrete uranium mill tailings piles exist near the mills. In addition, the tailings materials were used in communities situated near the mill sites as building materials, foundations for buildings, pipe runs, sand boxes, gardens, etc. The Uranium Mill Tailings Remedial Action Project (UMTRAP) is a U.S. Department of Energy Program designed with the intention of removing or stabilizing the mill tailings piles and the tailings used in communities. The result of this program will be the prevention of exposure of individuals to radiation levels above the EPA limits established for such tailings materials. This paper discusses the bioassay programs that are established for workers who remove tailings from the communities in which they are placed

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Tschaeché, A.N., R. Carr, and B. Rothman, Bendix Field Engineering Corporation, Grand Junction, CO

Internal Dosimetry for Uranium Mill Tailings

PNL-SA-14043; Radiobioassay and Internal Dosimetry, Proceedings of a Department of Energy Workshop, Albuquerque, NM, January 20, 1986; (pp. 265-276) (1987, March)

The history, basis and initial proposed internal dosimetry program for the Uranium Mill Tailings Remedial Action Program are presented.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM DISMANTLEMENT AND DEMOLITION

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Groundbreaking Set for Mexican Hat Tailings Site

DOE News (870728):1 (1987, July 28)

The groundbreaking ceremony for phase I of construction activity at the Mexican Hat Tailings site is announced. Construction during this phase will include installation of a perimeter fence, a wastewater retention basin, temporary ditches, and a decontamination pad. Existing structures are to be demolished. The work, which is part of the Uranium Mill Tailings Remedial Action Project, will be performed by the Navajo Engineering Construction Authority. Phase I will prepare the site for actual cleanup which will be performed in phase II.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Announces Award of Asbestos Removal Contract

DOE News (880411):1-2 (1988, April 11)

The U.S. Department of Energy (DOE) announced today that Southwest Hazard Control, Inc. of Tucson, Arizona has been awarded a contract under the DOE's Uranium Mill Tailings Remedial Action (UMTRA) Project to remove asbestos from the inactive Phillips-United Nuclear uranium mill tailings site at Ambrosia Lake, New Mexico. The asbestos, which had been used to insulate pipes and vessels, will be disposed of in a stabilized tailings pile to be constructed at the site. Work on the asbestos removal contract began the week of March 28, and is scheduled to be completed in July, 1988. Completion of the asbestos cleanup will clear the way for demolition of mill buildings and other structures before construction of the stabilized tailings pile. Two additional contracts will be awarded to carry out this portion of the work. Tailings pile construction is scheduled to begin in 1988 and be completed in 1990. Site preparation work began last fall and was completed in February. The demolition and construction phase of the project will require three years to complete.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

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DOE To Release Studies on Grand Junction Tailings Transport

DOE News (871218):1 (1987, December 18)

DOE announced today that the results of two studies on relocation of the uranium mill tailings and other contaminated materials from the inactive Climax uranium processing site in Grand Junction will be made available to the public during the week of January 4, 1988. DOE initiated an economic impact study in September, 1987, in response to community concerns that economic impacts to businesses in the south downtown area and along proposed tailings haul routes had not been adequately assessed. The study evaluates the economic impact to Mesa County from tailings relocation. Both the positive benefit of increased economic activity county-wide and the negative impact of temporary disruptions to local businesses from the tailings transport will be reported in the study findings. In addition to expenditures for the ongoing removal of tailings from homes and businesses around Mesa County, the DOE plans to spend in excess of \$46 million in Mesa County over the four-year duration of the tailings disposal project. Along with the construction workers needed to perform the work, jobs will be created in the service and retail trade sectors of the Mesa County economy as a result of the increased economic activity. The project is slated to begin in July, 1988. A second DOE study is being conducted to evaluate transport of the tailings to a remote site by slurry pipeline. The study will report conceptual cost estimates for the slurry pipeline alternative for the Grand Junction UMTRA Project. The DOE slurry pipeline study has been conducted in close consultation with the City of Grand Junction. The city has retained a slurry expert from the Colorado School of Mines to provide an independent evaluation of the DOE slurry pipeline study. In March, 1987, DOE issued a Final Environmental Impact Statement on the proposed remedial actions at the Grand Junction tailings site. A Record of Decision is targeted for issuance after presentation of the slurry pipeline and economic impact study results. DOE will also apply for a conditional use permit. Through this process, DOE will work with the community to establish appropriate mitigations for the tailings relocation project.

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D'Antonio, J.R., J.A. Caldwell, and G.R. Thiers,
U.S. Department of Energy, Albuquerque Opera-

tions Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM; Jacobs Engineering Group, Inc., Albuquerque, NM; Morrison-Knudsen Engineers, Inc., San Francisco, CA

Burying the Nuclear Past

Civil Engineering 57(2):55-57 (1987, February)

Twenty-four tailings piles are being reclaimed under the Uranium Mill Tailings Remedial Action Program. The work is being done to protect the environment and the public from the potential long-term health impact from radon gas from the piles. Remedial work involves consolidating tailings and windblown contaminated soils in a suitable location, and covering the pile with a radon barrier of compacted clay, and an erosion protection layer of sand and rock. Three examples of work in progress or recently completed are Canonsburg, Pennsylvania; Shiprock, New Mexico; and Lakeview, Oregon.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting Regarding the Cleanup of the Susquehanna-Western Uranium Mill Tailings Site

DOE News (870629):1 (1987, June 29)

A public meeting regarding the cleanup of the Susquehanna-Western uranium mill tailings site near Riverton, Wyoming is announced. The purpose of the meeting is to update area residents on progress and plans for the site. The Environmental Assessment will also be reviewed. UMTRA officials will be present to announce employment and subcontracting opportunities.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Last Tailings Haul from Vitro Site Set for December 4, 1987

DOE News (871116):1 (1987, November 16)

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

Removal of the final load of uranium mill tailings from the Vitro site in South Salt Lake is scheduled for December 4, 1987. This will end a three-year construction phase by the U.S. Department of Energy (DOE) and the State of Utah to clean up the inactive uranium processing site. Over four million tons of tailings and other materials have been removed from the Vitro site as part of the DOE UMTRA Project. The tailings were transported by truck and train to the remote Clive disposal site some 80 miles west of Salt Lake City in the desert. In compliance with the U.S. Environmental Protection Agency (EPA) standards issued in 1981 for the UMTRA Project, radiation levels at the Vitro site have been reduced to levels close to those which naturally occur in the surrounding environment. Contaminated materials will be encapsulated with approximately seven feet of earth to prevent escape of radon gas and inhibit water infiltration. A final covering of rock will protect the earthen radon barrier from erosion. The stabilized tailings pile has been designed to meet EPA Standards. Upon completion of the remedial action, a license will be issued by the U.S. Nuclear Regulatory Commission and the entire 102-acre disposal site will be deeded to the federal government for long-term surveillance and maintenance. In conjunction with cleanup of the Vitro site, 119 off-site properties, mostly residential, were cleaned up. The contaminated materials from these properties also were encapsulated at the Clive site.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Uranium Mill Tailings Cleanup Near Mexican Hat

DOE News (871120):1 (1987, November 20)

The U.S. Department of Energy (DOE) and the Navajo Nation will hold a public information meeting regarding cleanup of the uranium mill tailings site located at the Navajo community of Hachita near Mexican Hat, Utah, on December 2, 1987. Representatives of DOE, Jacobs Engineering Group (Technical Assistance Contractor to DOE), and the Navajo Nation will explain the contents of the Environmental Assessment (EA) regarding remedial action at the tailings site. In the Environmental Assessment, the DOE outlines the various options that are considered for disposal of the residual radioactive material and discusses the environmental consequences of the DOE's preferred option. The DOE proposes to sta-

bilize approximately 2.7 million cubic yards of tailings and other contaminated material on-site. The contaminated materials will be consolidated into a gently sloping pile, covered with a radon barrier of compacted earth to inhibit the escape of radon gas, and protected from erosion by rock placed on top. Construction is scheduled to begin in 1990, with a projected completion date of 1992.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE and State To Hold Public Meeting on Uranium Mill Tailings Cleanup at Lowman

DOE News (871204):1 (1987, December 4)

The newsletter announces a public meeting concerning the prospects for cleanup of the inactive uranium mill tailings site at Lowman, Idaho. Updated plans, schedules, and a progress report regarding preparations for the cleanup effort will be presented. Provisions for federal and state cost sharing of remedial actions, and measures to ensure continued funding of the project will also be discussed.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Addendum to Press Release Dated December 4, 1987: DOE and State To Hold Public Meeting on Uranium Mill Tailings Cleanup at Lowman

DOE News (871207):1 (1987, December 7)

Details of a planned meeting concerning the prospects for cleanup of the inactive uranium mill tailings site at Lowman, Idaho is given.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Cleanup of Naturita Tailings

DOE News (880126):1 (1988, January 26)

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

The U.S. Department of Energy (DOE) announced that a public meeting will be held in Nucla, Colorado on February 9, 1988 to present plans for the eventual cleanup of the Naturita uranium mill tailings site. Representatives from DOE's Uranium Mill Tailings Remedial Action (UMTRA) Project, Jacobs Engineering Group Inc. (Technical Assistance Contractor to DOE), and the Colorado Department of Health will present updated plans, schedules, and a progress report regarding cleanup activities. Project representatives will also provide information on the alternate tailings disposal site selection process being conducted to determine a suitable site to receive the tailings should relocation be necessary. A Naturita UMTRA Project Task Force will be formed from interested citizen volunteers.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting Regarding Cleanup of Green River, Utah

DOE News (880208b):1 (1988, February 8)

U.S. Department of Energy (DOE) and Utah state officials will hold a public meeting February 18, 1988, in Green River, Utah. Area residents will be updated on progress and plans in preparation for groundbreaking at the Green River site later this year. Subcontract and employment opportunities on the estimated \$14 million cleanup project will be announced. The inactive uranium processing site at Green River is designated for remedial action under the Uranium Mill Tailings Remedial Action (UMTRA) program with the project administered by DOE in cooperation with the State of Utah.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Groundbreaking Ceremony to Mark Riverton Tailings Cleanup

DOE News (880421):1-2 (1988, April 21)

The State of Wyoming and the U.S. Department of Energy (DOE) will hold a groundbreaking ceremony May 5, 1988 to officially commemorate the start of remedial

action on the Susquehanna-Western uranium mill tailings site located approximately two miles southwest of Riverton, Wyoming. The remedial action will eventually relocate over 1.5 million cubic yards of tailings and other contaminated materials by truck to the active UMETCO uranium mill site in the Gas Hills Uranium Mining District approximately 45 miles east of Riverton. The project is expected to create over 400 direct and indirect new jobs and to provide more than \$21 million in economic benefits to the Riverton area. Construction is scheduled to be completed in 1990. Jacobs Engineering Group Inc. is the Technical Assistance Contractor. Actual construction work at Riverton will be performed by UMETCO Minerals Corp. under a subcontract to MK-Ferguson.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Riverton Tailings Haul Begins

DOE News (880527):1 (1988, May 27)

The U.S. Department of Energy (DOE) began transporting the 1.7 million cubic yards of uranium mill tailings from the inactive Susquehanna-Western uranium mill tailings site on May 20, 1988 by truck to the active UMETCO uranium mill site in the Gas Hills Mining District approximately 50 miles east of Riverton. The tailings haul, originally scheduled to begin in early June, is expected to conclude in the spring of 1990. The initial site work to support remedial action involved the construction of a water retention basin, a site access road, and the demolition of existing mill buildings. In order to maintain safety standards along the haul route, the speed limit on Wyoming Highway 789 has been reduced to 30 mph on the portions of the highway approaching the intersection of Wyoming Highway 138. In addition, preparations are underway for the installation of a traffic light at this intersection. The project is expected to provide more than \$21 million in economic benefits to the Riverton area, as well as the creation of more than 400 jobs. Jacobs Engineering Group Inc. is the Technical Assistance Contractor for DOE on the UMTRA Project. MK-Ferguson Company, Inc. (MK-F) is the Remedial Action Contractor on the UMTRA Project. Actual construction work at Riverton will be performed by UMETCO Minerals Corporation under a subcontract to MK-F.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM SITE STABILIZATION AND RECLAMATION

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Lignite Ash Cleanup at Belfield/Bowman

DOE News (880614):1 (1988, June 14)

Representatives from the U.S. Department of Energy (DOE), Jacobs Engineering Group Inc, and the North Dakota Department of Health will hold a Public Meeting in Bowman, North Dakota on Wednesday, June 22, 1988. Updated plans, schedules, and a progress report regarding the cleanup activities will be presented. The Belfield site is a former processing site where uranium bearing lignite coal was burned in a rotary kiln. Soils at the site have been contaminated by residual uranium and radium from the ashing process. The Bowman site consists of 76,000 cubic yards of soils similarly contaminated by the lignite ashing process. The proposed remedial action involves consolidation and stabilization of contaminated materials from Belfield and Bowman at the Bowman site.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Contractor Establishes Office in Grand Junction for Tailings Cleanup

DOE News (880628):1 (1988, June 28)

The U.S. Department of Energy (DOE) announced today that MK-Ferguson, DOE's Remedial Action Contractor, has established an area office in Grand Junction, Colorado. Construction activities initiating the cleanup at Uranium Mill Tailing Remedial Action (UMTRA) Project sites at Grand Junction and Rifle, Colorado and Green River, Utah are scheduled to begin this summer. The Grand Junction area office will support work at these sites and at five other Colorado tailings sites planned for remedial action by 1994. As DOE's Remedial Action Contractor, MK-Ferguson performs final engineering and design tasks and manages construction of stabilized tailings piles at each site. To comply with U.S. Environmental Protection Agency (EPA) standards, the stabilized tailings piles are designed to reduce emissions of radon gas to safe levels, to withstand the forces of erosion for at least two hundred years, and to protect groundwater. Actual construction work is performed by firms selected through a competitive procurement process. MK-Ferguson field offices have been or will be established at each site to supervise construction work.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM WASTE DISPOSAL

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Management of Inactive Uranium Mill Tailings

Journal of Environmental Engineering 112(3):490-537 (1986, June)

This task committee report to the members of ASCE reviews the status of inactive uranium mills that are being stabilized by the U.S. Department of Energy through the Uranium Mill Tailings Remedial Action (UMTRA) Project. These tailings at 25 locations in the United States remain from the development of nuclear weapons by the Manhattan Engineer District, U.S. Army, and the Atomic Energy Commission. Standards set by the U.S. Environmental Protection Agency require long-term stability for a minimum of 200 years and for 1,000 years where possible. Other participants assisting in the project include the U.S. Nuclear Regulatory Commission, and the states and Indian tribes affected. Remedial action is in progress to bury these low-level wastes at the original milling sites or suitable disposal sites and is scheduled to be completed by March 1990. The outstanding issues, conclusions, and recommendations are presented.

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Sena, R., U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

UMTRAP Millsites - Lakeview Tailings Site

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 43-58) (1987)

Several aspects of the disposal of mill tailings from the Lakeview Mill site in Oregon are presented in a series of view graphs. Topics addressed include Environmental Protection Agency standards, local geology and hydrology, natural resources, and recent impetus for cleaning up the site. The layout and design of the Collins ranch site is shown. Locations of other sites are also presented.

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Thiers, G.R., and T.R. Wathen, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Recent Developments in Disposal and Isolation of Uranium Mill Tailings Under the UMTRA Program

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 833 pp.; (pp. 141-144) (1987)

Final design and construction of isolation systems for abandoned uranium mill tailings at 24 sites in 10 states is in the fourth year of a 7- to 10-year program. Construction is complete at two sites, and long-term surveillance and maintenance procedures are underway. Construction is in progress at two additional sites, and design at four others. The systems must be designed to be effective for 1000 years, to the extent reasonably achievable, and for at least 200 years in any case. Also, the design is to rely on passive systems rather than scheduled maintenance. These requirements force designing to the limit of technology, and in some cases advancing the state-of-the-art. This paper discusses the following previously unpublished developments: (1) optimization of radon barrier thickness during construction (Shiprock Site) using final distribution of radioactive materials; (2) application of the results of experiments testing resistance of riprap to sheet flow conditions; (3) design of ditches for overflow conditions; (4) prediction and monitoring settlements of slime-sand systems; and (5) implementation of post-construction surveillance and monitoring programs.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE To Hold Public Meeting on Tailings Disposal Site Selection

DOE News (870626):1 (1987, June 26)

A public meeting in Gunnison, Colorado is announced. The meeting will concern progress on the alternate tailings disposal site selection process which is being conducted by DOE and the State of Colorado. Preliminary results of the process will be presented for public discussion.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM REMEDIAL ACTION EXPERIENCE

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Garcia, J., and M. Madson, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM; UNC Geotech Inc., Grand Junction, CO

UMTRAP Vicinity Properties

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.: (pp. 59-79) (1987)

Photographs are presented for the purpose of reviewing the vicinity property case study as presented at the Annual Remedial Action Program Meeting held in Grand Junction, Colorado, on April 29, 1987. The slides were presented as a means of displaying the remedial actions performed on one vicinity property from the start of remedial actions to completion. The photos display remedial action states associated with a Strabane, Pennsylvania, vicinity property located near the Canonsburg Uranium Mill Tailings Remedial Action (UMTRA) site. Two hundred and seventy-six cubic yards of residual radioactive materials were excavated, removed, and encapsulated within the Canonsburg disposal cell. Remedial action included exterior excavation covering approximately 70% of the outdoor surface area and a small amount of interior excavation with the basement. This vicinity property was certified as having met EPA standards on April 17, 1987.

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Matthews, M.L., U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

The Uranium Mill Tailings Remedial Actions Project: A Progress Report on DOE's Cleanup Program

CONF-870306; Waste Management '87, Waste Isolation in the U.S., Technical Programs and Public Education, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 1-5, 1987, 833 pp.: (pp. 151-155) (1987)

In late 1978, Congress enacted Public Law 95-604, the "Uranium Mill Tailings Radiation Control Act of 1978." Title I of the Act instructed the Department of Energy to perform remedial actions at designated inactive uranium mill tailings sites. The Department established the Uranium Mill Tailings Remedial Actions (UMTRA) Project Office to implement remedial actions at twenty-four (24) sites, in cooperation with the affected States, Indian tribes, Nuclear Regulatory Commission, and owners of the sites. The UMTRA Project Office began remedial actions at the first site in 1983, and all sites are planned to be cleaned up by 1993. Numerous vicinity properties located near the designated sites are also undergoing remedial actions. All of this work is being performed in accordance with Environmental Protection Agency cleanup standards.

URANIUM MILL TAILINGS REMEDIAL ACTION PROGRAM GENERAL STUDIES

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Merz, B.

Deradiating the Former Uranium Capital

Journal of the American Medical Association
258(5):583-584 (1987, August 7)

The city that once proclaimed itself The Uranium Capital of America is in the process of divorcing itself from the radioactive element, literally as well as symbolically. The last vestiges of uranium are being shoveled from the community. The removal is part of the federal Department of Energy's (DOE) Remedial Action program. It was established in 1972 to clean up areas of the country in which radiation exposure in excess of normal background levels could be attributed to wastes from DOE-operated uranium processing plants. Grand Junction was the first area to qualify. A good portion of the city is built on radioactive tailings, by-products of a uranium-processing industry. The DOE and the Environmental Protection Agency established guidelines for acceptable levels of radiation. The standards were extrapolated from data from studies of lung cancer incidence in uranium miners in Europe and the U.S.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Annual Status Report on the Uranium Mill Tailings Remedial Action Program - Eighth Report

DOE/NE-0025/4 (Eighth Annual Status Report)
(1986, December)

This report summarizes the activities of the Uranium Mill Tailings Remedial Action (UMTRA) Program undertaken during Fiscal Year 1986 by the U.S. Department of Energy. Project goals for fiscal year 1987 are also presented. Relevant activities of other federal agencies including actions taken by the Department of Interior, the Department of Justice, the Nuclear Regulatory Commission, and the Environmental Protection Agency are also reviewed. Finally, the status of all sites designated under the UMTRA program is summarized.

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**

URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

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Uranium Revitalization, Tailings Reclamation and Enrichment Act of 1987 - Senate Bill 2097 (S 1846)

Environmental and Energy Study Institute Weekly Bulletin (880328):A3-A4 (1988, March 28)

Senate Bill 1846 would convert the Department of Energy's uranium enrichment program into a government corporation. The bill would limit the troubled program's unrecovered costs to \$364 million, impose charges on nuclear utilities that load their reactors with more than 37.5 percent foreign uranium, and establish a fund to clean up uranium mill tailings. Controversy is likely to focus on the proposed charges on foreign uranium and on the appropriate level of the enrichment program's unrecovered costs. One expected amendment would declare the unrecovered costs to be \$3.019 billion, the amount the White House Office of Management and Budget came up with after writing off unproductive assets. Senate Bill 2097 would establish a \$1 billion fund to clean up or stabilize large, mildly radioactive piles of uranium tailings. The proposal names 26 sites in Colorado, New Mexico, South Dakota, Texas, Utah, Washington, and Wyoming that would be eligible for assistance from the fund. Uranium mill owners, nuclear utilities, and the federal government each would contribute about a third of the fund. The federal share would include up to \$300 million from the \$364 million enrichment debt repayment. The fund would also include charges for foreign uranium usage and voluntary state contributions.

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Uranium Revitalization, Tailings Reclamation, and Enrichment Act of 1987, U.S. Senate, One Hundredth Congress, First Session

Senate Report 100-214; 140 pp. (1987)

The Committee on Energy and Natural Resources, after consideration, reports favorably an original bill. This bill: (1) provides for a viable domestic uranium industry; (2) establishes a program to fund reclamation and other remedial actions with respect to mill tailings at active uranium and thorium sites; (3) establishes a wholly-owned government corporation to manage the Nation's uranium enrichment enterprise, operating as a continuing, commercial enterprise on a profitable and efficient basis; and

(4) for other purposes, it is recommended that the bill be passed. The purpose of the Uranium Revitalization, Tailings Reclamation and Enrichment Act of 1987, as reported by the Committee on Energy and Natural Resources, is to ensure an adequate long-term supply of domestic uranium and enrichment capacity for the Nation's nuclear power program.

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Atomic Energy Control Board, Ottawa, Ontario, Canada

Proposed Regulatory Guide: A Guide to the Licensing of Uranium and Thorium Mine and Mill Waste Management Systems

Atomic Energy Control Board Consultative Document C-36 (1986, June 2)

The objectives of this document are to assist the industry and public in understanding the licensing process used by the Atomic Energy Control Board (AECB), and to describe and consolidate the requirements, criteria and guidelines which the AECB uses in the regulation of uranium and thorium mine and mill waste management systems. All phases of these systems are addressed, including pre-development activities, siting and construction, operation, and decommissioning and subsequent abandonment.

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Atomic Energy Control Board, Ottawa, Ontario, Canada

Regulatory Policy Statement: Regulatory Objectives, Requirements and Guidelines for the Disposal of Radioactive Wastes - Long-Term Aspects

Atomic Energy Control Board Regulatory Document R-104 (1987, June 5)

The purpose of this document is to present a basis for on which to judge the long-term acceptability of radioactive waste disposal options, assuming that the operational aspects of waste emplacement and facility closure satisfy the existing regulatory framework of requirements. Basic objectives of radioactive waste disposal are given, as are

URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

the regulatory requirements which must be satisfied in order to achieve these objectives. In addition, guidelines are given on the application of the radiological requirements to assist proponents in the preparation of submissions to the Atomic Energy Control Board (AECB). The primary focus of the requirements is on radiation protection, although environmental protection and institutional controls are also addressed in a more general way since these factors stem directly from the overall objectives for radioactive waste disposal. Other types of regulatory requirements such as might concern additional aspects of conceptual assessments, siting, design, construction, operation, and decommissioning of facilities for the management of particular waste types are addressed in separate regulatory documents.

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Chamney, L.G., Atomic Energy Control Board, Ottawa, Ontario, Canada

Licensing of Uranium Mine and Mill Waste Management Systems

INFO-0218; CONF-860910; Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-12, 1986; (16 pp.) (1986, September)

Systems for the management of wastes arising from uranium mining facilities are subject to regulatory control by the Atomic Energy Control Board (AECB). This paper describes the primary objectives, principles, requirements and guidelines which the AECB uses in the regulation of waste management activities at uranium mining facilities, and provides an understanding of the licensing process used by the AECB.

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Chilk, S.J., U.S. Nuclear Regulatory Commission, Washington, DC

Uranium Mill Tailings Regulations: Ground-Water Protection and Other Issues (10 CFR Part 40)

Federal Register 52(219):43553-43568 (1987, November 13)

The Nuclear Regulatory Commission (NRC) is amending its regulations governing the disposal of uranium mill tailings. The changes 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.

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Holmes, R.W., National Technical Planning Group on Uranium Tailings Research, Ottawa, Ontario, Canada

Uncertainty Analysis for the Long-Term Assessment of Uranium Mill Tailings

Uncertainty Analysis for Performance Assessments of Radioactive Waste Disposal Systems, Proceedings of an OECD/NEA Workshop, Seattle, WA, February 24, 1987. Organization for Economic Co-Operation and Development, Paris, France; (pp. 167-176) (1987)

An analytical tool (computer code) called UTAP has been developed for the long-term assessment of uranium tailings close-out options. UTAP accepts probability density functions for input parameters, and produces output frequency histograms. The uncertainty expressed in UTAP results can be combined with uncertainty estimates for event frequencies to evaluate the risk arising from uranium tailings.

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International Atomic Energy Agency, Vienna, Austria

Safe Management of Wastes from the Mining and Milling of Uranium and Thorium Ores - Code of Practice and Guide to the Code

IAEA Safety Series No. 85; 70 pp. (1987)

Wastes from the mining and milling of uranium and thorium ores pose potential environmental and public

URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

health problems because of their radioactivity and chemical composition. This document consists of two parts: a Code of Practice (Part I); and a Guide to the Code (Part II). The Code sets forth the requirements for the safe and responsible handling of the wastes resulting from the mining and milling of uranium and thorium ores, while the Guide presents further instruction in the use of the Code together with some discussion of the technology and concepts involved.

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Lush, D.L., C.L. Lendrum, C. Hostovsky, and W. Eedy, Beak Consultants Limited, Mississauga, Ontario, Canada

The Cost of Decommissioning Uranium Mill Tailings

INFO-0198; 97 pp. (1986, April)

All uranium mining and milling facilities have a finite life of operation and, at some point in time, require decommissioning. A part of this decommissioning is the close-out of the waste management or tailings area. In Canada, at present, the objectives of decommissioning the waste management area are to ensure that the facility is left in such a condition that no physical, chemical, or radiation risk of an unacceptable nature remains. In order to ensure this, mining and milling companies are required to carry out a decommissioning program and to demonstrate, through monitoring over a period of years following decommissioning, that the site is behaving as predicted and is currently or will not in the foreseeable future present an unacceptable risk to the human or natural environment. The present concept in Canada is that, after a reasonable monitoring period in which the site has been shown acceptable levels, the responsibility for the site and its subsequent monitoring would revert to the Crown. At present, there is a need for industry to know the estimated costs of decommissioning and post-decommissioning monitoring and for government to know the costs of continuing surveillance. This report identifies several key operations that are commonly carried out during decommissioning at tailings areas in the Canadian environment. These operations are unit costed for a generic site to provide a base reference case. The unit costs have also been scaled to the quantities required for the decommissioning of four Canadian sites and these scaled quantities compared with site specific engineering cost estimates and actual costs incurred in carrying out the decommissioning activities. Variances in

costing are discussed. The report also recommends a generic monitoring regime upon which both short- and longer-term environmental monitoring costs are calculated. Although every site must be addressed as a site-specific case, and monitoring programs must be tailored to fit a specific site, it would appear that for the conventional decommissioning and monitoring practices that have been employed to date, costs can be reasonably estimated when site-specific conditions are taken into account.

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McNally, P.E., Ranger Uranium Mines Pty. Limited, Jabiru, Northern Territory, Australia

Contingency Planning and Risk Analysis for Water and Tailings Management at Ranger Uranium Mines

Proceedings of an Environmental Workshop, Launceston, Australia, October 13, 1986; (pp. 254-281) (1986)

This paper describes some of the more likely risks and contingency procedures associated with the variable monsoonal climate of the Alligator Rivers region in the Northern Territory. This is related to the Ranger Uranium Mine. The tailings management system is basically a large storage impoundment and a reticulation system that delivers tailings sludge and recycles supernatant water. It is a closed circuit within the water management system, but is dealt with as an integral part of that system.

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Potter, J.C., U.S. Environmental Protection Agency, Washington, DC

National Emission Standards for Hazardous Air Pollutants (NESHAPS): Extension Under Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings

Federal Register 52(198):38130-38132; AO-FR-3276-2 (1987, October 14)

Notice is being given in accordance with the provisions of 40 CFR 61.252(e)(4), that Pathfinder Mines Corpora

URANIUM MILL TAILINGS MANAGEMENT DESIGN, PLANNING, AND REGULATIONS

tion has applied for a five year extension so that it can continue to place uranium mill tailings on existing mill tailings piles at its Shirley Basin mill site and its Lucky Mc mill site. EPA is inviting public comment as to whether or not the application should be approved for any of the piles at either the Shirley Basin or the Lucky Mc facility, or both.

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Rouse, J.V., R.Z. Pyrih, and J.H. Kleinfelder, Kleinfelder (J.H.) and Associates, Denver, CO

Natural Geochemical Attenuation of Contaminants Contained in Acidic Seepage

EPA/600/9-85-025; New Frontiers for Hazardous Waste Management, Proceedings of an International Conference, Pittsburgh, PA, September 15, 1985; (pp. 192-199) (1985)

A conceptual geochemical model is developed to explain the interaction of acidic seepage with natural soil materials. The model is based on numerous laboratory tests and field investigations of the saturated and vadose zones at uranium, copper, and phosphate milling and processing sites throughout the United States, Canada, and Australia. Principal geochemical reactions are identified and case histories are presented to illustrate the degree of natural control on contaminant migration.

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Smith, G.M., S.R. Abt, and J.D. Nelson, Sergeant, Hauskins and Beckwith Geotechnical Engineers Inc., Albuquerque, NM

Profile Prediction of Hydraulically Deposited Tailings

Transactions of Society of Mining Engineers 280:2024-2027; Transactions of Society of Mining Engineers, Volume 280. Society of Manufacturing Engineers, Dearborn, MI; (pp. 2024-2027) (1987)

An empirical investigation was conducted to formulate design criteria for predicting the beach profile of hydraulically deposited tailings. Field data were obtained from mining operations producing gold sulfides, silver, molybdenum, copper, platinum, and uranium. The site-specific

parameters that were collected include beach slopes, tailings soil properties, slurry properties, and the slurry distribution system characteristics. Each of the beach profiles were dimensionlessly plotted, and regression expressions were computed. It was determined that either a power expression or exponential expression closely predicted each beach slope. A general power expression and a general exponential expression were developed resulting in design criteria. A procedure was formulated to determine which expression, power or exponential, is applicable to any specific site. A slope designation chart was developed as a function of the discharge, the tailings critical tractive shear stress, and the inertial forces exerted by the slurry on the beach.

513

Walters, W.H., Pacific Northwest Laboratory, Richland, WA

Construction Methods and Materials of Archaeological Mounds: Implications for Uranium Tailings Impoundments

Nuclear Safety 28(2):212-220 (1987, April-June)

One aspect of long-term protection of uranium tailings impoundments concerns the ability of a large earthen structure to resist destruction from natural forces for time periods of up to 1000 years. Evidence in archaeological records suggests that man-made earthen mounds can remain sound and intact for comparable time periods. Specific examples of man-made earthen and rock mounds exist throughout the world. Archaeological records identify the types of building materials, construction techniques, and factors that contribute to the survival of these mounds.

514

Weatherhead, J., Queensland Mines Limited, Darwin, Northern Territory, Australia

Planning the Nabarlek Decommissioning - Part 2: Technical Aspects

Proceedings of an Environmental Workshop, Launceston, Australia, October 13, 1986; (pp. 288-297) (1986)

After a general review of the decommissioning and rehabilitation requirements, the paper details the work

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necessary to dewater and consolidate the tailings stored in the open pit. This work will be preparatory to placing the final cover. Some mention is made of failure modes of the tailings impoundment. Methods of disposing of water stored on-site are discussed. Water quantity calculations are presented. Removal of the plant and revegetation of the site is also discussed.

515

Whitehead, W.

Decommissioning of Uranium Mines and Mills - Canadian Regulatory Approach and Experience

CONF-860910; Radioactive Waste Management. Proceedings of the Second International Confer-

ence, Winnipeg, Manitoba, Canada, September 7-12, 1986 (1986, September)

At the time of the recent closures of the Agnew Lake, Beaverlodge, and Madawaska Mines Limited uranium mining and milling facilities, several relevant regulatory initiatives, including the development of decommissioning criteria, were underway or contemplated. In the absence of precedents, the regulatory agencies and companies adopted approaches to the decommissioning of these facilities that reflected site specific circumstances, federal and provincial regulatory requirements, and generally accepted principles of good engineering practice and environmental protection. This paper summarizes related historical and current regulatory policies, requirements and guidelines including those implemented at the three decommissioned sites.

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516

Blowes, D.W., and R.W. Gillham. University of Waterloo. Institute of Groundwater Resources, Waterloo, Ontario, Canada

The Generation and Quality of Streamflow on Inactive Uranium Tailings near Elliot Lake, Ontario

Journal of Hydrology 97(1-2):1-22 (1988)

This study was undertaken to investigate the physical and chemical interactions between groundwater and surface water in an area of inactive uranium mill tailings near Elliot Lake, Ontario. The study area had a shallow water table and was drained by a single channel. Streamflow chemistry and discharge and the hydraulic response of the groundwater system were monitored for several runoff events during the period of September 1981 through May 1982. The hydrographs measured for each event were separated into groundwater and surface-water components. The findings of this study indicate that groundwater can be a major component of streamflow during runoff events in inactive tailings areas, and as a result, can have a major influence on runoff quality. The groundwater contribution to streamflow represents an important pathway of contaminant migration to the biosphere which can be anticipated to persist for long periods of time.

517

Caldwell, J.A., J. Thatcher, and J. Kiel, Jacobs Engineering Group, Inc., Albuquerque, NM

Environmental Geotechnological Considerations in the Design of the Cannon Mine Tailing Impoundment

Environmental Geotechnology, Fang, H.Y. (ed.), Proceedings of an International Symposium, Allentown, PA, April 21, 1986. Enviro Publishing Company, Inc., Bethlehem, PA, Vol. 1: (pp. 312-322) (1986)

Environmental geotechnology may be viewed as a planning tool, a philosophy of approach, or as the set or class of problems in geotechnical engineering that relates to environmental considerations. This paper explores these ideas by way of a description of the design and construc-

tion of the Cannon Mine Tailings Impoundment. The case history shows that each view of environmental geotechnology is valid in particular applications and when used appropriately, environmental geotechnology facilitates planning, public acceptance, and sound construction of soil and rock structures that have considerable environmental significance.

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Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Mining Research Laboratories, Ottawa, Ontario, Canada; IEC Beak Consultants Limited, Mississauga, Ontario, Canada

Hydrogeochemical Studies on WTC Uranium Tailings Lysimeters

INIS-mf-11160; 179 pp. (1983, March)

In 1974, Environment Canada initiated a series of tailings lysimeter studies at the Wastewater Technology Centre (WTC) in Burlington, Ontario, to examine the leachability of radionuclides and major constituents (TDS, pH) from uranium mill tailings. In addition, the study attempted to assess the effect of two leachate control methods (chemical fixation and vegetation) upon the characteristics of tailings leachate. In 1982, IEC Beak Consultants Limited was retained to conduct additional physical/chemical characterization of the tailings solids and some leachate samples. This information, together with the existing data, was then used to develop a conceptual model with which to try to explain the behavior of the tailings during the leaching of the lysimeters. The specific tasks undertaken included: multi-parameter analysis of leachates collected from 4 lysimeters over the last 18 months of operation; physical/chemical characterization of the final lysimeter solids including grain size, bulk density, sulphate and carbonate content; use of Scanning Electron Microscopy (SEM) coupled with X-ray Emission (XRE) spectroscopy, plus Mossbauer spectroscopy to characterize surface precipitates and iron speciation respectively; chemical equilibrium modeling on leachates to estimate controlling species in radioisotope and TDS release.

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Department of Mines and Energy, Darwin, Northern Territory, Australia

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Six-Monthly Report on Surveillance of Environmental Monitoring in Alligator Rivers Region for the Period October 1, 1986 - March 31, 1987

Report No. 13; 73 pp. (1986)

This report outlines the Northern Territory Government Department of Mines and Energy, Conservation Commission's, and Department of Health's activities in meeting their responsibilities for surveillance of environmental monitoring in the uranium mining and related operations in the Alligator Rivers Region. The report period is from October 1, 1986 to 31 March 1987.

520

Dubrovsky, N.M., University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada

Geochemical Evolution of Inactive Pyritic Tailings in the Elliot Lake Uranium District

Thesis (Ph. D.) (1986)

Geochemical data on the groundwaters and solids from three inactive uranium tailings impoundments in the Elliot Lake district of Ontario indicate that oxidation of pyrite occurring in the shallow part of the vadose zone is causing severe acidification of the tailings groundwater. A two-layer hydrochemical zonation has developed in which low pH infiltration with high concentrations of SO_2 , Fe, and heavy metals is gradually migrating downward at 0.2 and 2 m per year. This causes the downward displacement of the original mill process water which has neutral pH. The oxidation process involves oxidation of pyrite to Fe(III) , but is driven by entry of atmospheric oxygen into the shallow vadose zone in the tailings. The heavy metals Co, Ni, Zn, Pb, and Cu are solubilized in the pore waters of the vadose zone due to acidification by pyrite oxidation. Concentrations of Pb are limited by the PbSO_4 precipitation in zones of the tailings affected by pyrite oxidation. Batch and column experiments were conducted on samples of fresh tailings in order to study the pH and acid neutralization processes. Results showed that the tailings have a significant capacity to neutralize acidity under low pH conditions, and pH buffering in the high pH range exceeds that predicted on the basis of the carbonate mineral content. Application of an equilibrium geochemical model, ADNEUT, to the column results pre-

dicts a sequence of equilibrium pH in the effluent similar to the experimental data. Mass-balance calculations indicate that the vadose zone contains sufficient pyrite for the generation of high-Fe and low-pH groundwater to continue for several decades to several hundred years.

521

East, T.J., Office of the Supervising Scientist, Jabiru East, Australia

Geomorphological Assessment of Sites and Impoundments for the Long Term Containment of Uranium Mill Tailings in the Alligator Rivers Region

Australian Geographer 17(1):16-21 (1986, May)

This paper presents a program of current and future research into those geomorphological processes likely to affect the long-term containment of uranium mill tailings in the Alligator Rivers Region of the Northern Territory. Research is directed at three main areas: identification of geomorphic hazards at proposed impoundment sites; determination of erosion rates on impoundment slopes; and prediction of patterns of fluvial dispersal of released tailings. Each necessitates consideration of present and future geomorphic processes.

522

Felmy, A.R., S.R. Peterson, and R.J. Serne, University of California at San Diego, Department of Chemistry, La Jolla, CA; Pacific Northwest Laboratory, Richland, WA

Interactions of Acidic Uranium Mill Tailings Solution with Sediments: Predictive Modeling of Precipitation/Dissolution Reactions

Uranium 4(1):25-41 (1987, July)

A conceptual chemical modeling methodology was applied to a system where an acidic uranium mill tailings solution passed through a laboratory column packed with sediment. The modeling approach proved effective in defining the importance of specific precipitation/dissolution reactions. A chemical model, which included amorphous aluminum hydroxide and amorphous basal-

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urinite, was used to accurately predict the aqueous Al concentrations in the column effluents. Predictions of the effluent Ca concentrations demonstrated the importance of considering magnesian calcite solid solutions in the predictive geochemical modeling of these systems. Knowledge of the effluent Ca concentrations allowed successful prediction of sulfate effluent concentrations because of the precipitation of gypsum. The effluent Fe concentrations could be accurately predicted by including the solid ferrihydrite in the chemical model as long as the pH remained above 5. The importance of considering ion exchange/adsorption of reduced Mn(II), along with precipitation/dissolution of rhodochrosite, was also demonstrated.

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Foote, H.P., W.A. Rice, and C.T. Kincaid, Pacific Northwest Laboratory, Richland, WA

DIGRD - An Interactive Grid Generating Program

NUREG/CR-2845; PNL-4345; 53 pp. (1982, November)

Pacific Northwest Laboratory has completed the development and documentation of an interactive grid generating program (DIGRD, DIGITIZE GRID). This program is designed to rapidly generate or modify grids necessary for the unsaturated flow code trust. In addition to the code, a user's manual was prepared. Unfortunately, the computer hardware that comprises the PNL interactive graphics capability is unique. Direct technology transfer is not possible, therefore, this report is intended to convey the utility of interactive graphics in supplying a grid generating capability. DIGRD has already been effectively used in the preparation of grids for the analysis of leachate movement from uranium mill tailings. The principal conclusion is that the interactive graphics employed in DIGRD are useful and economical in the development of complex grids. Grid generation activities that previously took between a half- and a full-man month can now be completed in less than a week. DIGRD users have recommended development of a uniform grid of either rectangles or equilateral triangles, which could be superimposed on any domain and then adjusted through the DIGRD program to match the boundaries of a tailings disposal facility. This improvement to the DIGRD package could further reduce the effort in grid generation while providing more optimal grids.

524

Goode, D.J., and R.J. Wilder, U.S. Geological Survey, Reston, VA

Groundwater Contamination near a Uranium Tailings Disposal Site in Colorado

Ground Water 25(5):545-554 (1987, September)

Contaminants from uranium tailings disposed of at an active mill in Colorado have seeped into the shallow groundwater on-site. This groundwater discharges into the Arkansas River Valley through a superposed stream channel cut in the resistant sandstone ridge at the edge of a synclinal basin. In the river valley, seasonal surface water irrigation has a significant impact on hydrodynamics. Water levels in residential wells fluctuate up to 20 ft and concentrations of uranium, molybdenum, and other contaminants also vary seasonally, with highest concentrations in the Spring, prior to irrigation, and lowest concentrations in the Fall. Results of a simple transient mixing cell model support the hypothesis that lateral groundwater inflow, and not irrigation recharge, is the source of groundwater contamination.

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Gureghian, A.B., Pacific Northwest Laboratory, Richland, WA

Influence of Climatic Parameters on Movement of Radionuclides in a Multilayered Saturated-Unsaturated Media

PNL-SA-10325; NUREG/CP-0030; CONF-820364; Unsaturated Flow and Transport Modeling, E.M. Arnold, G.W. Gee and R.W. Nelson (eds.), Proceedings of a Symposium, Seattle, WA, March 23, 1982; (pp. 77-93) (1982, September)

A numerical analysis of the influence of climatic parameters on the movement of a typical radionuclide, Ra-226, in the profile of an inactive uranium mill tailings impoundment is reported. Two scenarios of meteorological events assumed to characterize the lower and upper bounds of potential Ra-226 migration rates are investigated. The first duplicates the true climatological conditions prevailing at the site of interest where evaporation is in excess of rainfall. The second is a hypothetical case in which the annual evaporation balances the rainfall. The changes over time of these surface fluxes are

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simulated by simple harmonic functions. The model is composed of two modules: the first to calculate the pressure distribution in the domain of interest, enabling one to compute the velocities and soil moisture; the second to calculate the migration of the various species by taking into account all the major processes associated with the transport phenomena of a dissolved substance in porous media, i.e. advection, mechanical dispersion, molecular diffusion, radioactive decay and sorption (assuming a linear equilibrium isotherm). The numerical method of solving the one-dimensional transport of water and Ra-226 in the nonhomogeneous soil system under saturated-unsaturated and isothermal conditions as adopted here is the finite-element method based on weighted residual techniques. The flow equation is solved by the Bubnov-Galerkin Method in which the weighting functions are identical to the linear basis functions. The solute equation is solved by a Petrov-Galerkin type method in which the convective and dispersive terms are weighted with asymmetric quadratic functions yielding an upstream weighting of the convection term. A test case involving the movement of a nonreacting ionic species in an actual field experiment is used to validate the model.

526

Ibrahim, S.A., and F.W. Whicker, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Plant Accumulation and Plant/Soil Concentration Ratios of Pb-210 Po-210 at Various Sites Within a Uranium Mining and Milling Operation

Environmental and Experimental Botany 27(2) :203-213 (1987)

The primary objectives of this study were to determine Pb-210 and Po-210 concentrations in soil and native plants and to estimate plant/soil concentration ratios from various sites around a uranium mining and milling operation that is typical of most in the Western United States. Soil and vegetation samples were collected at exposed, weathered tailings; near the edge of a tailings pond; downwind from a tailings impoundment; from a reclamation area; and at several background locations. The mean concentrations of Pb-210 and Po-210 in background soil and vegetation were within the reported range for the U.S. Concentrations in soil and vegetation varied significantly among the sites and were generally

elevated above the background in the disturbed areas near tailings. Both radionuclides occurred at near-radioactive equilibrium in natural soil and tailings and are accumulated by native plants to a similar degree. No demonstrable differences among plant groups were found. A wide range of concentration ratios (CR) was observed for both radionuclides, and CR values were estimated for plants growing at the tailings pond edge relative to all other locations. We speculate that acidity and the diminished soil binding capacity caused by the saturated pond edge are responsible for the enhanced plant uptake at this location. Po-210 CR values for plants growing on exposed tailings were higher than previously reported from soil contaminated with polonium oxide. The sulfuric acid leaching process of uranium ore may create a more soluble form of polonium in tailings material. Comparatively low CR values were observed for plants downwind from the tailings source. Evidence is presented for both radionuclides that plant accumulation is a nonlinear function of substrate concentration. Thus, the usefulness of a single CR value may be severely limited due to the lack of linear relationship between plant and soil activities.

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Moline, N.T., R.F. Cull, T.J. East, R. Marten, A.S. Murray, and K. Duggan, Alligator Rivers Region Research Institute, Jabiru, Australia; Conservation Commission of the Northern Territory, Jabiru, Northern Territory, Australia

Tailings Transport and Deposition Downstream of an Abandoned Uranium Mill

Proceedings of an Environmental Workshop, Launceston, Australia, October 13, 1986; (pp. 543-544) (1986)

The derelict mill at Moline near Pine Creek, produced 246,000 tons of uranium and other metalliferous tailings between 1959 and its closure in 1972. During that period tailings were contained by earthen bunds which later failed, resulting in the erosion and transport of tailings by Tailings and Eureka creeks. The radioactivity of the tailings proved a convenient means of tracing deposition patterns of tailings downstream.

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Morin, K.A., and J.A. Cherry, University of Water-

URANIUM MILL TAILINGS MANAGEMENT ENVIRONMENTAL STUDIES AND SITE SURVEYS

100. Department of Earth Sciences, Waterloo, Ontario, Canada

Trace Amounts of Siderite Near a Uranium-Tailings Impoundment, Elliot Lake, Ontario, Canada, and Its Implication in Controlling Contaminant Migration in a Sand Aquifer

Chemical Geology 56(1-2):117-134 (1986)

Aspects of the low-temperature geochemistry of siderite are reviewed, especially in respect to the siderite-calcite solid solution. The mechanism of siderite formation in aquifers is the replacement of calcite. Under these circumstances, both calcite and siderite occur at levels of less than 1 wt.%. Calculations show this minor amount of carbonate has a major effect on contaminant migration through pH neutralization. The replacement of calcite by siderite at the field site removes a substantial portion of the aquifer's neutralization capacity.

529

Nilsson, K., K. Pilegaard, and E. Sorensen. Risoe National Laboratory, Roskilde, Denmark

Application of a Method for Rapid Ra-226 Determination in Uranium Tailings Using Alpha Spectrometry

Nuclear Instruments and Methods in Physics Research, Section A, 223(2-3):582-584 (1984)

A method for rapid Ra-226 detection was employed on tailings at a pilot plant project involving Greenland uranium deposits. Attempts to measure Ra-226 by alpha spectrometry directly were not successful due to poorly resolved spectra. As a result, it proved necessary to make use of conventional techniques. The results suggest different behavior of Ac-228 and Pa-234 during the uranium extraction process. The Ra-226 released during processing is immediately concentrated in a material which may coat the tailings to some extent. In this form, the Ra-226 is and remains completely insoluble.

530

Silver, M., Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Distribution of Iron-Oxidizing Bacteria in the Nordic Uranium Tailings Deposit, Elliot Lake, Ontario, Canada

Applied and Environmental Microbiology 53(4):846-852 (1987, April)

Iron-oxidizing bacteria are present within the top 2 m and near the water table-capillary fringe of the vegetated Nordic uranium deposit, Elliot Lake, Ontario, Canada. They are distributed uniformly in the top 0.5 m of unvegetated tailings. The locations of these bacteria correlated with zones of pyrite oxidation as delineated in previous studies by the formation of soluble iron and sulfate. Heterotrophic bacteria are also present in the tailings, with greatest concentrations at the surface and near the water table-capillary fringe. Sulfate-reducing bacteria were detected in the soil and peat at the base of the tailings. The results of this study suggest that the establishment of vegetation directly upon the tailings surface does not arrest bacterial pyrite oxidation.

531

Steger, H.F., and M. Legeyt, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada; Chemex Laboratories Limited, Vancouver, British Columbia, Canada

Radium-226 in Uranium Mill Tailings - Part 1: Fate and Consequent Dissolution

Journal of Radioanalytical and Nuclear Chemistry 110(2):95-104 (1987, April)

The physical state of Ra-226 in uranium mill tailings was studied. A test portion of a leached uranium ore was collected just prior to neutralization with lime and subjected to repetitive batch water leaching. The leachates were analyzed for barium, lead, Ra-226, iron and sulphate. The experimental results suggest that Ra-226 is coprecipitated with lead sulphate during uranium leaching of the ore with sulphuric acid. The attainment of equilibrium conditions in the pore water of the leached ore then allows a reportioning of Ra-226 between solid lead and barium sulphates. This results in a depletion of Ra-226 in the outer layers of the crystals of solid lead sulphates and an enrichment in Ra-226 in the outer layers of solid barium sulphate.

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Thomas, V.W., K.K. Nielson, and M.L. Mauch,
Pacific Northwest Laboratory, Richland, WA

Radon and Aerosol Release from Open Pit Uranium Mining

NUREG/CR-2407; PNL-4071; 375 pp. (1982, August)

In order to assist the Nuclear Regulatory Commission in establishing the radon and aerosol releases from existing open pit uranium mines, and to supplement their update of Table S3 of 10 CFR 51, estimates were made of the quantities of Radon-222 and aerosols released from open pit uranium mining. The estimates were based on extensive field measurements of radon fluxes and concentrations, aerosol properties, and surveys of characteristic mine parameters. Annual radon releases were estimated as the product of a surface area, its uranium or radium content, and its specific flux. Specific radon fluxes were calculated from monthly radon flux and radium concentration measurements made on characteristic surfaces common to open pit uranium mines. The measurements were made over a period of about one year at the Morton Ranch Mine. Corroborative measurements were also made at four other Wyoming mines in the fall and spring. This study has shown that the data collected in the field are so highly variable among different mines, different surface types, and even within each surface type, that the typical values presented must be considered very approximate if used for extrapolation to other mines or to the uranium mining industry in general. The field data indicated that soil moisture content above 10 to 12 % limits the release of radon. Atmospheric radon concentrations in the near vicinity (less than about 1 km) of radon sources were dependent upon wind speed and wind direction. The study of atmospheric aerosols at Morton Ranch showed the particle size distributions to be bi-modal with minimums occurring at a particle size of about 2 microns. Chemical analyses of the particulates indicated possible sources to be primarily local soil and a local fossil-fueled power plant. Analysis of atmospheric aerosols indicated that the only significant impact which could be attributed to the mining operation on aerosol composition was the enrichment of uranium which was enhanced over that in natural ambient soil by a factor of about 50 during high winds near the ore pile.

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Wallo, A., M.K. Tucker, and J.R. Duray, U.S.

Department of Energy, Washington, DC; U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO; UNC Geotech Inc., Grand Junction, CO

Summary - Verification Measurements Systems Workshop

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 35-38) (1987)

The Verification Measurements Workshop concentrated on three principal topics: measurements and their use in the verification/certification process, the application of supplemental standards, and independent verification. These topics are covered in four major sections and are followed by a fifth section on recommendations and concerns.

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Wang, H., and Y. Pan

Environmental Radiation of Solid Wastes and Protective Measurements in Uranium Mining Industry

Youkuangye (China) 5(2):30-36 (1986, May)

The origins and characteristics of solid wastes (waste ore, tailings) in the uranium mining and metallurgy industry are described. Environmental problems caused by radioactivity are discussed and principles of radioactive environmental protection and solid waste disposal measurements are suggested.

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Whicker, F.W., and S.A. Ibrahim, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Radioecological Investigations of Uranium Mill Tailings Systems - Final Report for the Period September 1, 1979 Through April 30, 1987

DOE/EV-10305-18; 27 pp. (1987, April 30)

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This document is the final report on studies of the integrity and transport of uranium and radioactive progeny in active and reclaimed uranium mill tailings. The overall program was designed to provide basic information on the radioecology of uranium-238, thorium-230, radium-226, lead-210, and polonium-210, responses of plants and animals to the landscape disruptions associated with uranium production, and guidance for impact analysis, mitigation and regulation of the uranium industry. The studies reported were conducted at the Shirley Basin Uranium Mine, which is operated by the Pathfinder Mines Corporation. The mine/mill operation, located in southeastern Wyoming, is typical in terms of the ore body, mill process, and ecological setting of many uranium production centers in the western United States. The research was motivated originally by the general lack of knowledge on the transport of uranium and its radioactive daughter products through the environment, particularly through food chains in the immediate environs of uranium production operations. The work was also motivated by the relatively high contribution of uranium mining and milling to the radiation exposure of the general population from the nuclear fuel cycle.

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Young, J.A., P.O. Jackson, and V.W. Thomas,
Pacific Northwest Laboratory, Richland, WA

Evaluation of Experiences in Long-Term Radon and Radon-Daughter Measure- ments

NUREG/CR-3004; PNL-4509; 41 pp. (1982,
December)

Pacific Northwest Laboratory (PNL) is performing side-by-side measurements of radon and radon daughter concentrations using several instruments and techniques, and is comparing these measurements with side-by-side measurements made by other investigators at other locations. The standard deviation of the differences between the (natural) logarithms of the Terradex track etch radon concentrations and the logarithms of the radon progeny integrating sampling units (RPISU) radon daughter concentrations (S.D.-LN) measured in 50 buildings in Edgemont, South Dakota, was 0.37. Using this S.D.-LN, it can be calculated that if the track etch radon daughter concentration is 0.010 WL there should be only a 14% probability that the RPISU average would be greater than 0.015 WL, and only a 3% probability that the RPISU average would be greater than 0.020 WL. If buildings had been cleared from remedial action when the track etch averages were less than 0.10 WL, then about 61% of the buildings would have been cleared from remedial action, and only a few percent of these buildings would have actually had average RPISU concentrations greater than 0.015 WL. The S.D.-LN between the track etch radon measurements and the RPISU radon daughter measurements made by ALARA at Grand Junction, the perm radon measurements and the mod-225 radon daughter measurements made by Mound Facility at Canonsburg and Middlesex, and the perm and track etch radon measurements made by Mound Facility at Salt Lake City were similar to the S.D.-LN between the track etch radon measurements and the RPISU radon daughter measurements at Edgemont.

URANIUM MILL TAILINGS MANAGEMENT HEALTH, SAFETY, AND BIOMEDICAL STUDIES

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Apps, M.J., M.J.M. Duke, and B.V. Turner, Northern Forestry Research Centre, Edmonton, Alberta, Canada; University of Alberta, Edmonton, Alberta, Canada

Fission Track Mapping of Uranium in Black Spruce (PICEA MARIANA) Twigs

Nuclear Analytical Chemistry, Proceedings of an International Symposium, Halifax, Nova Scotia, Canada, June 5, 1985; (pp. 245-252); Journal of Radioanalytical and Nuclear Chemistry 110(1):245-252 (1987, March)

Fission track analysis (FTA) was used to investigate the biological uptake of uranium. Examination of fission track maps of black spruce twigs (from areas of uranium mineralization and mill tailings) shows uranium to be concentrated in the inner bark while decreasing in the outer bark of the twigs. Track clusters in the bark, too large to be uraniferous airborne particulate matter, are identified as being associated with resin canals in the twigs. The results of this work help clarify the mechanisms by which uranium is incorporated in black spruce twigs. The observation by an earlier worker of decreasing uranium content with the increasing age of black spruce twigs can now be explained by the relative reduction in volume of the uranium enriched inner bark with age.

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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

Metal (Cu, Ni, Fe, Co, Zn, Pb) and Ra-226 Levels in Tissues of Meadow Voles MICROTUS PENNSYLVANICUS Living on Nickel and Uranium Mine Tailings in Ontario, Canada: Site, Sex, Age and Season Effects with Calculation of Average Skeletal Radiation Dose

Environmental Pollution, Series A: Ecological and Biological 41(4):295-314 (1986)

Metal (Cu, Ni, Fe, Co, Zn, Pb) and radium-226 levels were compared in several tissues of meadow voles MICROTUS PENNSYLVANICUS of both sexes and differing age groups, collected seasonally on Ni and U mine tailings and at a control site. Skeletal Pb was highest during the summer and autumn on the uranium mine tailings while skeletal radium-226 was highest for voles from that site during all seasons. Internal dose rates, due to radium-226 and cumulative dose at capture, were calculated as 0.04 rad per day and 2.5 rad for animals captured in the spring; 0.009 rad per day and 0.6 rad for summer captures; and 0.005 rad per day and 0.3 rad for those taken in the autumn.

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Clulow, F.V., N.R. Cloutier, N.K. Dave, and T.P. Lim, 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

Radium-226 Concentrations in Feces of Snowshoe Hares, LEPUS AMERICANUS, Established near Uranium Mine Tailings

Journal of Environmental Radioactivity 3(4):305-314 (1986)

Samples of snowshoe hare feces were collected near revegetated and chemically stabilized uranium mine tailings and at a control site. Washing the fecal pellets in water with concurrent ultrasonic agitation was ineffective in removing all traces of external contamination. Internal Ra-226 levels in the feces from the mine wastes were higher than controls. Ra-226 levels in feces are considered too low to constitute an important avenue for dispersing the radionuclide from the waste site.

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Hans, J.M., J.B. Hall, and W.E. Moore, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas, NV

Estimates of Population Distributions and Tailings Areas Around Licensed Uranium Mill Sites - Final Report

PB-87-205-217; 89 pp. (1986, August)

URANIUM MILL TAILINGS MANAGEMENT HEALTH, SAFETY, AND BIOMEDICAL STUDIES

Population distributions and tailings areas were estimated from aerial photography for each of 21 licensed uranium millsites. Approximately 11,600 persons live within 5 kilometers of the tailings impoundments at the millsites. About 82% of these persons live near five of the millsites. No persons were found living within 5 kilometers of six of the millsites. Tailings area measurements include the surface area of tailings in impoundments, heap-leached ore, and carryover tailings in evaporation ponds. Approximately 4,000 acres of tailings surfaces were measured for the 21 millsites. About 55% of the tailings surfaces were dry, 11% wet, and the remainder ponded. The average tailings surface area for the millsites is about 200 acres and ranges from 7 to 813 acres.

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IEC Beak Consultants Limited, Mississauga, Ontario, Canada

Probabilistic Calculation of Dose Commitment from Uranium Mill Tailings

INFO-0139; 97 pp. (1983, October)

The necessity of using mathematical modeling methods for predicting the long-term behavior and effects of radioactive waste disposal systems is indicated. A conceptual framework is provided for discussions of reliability of an individual mathematical model: the dependability of information concerning its parameters, the reliability of performance scenarios, and model quality. The role of expert opinion in assessing data reliability and the reliability of results obtained using modeling are discussed. A simple mathematical framework is defined for subsequent discussions of various methods for assessment of prediction reliability. Various ways of specifying parameter values and their reliabilities, namely, point estimates and auxiliary statistics, confidence intervals, and probability distributions on the ranges of parameters are outlined. Methods for converting information about the reliabilities of parameters into information about the reliabilities of predictions (interval arithmetic, Monte Carlo methods, and "analytical methods") are introduced. General comments concerning the usefulness and validity of results of methods for assessing modeling results reliability are made.

542

Lewis, B.G., and M.M. MacDonell, Northwestern University, Department of Civil Engineering, Evanston, IL.

Radon Transport Through a Cool-Season Grass

Journal of Environmental Radioactivity 4(2):123-132 (1986)

The amount of radon-222 released by mature tall fescue (*FESTUCA ARUNDINACEA* SCHREB) growing on uranium mill wastes in a controlled environment was a direct function of leaf area and essentially unrelated to the quantity of water transpired by the plants. The quantity of radon-222 released by the grass blades at maturity was approximately 0.01 Bq per square meter per second. The authors suggest that the radioactive gas is transported from the rooting medium to leaves by mass flow in liquid water, but from leaves to the atmosphere by a path generally independent of water, i.e. primarily through the leaf cuticle and epicuticular wax.

543

Murray, M.L., D.B. Chambers, R.A. Knapp, and S. Kaplan, Senes Consultants Limited, Willowdale, Ontario, Canada

Estimation of Long-Term Risk from Canadian Uranium Mill Tailings

Risk Analysis 7(3):287-298 (1987, September)

A methodology is presented for assessing the risk from Canadian uranium mill tailings piles. The methodology is based on the set of triplets concept and uses an event tree to identify various scenarios representing the performance of a pile over its 1,000-year design life. Compartment-type mathematical models are used to quantify the movement of hazardous substances through the environment. Numerical examples are given of both level 1 (straight probabilistic) and level 2 (probability of frequency) type analyses.

544

National Research Council, Uranium Mill Tailings Study Panel, Washington, DC

Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings

DOE/DP-93032-T2; 262 pp. (1986)

URANIUM MILL TAILINGS MANAGEMENT HEALTH, SAFETY, AND BIOMEDICAL STUDIES

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 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.

545

National Technical Information Service, Springfield, VA

Uranium Mining and Milling Environmental Studies: Report for January 1970 - December 1987

PB-88-855-788; 120 pp. (1988, January)

This bibliography contains citations concerning environmental and social aspects of uranium mining, milling, and ore treatment. Environmental and social aspects include air and water pollution, public health, occupational safety, land reclamation, and waste disposal. The citations refer to monitoring and control of contaminants, and environmental surveys and impact statements for specific areas in the vicinity of mining and ore treatment facilities. There are also references to health studies performed on miners and millworkers. This updated bibliography contains 325 citations, 84 of which are new entries to the previous edition.

546

Nirdosh, I., Lakehead University, School of Engineering, Thunder Bay, Ontario, Canada

Review of Recent Developments in the Removal of Ra-226 and Th-230 From Uranium Ores and Mill Tailings - Review Paper

Uranium 4(2):83-95 (1987, August)

Various technologies developed recently for removing Ra-226 and Th-230 from the uranium ores and mill tailings are critically reviewed and assessed.

547

Parker, F.L., Vanderbilt University, Nashville, TN

Risk Analysis as Applied to Mill Tailings Piles and Hazardous Wastes

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 7-24) (1987)

Some social and scientific aspects of risk assessment are explored by considering applications to three problems. Case studies of risk analysis of uranium tailings, thorium tailings, and chemical wastes are presented. Reliability of knowledge and data bases and effects of public perception of risk and the assessment process are considered.

548

Platford, R.F., and S.R. Joshi, Canada Centre for Inland Waters, Environmental Contaminants Division, Burlington, Ontario, Canada

Dose Rates to Aquatic Life Near a U Waste Site

Health Physics 54(1):63-68 (1988, January)

Radiation dose rates to aquatic organisms have been estimated from radionuclide levels in fish, in water, and in the sediments near an abandoned U waste site. The dose rates in the sediments were high (0.5 Gy per year). Whitefish received dose rates of 10 mGy per year from internal Ra-226 and could have received comparable external dose rates from the sediments when they forage near the lake bottom, as they usually do. The calculated dose rates to fish were comparable to those near an adjacent U mine reported by Swanson in 1983.

549

Reif, J.S., D.J. Schweitzer, S.W. Ferguson, and S.A. Benjamin, Colorado State University, Department of Microbiology and Environmental Health, Fort Collins, CO; Colorado State University, College of Veterinary Medicine and Biomedical Sciences, Fort Collins, CO; Colorado Department of Health, Denver, CO

URANIUM MILL TAILINGS MANAGEMENT HEALTH, SAFETY, AND BIOMEDICAL STUDIES

Canine Neoplasia and Exposure to Uranium Mill Tailings in Mesa County, Colorado

CONF-830101; Epidemiology Applied to Health Physics, Proceedings of the Health Physics Society 16th Midyear Topical Meeting, Albuquerque, NM, January 9-13, 1983, 556 pp.; (pp. 461-469) (1983)

A canine cancer registry was established for Mesa County, Colorado, in order to collect material for a case control analysis of exposure to uranium tailings. Between 1979 and 1981, 212 cases of canine cancer were confirmed histologically. Based on the address provided at the time of diagnosis, 33 dogs (15.6%) lived in a house with some exposure to uranium tailings. A control group, comprised of dogs with a histologic diagnosis other than cancer, was stratified according to hospital and matched with cases on a 1:1 basis. No significant differences were noted with respect to exposure to uranium tailings for total cancers or cancers of specific sites including lymph node, breast, liver, testicle, and bone. The overall estimated relative risk was 0.70 (95% CI 0.04-1.16). Canine population estimates were derived for Mesa County in order to develop crude incidence rates for the major types and sites of cancer. Crude rates were compared with those published previously for Alameda County, California and Tulsa County, Oklahoma. Mesa County rates for total cancer incidence, connective tissue tumors and nonmelanoma skin cancer were higher than those reported for Alameda County. When compared with Tulsa County, Mesa County rates for total cancer, breast cancer, melanoma, and mastocytoma were lower than expected while rates for osteosarcoma, hemangiosarcoma, and fibrosarcoma significantly exceeded expected values.

550

Rope, S.K., and F.W. Whicker, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

A Field Study of Ra Accumulation in Trout with Assessment of Radiation Dose to Man

Health Physics 49(2):247-257 (1985, August)

The purpose of this study was to determine the concentrations of Ra-226 in edible fish from surface ponds near an open pit uranium mine. Because one reclamation plan for the uranium mine proposed formation of an artificial

lake in the open pit, potential radiation dose to man from ingestion of fish needed to be investigated. Trout were collected from four existing ponds which varied in mean Ra-226 concentration from 12-33 pCi/l and in Ca concentration from 30-330 mg Ca/l. Radium and calcium accumulation in trout flesh, skin, fins and bone were measured. Geometric mean concentrations of Ra-226 in trout flesh from four ponds ranged from 6.3 to 30 pCi/kg wet weight. The distribution of Ra in the trout body was similar to that of Ca. Of the total Ra-226 in trout carcasses, 6% was in flesh, 25% was in skin, 28% was in fins, 41% was in bone. Mean concentration factors for Ra-226 in trout flesh from the four ponds ranged 0.29-2.5. Bone concentration factors were up to 260 higher than for flesh. Observed ratios (Ra/Ca in fish tissue divided by Ra/Ca in water) were used to normalize the differences in Ca availability among the locations. Observed ratios were higher in all tissues of fish which had been in the ponds for a longer time, indicating that Ra-226 concentrations in fish may increase with continued exposure to the nuclide. The calculated dose equivalent commitment to human endosteal tissue ranged from 0.2-2 mrem per fish consumed, depending on the assumed dietary and environmental parameters. Neglecting the consumption of trout skin underestimated the ingestion dose from Ra-226 by a factor of 5-10. Estimated annual dose equivalent rates to human endosteal tissue ranged from 1.0-83 mrem/yr for an individual who consumed one fish per week for a 50-yr period. The dose to man from ingestion of Ra-226 in fish would not likely preclude the establishment of a recreational lake at this site.

551

Streng, D.L., and T.J. Bander, Pacific Northwest Laboratory, Richland, WA

MILDOS - A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations

NUREG/CR-2011; 179 pp. (1981, April)

MILDOS is a FORTRAN computer code which calculates the dose commitments received by individuals and the general population within an 80 kilometer radius of an operating uranium recovery facility. In addition air and ground concentrations are presented for individual locations, as well as for a generalized population grid. Extra-regional population doses resulting from transport of radon and export of agricultural produce are also displayed. The transport of radiological emissions from

URANIUM MILL TAILINGS MANAGEMENT HEALTH, SAFETY, AND BIOMEDICAL STUDIES

point and area sources is predicted by using a sector-averaged gaussian plume dispersion model. Mechanisms such as radioactive decay, plume depletion by deposition, in-growth of daughter products and resuspension of deposited radionuclides are included in the transport model. Alterations in operation throughout the facility's lifetime can be accounted for in the input stream. The pathways considered are: inhalation; external exposure from ground shine and cloud immersion; and ingestion of vegetables, meat and milk. Dose commitments are calculated primarily on the basis of the recommendations of the international commission on radiological protection (ICRP). Predictive 40 CFR 190 and 10 CFR 20 compliances are also performed. This computer code is designed primarily for uranium milling facilities and should not be used for operations with different radionuclides or processes.

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U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management, Washington, DC

Radon Releases from Uranium Mining and Milling and Their Calculated Health Effects - Topical Report

NUREG-0757; 110 pp. (1981, February)

The Nuclear Regulatory Commission's Fuel Cycle Rule, 10 CFR 51.20, Table S-3 summarizes the environmental effects of the uranium fuel cycle. In April 1978 the Commission deleted from Table S-3 the original radon-222 estimate which did not include long-term radon releases from uranium mill tailings piles or radon releases from uranium mining operations. Commission-sponsored milling operations have provided the technical basis for new estimates of radon releases from the uranium fuel cycle. This report summarizes results of the research projects and explains how new radon estimates were developed. The new estimates are: 5350 curies of radon-222 from mining and milling of the uranium for one

year's operation of a 1000-MW(e) light water reactor, plus continuing releases of 17 Ci per year from reclaimed mine and mill sites, increasing to 30 Ci/year as reclamation measures are degraded with time. These releases are calculated to cause less than one cancer death in the next 1000 years. For the entire nuclear industry projected in 1985, radon releases have a calculated potential to cause 61 premature deaths from cancer in the total U.S. Population by the end of the 21st century.

553

Walsh, M.L., W&W Radiological and Environmental Consultant Services, Inc., Canada

Doses Resulting from Intrusion into Uranium Tailings Areas

INFO-0182; 78 pp. (1986, February)

In the future, it is conceivable that institutional controls of uranium tailings areas may cease to exist and individuals may intrude in these areas unaware of the potential radiation hazards. The objective of this study was to estimate the potential doses to the intruders for a comprehensive set of intrusion scenarios. Reference tailings areas in the Elliot Lake region of northern Ontario and in northern Saskatchewan were developed to the extent required to calculate radiation exposures. The intrusion scenario, for which dose calculations were performed, were categorized into the following classes: habitation of the tailings, agricultural activities, construction activities, and recreational activities. Realistic exposure conditions were specified and annual doses were calculated by applying standard dose conversion factors. The exposure estimates demonstrated that the annual doses resulting from recreational activities and from construction activities would be generally small, less than twenty millisieverts, while the habitation and agricultural activities could hypothetically result in doses of several hundred millisieverts. However, the probability of occurrence of these latter classes of scenarios is considered to be much lower than scenarios involving either construction or recreational activities.

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Demopoulos, G.P.

Pressure Leaching of Uranium Ores in a Calcium Chloride Medium with Simultaneous Solubilization of Radium

Transactions - Institution of Mining and Metallurgy 96:C28-C36 (1987, March)

A pressure-leach system has been developed that simultaneously extracts uranium and radium from uranium ores. This minimizes environmental risk from the tailings. The ore is leached under oxygen overpressure in an acidified calcium chloride medium. The addition of CaCl_2 to the leach slurry allows effective solubilization and extraction of radium. In contrast, conventional H_2SO_4 leaching leaves all radium in the residue. The present leaching method proved very effective with both low-grade (0.11% U; 380 pCi/g Ra) and high-grade ores (1.69% U; 5880 pCi/g Ra) found in Canada. Final leach residues containing less than 40 pCi/g Ra are produced. These can be safely discarded without the need for short, or long-term tailings management. The effects of various leaching parameters, such as temperature, oxygen pressure, slurry density and concentration of CaCl_2 and HCl , on the coextraction of uranium and radium were investigated. All are discussed, along with the chemistry of the new leaching system.

555

Forssberg, E. and L. Nilsson, Lulea University, Division of Mineral Processing, Sweden

Treatment of Uranium Extraction Residues

Erzmetall 40(7-8):398-406 (1987, July-August)

This report describes the treatment of residues from uranium extraction. It contains a brief review of the various processes for uranium extraction, particularly extraction in an acidic environment. The properties and treatment of the residues are described in more detail with special reference to the uranium deposit at Lilljuthatten in the Swedish province of Jaemtland. The results of the study show that the tailings have good properties from an environmental standpoint. This is largely because the ore does not need to be ground to small particle sizes to liberate uranium minerals for the leaching process. The properties of the tailings can be further improved by stabilization with cement or pozzuolane.

556

Halbert, B.B., J.M. Scharer, and R.A. Knapp, Senes Consultants Limited, Willowdale, Ontario, Canada

Report on Assessment of the Mechanism of Bacterially Assisted Oxidation of Pyritic Uranium Tailings

INIS-mf-11159; 150 pp. (1984, July)

The oxidation of pyritic minerals has been shown to be catalyzed by the presence of iron- and sulphur-oxidizing bacteria. *THIOBACILLUS FERROXIDANS* plays the most significant role in the formation and propagation of acidic conditions. Optimum growth conditions for the *T. FERROXIDANS* occurs at a temperature of 35 deg C and pH of 2 to 3. Bacterially assisted oxidation of pyrite involves both direct and indirect contact mechanisms. The direct contact mechanism entails enzymatic oxidation of the insoluble sulfide moiety. The indirect mechanism involves bacterial oxidation of the dissolved ferrous component to the ferric state. The ferric iron, in turn, acts as the prime oxidant of pyrite and is reduced to ferrous iron. The re-oxidation of the dissolved ferrous component which is catalyzed by bacterial activity, completes the cyclic process. The rate of bacterial oxidation is affected by: the geochemistry and reactivity of the pyritic material; the amount of pyrite present in the waste material and the exposed surface area of the pyritic component; the availability of oxygen and carbon dioxide; the pH and temperature of the leach solution; and the presence (or absence) of organic inhibitors. Of the above factors, oxygen has been frequently identified as the rate limiting reactant in tailings.

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Kearns, A., Damez and Moore, Darwin, Australia

Rapid Soil Toxicity Assessment at Rum Jungle, Northern Territory - A Requirement for Rehabilitation Design, Quality Control and Monitoring

Environmental Planning and Management for Mining and Znergy, P.J.R. Broese van Groenou and J.R. Burton (eds.), Proceedings of the Tenth North Australian Mine Rehabilitation Workshop, Darwin, Australia, June 7, 1986, 301 pp.; (pp. 81-112) (1986)

URANIUM MILL TAILINGS MANAGEMENT DECONTAMINATION STUDIES

The rehabilitation of degraded land at the old Rum Jungle mine site was designed and constructed over a three year period, from November, 1982 to December, 1985, under strict time and budget constraints. Reliable information on the potential toxicity of affected soil/spoil to plant growth could not be gathered by pot or field trials due to time constraints but was still required to develop cost effective and successful rehabilitation options. Detailed chemical analyses of heavy metals, cations, and anions were too costly and time-consuming to form a regular part of a routine toxicity assessment program. Therefore, detailed chemical data from earlier investigations were compared to general parameters of pH, electrical conductivity and lime requirement to assess the degree of soil toxicity. These rapidly determined parameters were found to be reproducible and representative indications of soil conditions. The rapid soil toxicity assessment was a sufficient source of information to develop options for soil/spoil removal, depth or type of soil cover, or amount of lime treatment to overcome soil toxicity and allow successful revegetation.

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Melis, L.A., Melis Consulting Engineering Limited, Saskatoon, Saskatchewan, Canada

Radium Removal from Canadian Uranium Mining Effluents by a Radium-Selective Ion Exchange Complexer

CIM (Canadian Institute of Mining and Metallurgy) Bulletin 78(883):82-90 (1985, November)

A laboratory test program was initiated by the Department of Energy, Mines and Resources as part of the National Uranium Tailings Program to investigate the applicability of a radium-selective ion exchange complexer for removing radium from Canadian uranium mining effluents. The test program was carried out by Melis Consulting Engineers Limited, under contract to the Department of Supply and Services using the Saskatchewan Research Council facilities located in Saskatoon, Saskatchewan. The results of this work showed the ion exchange complexer, Dowex XFS 43230.00, to be efficient in removing radium from contaminated water of uranium mining operations. The ultimate loading capacity of the resin on one type of water treated was determined to be approximately 1,6000 Bq/cu cm of new resin. Although this resin has potential application for treatment of effluent streams in uranium operations it has been shown that the resin effi-

ciency and capacity is directly related to the chemistry of the water being treated. Site-specific test work is, therefore, required in order to establish reliable design data for full-scale operations.

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

Treatment Scheme for Controlling the Migration of Radium from a Tailings Impoundment

Radon, Radium, and Other Radioactivity in Ground Water: Hydrogeologic Impact and Application to Indoor Airborne Contamination, Graves, B. (ed.), Proceedings of a Conference, Somerset, NJ, April 7, 1987. Lewis Publishers, Chelsea, MI; (pp. 499-510) (1987)

Under sponsorship of the Nuclear Regulatory Commission's Uranium Research and Recovery Program, Pacific Northwest Laboratory (PNL) has investigated the use of various neutralizing reagents and techniques to attenuate the movement of contaminants associated with acidic uranium mill tailings. The objective of this study was to identify those contaminants which are not effectively attenuated by common neutralization methods and to develop alternative control measures. Of those contaminants associated with uranium mill tailings which were identified as not being effectively immobilized by tailing neutralization, radium imposes an important environmental concern in terms of potential groundwater contamination. Control or attenuation of radium is of special concern primarily due to its radiological health implications. For that reason, the Environmental Protection Agency (EPA) has implemented strict guidelines governing the maximum allowable concentration in drinking waters. Current EPA guidelines call for total radium activities not to exceed 5 pCi/l. Due to the high activity of soluble radium in the acidic uranium mill tailings environment (several hundred to several thousand pCi/l), specific ion removal procedures were investigated for use in attenuating radium in order to prevent future groundwater contamination. Results of these investigations led to the development of a tailing additive comprised of a mixture of hydrated lime and barium chloride, which added to acidic tailings, can reduce the amount of leachable radium escaping a designated tailing impoundment. In laboratory verification tests, this

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radium specific tailings treatment reduced the effluent solution activity of radium by three orders of magnitude, from greater than 3500 pCi/l to 1.7 pCi/l, in comparison with untreated acidic tailings.

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Rum Jungle Rehabilitation Project - Update

Water 13(4):21-22 (1986, December)

The Rum Jungle uranium mine project created a serious pollution and public health problem, which was exacerbated by the monsoonal climate and the dispersed nature of the site. The rehabilitation activities successfully reduced the environmental pollution, and pleasingly transformed the original stark landscape. The project serves as a model for the management and rehabilitation of other mine sites in this climate.

561

Allen, C.G., Northern Territory Department of Mines and Energy, Darwin, Australia

Rum Jungle - A Perspective

Environmental Planning and Management for Mining and Energy, P.J.R. Broese van Groenou and J.R. Burton (eds.), Proceedings of the Tenth North Australian Mine Rehabilitation Workshop, Darwin, Australia, June 7, 1986, 301 pp.; (pp. 19-37) (1986)

The Rum Jungle Rehabilitation Project includes work aimed at reducing the environmental pollution emanating from the abandoned Rum Jungle mine site. This pollution is a result of mining and treatment of uranium and other metals activities at Rum Jungle during the period 1952 to 1971. This review attempts to relate specific aspects of the rehabilitation works, which were done a considerable time after the closure of the mine, to similar measures had they been carried out during, or immediately after, the mine's operating phase. Conclusions are drawn with respect to the economics of the timing of mine rehabilitation in relation to the Rum Jungle Project. Observations concerning certain aspects realized as a result of the Rum Jungle Project are given.

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Allen, C.G., and T.J. Verhoeven, Department of Mines and Energy, Darwin, Northern Territory, Australia; Department of Resources and Energy, Canberra, Australia

Rum Jungle Rehabilitation Project - Final Project Report

Rum Jungle Rehabilitation Project: Final Project Report, C.G. Allen and T.J. Verhoeven (eds.), Northern Territory Department of Mines and Energy, Darwin, Australia (1986)

The Rum Jungle Rehabilitation Project which was carried out over a four year period commencing in July 1982 was a Commonwealth funded project managed by the Northern Territory Government. The Project was aimed at substantially reducing the adverse environmental effects of the mining and milling of uranium and other metals at Rum Jungle between 1952 and 1971. The Project was, with the exception of some minor works and the ongoing monitoring and maintenance program, completed in June 1986. The rehabilitation program is expected to be completed within the escalated budget of \$16.2 million (in 1982 values). The monitoring program, established as an integral part of the Project, has demonstrated the effectiveness of the rehabilitation measures implemented during the program. It has provided positive evidence of reductions in the heavy metal burden being carried by the East Branch of the Finnis River, thus confirming a reduction in the pollution from the Rum Jungle mine site.

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Australian Mining Industry Council, Canberra, Australia; Department of Mines and Energy, Darwin, Northern Territory, Australia

Rehabilitation of Rum Jungle

Proceedings of an Environmental Workshop, Launceston, Australia, October 13, 1986; (pp. 550-552) (1986)

Mining and treatment operations, and disposal of waste products from these operations, were carried out within the structures of the environmental regulations applying between 1954 and 1971. As a result, the operation left a legacy of continuing environmental pollution which the Rum Jungle Rehabilitation Project was aimed at alleviating. The problems at Rum Jungle consisted of three major elements: overburden heaps and copper heap leach piles were slowly oxidizing producing acid mine drainage (the most serious form of pollution at Rum Jungle); water in the open cut pits became acidic and contained

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significant concentrations of heavy metals; and the tailings dam was a low-level source of radioactivity, aesthetically disastrous, and a source of acids and heavy metals.

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Beak Consultants Limited, Toronto, Ontario, Canada; Golder Associates, Inc., Toronto, Ontario, Canada

Waste Management Implications of Concentrating Slimes - Characteristics and Potential Problems

INFO-0195-1; 112 pp. (1986, May)

This report describes the geotechnical and environmental characteristics of fine-grained uranium tailings (slimes) which may influence both short- and long-term management of slime-enriched uranium tailings impoundments. Properties of slimes are compared with those of sand tailings using field and laboratory data primarily from naturally segregated tailings in the Elliot Lake area, Ontario, and Northern Saskatchewan uranium-bearing regions of Canada. Slimes may be generally characterized as silt-sized particles (less than 200 mesh or 75 microns) with high water contents, relatively low permeability, low density, and high compressibility relative to sand tailings. Plasticity indices range from low to high depending on clay content and mineralogy of the parent ore; Elliot Lake slimes are almost nonplastic, while Northern Saskatchewan slimes exhibit high plasticity. Radionuclides such as Ra-226 and Pb-210 are strongly associated with the fine particle fraction. Data from northern Saskatchewan slimes suggest that trace metals follow a similar pattern. In pyritic tailings (Elliot Lake) most of the metals are associated with pyrite and thus distributions are similar in coarse and fine tailings. Pyritic tailings generally exhibit low pH and high concentrations of soluble metals, sulfate and radionuclides. However, due to the high water retention capacity of slimes, pyrite oxidation is inhibited and soluble contaminant concentrations may also be lower than in coarse-grained tailings. Similarly, radon gas exhalation from slimes may also be lower due to lower diffusion coefficients through the saturated tailings. Reclamation of slimes by revegetation has been unsuccessful to date. Poor aeration of the root zone appears to be the major growth limiting factor, although under aerobic conditions, low pH and high concentrations of toxic elements would inhibit growth. Key management considerations

for slime-enriched tailings areas include: overall mass stability, drainage/settlement and site accessibility, dusting/water erosion, overall water balance/seepage, and reclamation. Management alternatives are discussed in terms of interactions between geotechnical, geochemical and biological processes.

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Broese van Groenou, P.J.R., and J.R. Burton

Environmental Planning and Management for Mining and Energy

Proceedings of the Tenth North Australian Mine Rehabilitation Workshop, Darwin, Australia, June 7, 1986, 301 pp. (1986)

Papers presented at the Tenth North Australian Mine Rehabilitation Workshop cover environmental planning and assessment, rehabilitation proposals for the Rum Jungle uranium mine, slope stabilization, revegetation and rehabilitation of the Ranger uranium mine.

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Farmer, E.E., and G.E. Schuman, Intermountain Research Station, Logan, UT

Reclamation of Uranium Mining and Milling Disturbances

Environmental Consequences of Energy Production: Problems and Prospects, Majumdar, S.K., F.J. Brenner, and E.W. Miller (eds.). Pennsylvania Academy of Science, Phillipsburg, NJ; (pp. 182-197) (1987)

Since 1945 the history of uranium mining and milling in the United States has been a story of wide fluctuations in market prices and in mining and milling capacity. The late 1960s and the 1970s saw a sizeable reduction in the production of yellowcake because of an earlier oversupply, a leveling off of the military demand, and a failure of the nuclear electric power industry to create the anticipated commercial demand. The decline in the domestic production of yellowcake has continued through the early 1980s to the present. Today, there are five operating uranium mills in the U.S.: one in Wyoming, two in Utah, one in New Mexico, and one in Texas.

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Of these five mills, three are operating on a reduced schedule, as little as three days a month. A significant portion of the current U.S. production of uranium goes overseas to fulfill Japanese, French, and other European contracts. There is still a sizeable reclamation job to be accomplished on old uranium wastes, both tailings impoundments and overburden embankments. Before the Uranium Mill Tailings Control Act of 1978 (PL 95-604), reclamation was frequently omitted altogether, or else done in a haphazard fashion. The total area of unreclaimed, radioactive, uranium overburden wastes in the western U.S. is not known, but the area is large, probably several thousand hectares. Fortunately, these overburden wastes are almost entirely located in remote areas. Mill tailings are more difficult to reclaim than overburden, and represent more serious health hazards. There are approximately 25 million metric tons of unreclaimed uranium mill tailings, with variable health hazards, located in the U.S.

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Canada Centre for Mineral and Energy Technology,
Department of Energy, Mines and Resources,
Ottawa, Ontario, Canada

Evaluation of Flexible Membrane Liners as Long-Term Barriers for Uranium Mill Tailings: Phase I

INIS-mf-11156; 583 pp. (1984, July)

The National Uranium Tailings Program has commissioned a study to evaluate flexible membrane liners (geomembranes) as long-term barriers for Canadian uranium mill tailings. This study reviews the common liner type and addresses flexible liners (polymeric membranes and asphalt) in detail. Liner fabrication, design, installation, and performance are reviewed. Conceptual designs are presented for basins to accommodate 20 years accumulation of uranium tailings from mills in Elliot Lake and southeastern Athabasca. Nine polymeric and three asphalt liner types have been considered with respect to the physical and chemical environment in the uranium producing areas of Canada. All materials indicate good chemical resistance to uranium wastes but are subject to installation problems.

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Koperski, J., Ranger Uranium Mines Pty. Limited,
Jabiru, Northern Territory, Australia

Radiological Aspects of Rehabilitation of Ranger Uranium Mines Site

Environmental Planning and Management for
Mining and Energy, P.J.R. Broese van Groenou
and J.R. Burton (eds.), Proceedings of the Tenth
North Australian Mine Rehabilitation Workshop,
Darwin, Australia, June 7, 1986, 301 pp.; (pp. 253-
263) (1986)

Waste management and disposal will be the central issue during the rehabilitation of the Ranger site. The principal wastes which will remain after mining and milling operations have ended at Ranger are mine waste rock materials and mill tailings. These will contain significant amounts of radioactive elements. The long-lived nature of the residual radioactivity in the uranium mining and milling wastes may present a radiological hazard to the public.

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Kvasnicka, J., Northern Territory Department of
Mines and Energy, Darwin, Australia

Rehabilitation Proposal for the Abandoned Uranium Mine at Rum Jungle Creek South

Environmental Planning and Management for
Mining and Energy, P.J.R. Broese van Groenou
and J.R. Burton (eds.), Proceedings of the Tenth
North Australian Mine Rehabilitation Workshop,
Darwin, Australia, June 7, 1986, 301 pp.; (pp. 48-64)
(1986)

The abandoned uranium mine Rum Jungle Creek South was not rehabilitated after the Rum Jungle uranium project ceased operation in 1971. The mine area is characterized by high levels of external gamma-radiation, radioactive dusts, and radon daughters. This implies that the annual doses to some individuals are about 5 mSv which is the present Australian public limit. The present annual collective dose equivalent to members of the public visiting the area was evaluated about 0.42 man Sv, and the 100 years collective dose commitment is calculated to be about 260 man Sv. Since the new Australian public

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limit for exposures extending over many years is going to be 1 mSv/y, the number of people receiving doses higher than the regulatory limits will increase. Four rehabilitation options ranging from a general cleanup, burial, and stabilization to full rehabilitation and revegetation have been considered. The ALARA/cost benefit analysis was used to find the optimum rehabilitation option. This procedure has an associated cost of \$2.13 million (Australian dollars). If rehabilitation takes place, the present collective dose commitment will be reduced by a factor of 7 and individuals exposed above the new public limit of 1 mSv/y would be unlikely.

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Kvasnicka, J., Department of Mines and Energy, Darwin, Northern Territory, Australia

Rum Jungle Creek South Uranium Mine - Present Radiological Impact and Rehabilitation Proposal, Appendix F: External Gamma-Ray Survey and Soil Gamma Activity Survey Results

Report; 20 pp. (1987, July)

This is an appendix to the main report which estimated the radiological conditions on-site. The appendix presents the results of the detailed on-site external gamma radiation exposure rate survey together with the soil gamma activity depth dependence results. In order to identify any differences between the two, soil contamination studies performed in this report are compared with those from the main report. The experimentally assessed decontamination factors are generally higher than those factors used in the main report and their application would further support the conclusions of the report. In retrospect, the rehabilitation of the Rum Jungle Creek South abandoned uranium mine should have required consideration of these points: (1) the location of an appropriate disposal site; (2) the stabilization of radioactive materials; and (3) the design of a rehabilitation plan (two steps are recommended with the first step following the strategy as described in rehabilitation option No. 2 of the main report and the second step comprising those works as suggested in rehabilitation option No. 3). Any different partial rehabilitation of the site should not be contemplated as the public may develop the false impression that the site is safe.

571

McCready, A.A., Harding-Lawson Associates, Novato, CA

QC/QA for Large Geomembrane Installations in the Uranium Milling Industry

Environmental Geotechnology, Fang, H.Y. (ed.), Proceedings of an International Symposium, Allentown, PA, April 21, 1986. Envo Publishing Company, Inc., Bethlehem, PA, Vol. 1; (pp. 257-261) (1986)

Quality Control (QC) and Quality Assurance (QA) of geomembrane installations have recently received considerable attention. In the past, QC/QA was largely left to the installer. Adequate control measures were sometimes provided; however, there are many examples of failed geomembrane installations, and membranes that now demand extensive maintenance because of poor QC/QA practices. QC and QA programs insist on quality workmanship. This is accomplished by observation, tests, and repair of damage or defects in the field.

572

Nichols, F.D., J.M. Brink, and P.C. Nyberg, U.S. Environmental Protection Agency, Region VIII, Denver, CO

Cleanup of Radioactive Mill Tailings from Properties in Monticello, Utah

Management of Uncontrolled Hazardous Waste Sites, Proceedings of the Fifth National Conference, Washington, DC, November 7, 1984. Hazardous Materials Control Research Institute, Silver Spring, MD; (pp. 504-508) (1984)

Elevated levels of radon daughter products were discovered in two structures in Monticello, Utah. The radiation source was radioactive mill tailings sand (a waste residue from ore extraction processes) used as fill and building material when the structures, a house and a store, were built during the mid-1940s. The tailings, which contained small amounts of uranium and radium, originated from a local World War II-era vanadium processing mill. U.S. Department of Energy, present-day custodian of the millsite, determined that it did not have the legal authority to address the health threat to the occupants of the

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structures. The U.S. Environmental Protection Agency undertook a Superfund Planned Removal Action to eliminate the exposure source and the associated health threat.

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Ritchie, A.I.M., and J.R. Harries, Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sutherland, Australia

Pyritic Oxidation: Lessons from Rum Jungle

Nuclear Spectrum 3(1):25-30 (1987)

Oxidation of pyrite is the main cause of pollution in the abandoned uranium mine site at Rum Jungle in the Northern Territory of Australia. This problem and the rehabilitation of the Rum Jungle site are discussed.

574

Talmage, S.S., and B.D. Chilton, Oak Ridge National Laboratory, Oak Ridge, TN

Cleanup Procedures at the Nevada Test Site and at Other Radioactively Contaminated Sites Including Representative Costs of Cleanup and Treatment of Contaminated Areas

ORNL-6317; NVO/AEIC-306 (1987, September)

This review summarizes available information on cleanup procedures at the Nevada Test Site and at other radioactively contaminated sites. Radionuclide distribution and inventory, size of the contaminated areas, equipment and cleanup procedures are included. Information about the cost of cleanup and treatment for contaminated land is presented. Selected measures that could be useful in estimating the cost of cleaning up radioactively contaminated areas are described.

575

Tsezos, M., M.H.I. Baird, and L.W. Shemilt, McMaster University, Department of Chemical Engineering, Hamilton, Ontario, Canada

The Use of Immobilised Biomass to Remove and Recover Radium from Elliot Lake Uranium Tailing Streams

Hydrometallurgy 17(3):357-368 (1987)

Return sludge from a municipal wastewater treatment plant was killed and subsequently immobilized in the form of particles of approximately 1 mm in diameter. The immobilized biomass particles were then tested for their capacity to selectively adsorb radium-226 from the waste waters of the uranium mining and milling operations in Elliot Lake, Ontario. Both the adsorption equilibrium and the kinetics of radium uptake were examined. The elution of the adsorbed radium from the biomass particles and the subsequent reuse of the particles for additional radium uptake were also studied. This information has provided an improved understanding of the way the immobilized biomass functions as a radium adsorbent.

576

U.S. Bureau of Land Management, Albuquerque, NM

Jackpile-Paguate Uranium Mine Reclamation Project, Laguna Indian Reservation, Cibola County, New Mexico

Report; EIS-86-0412 (Final) (1986, October)

The final version of environmental impact statement, EPA No. 860443P, relates to a proposed reclamation plan for the Jackpile-Paguate uranium mine in New Mexico. The statement describes backfilling of disturbed areas, the reduction of waste dump slopes, stream stabilization, and revegetation plans. Positive impacts include the restoration of the site to productive land use, the reduction of hazards, and aesthetic improvements. Negative impacts include a one-time loss of water and assignment of labor. The Surface Mining Control and Reclamation Act of 1977 provides a legal mandate for the statement. The summary includes a reference to the draft statement.

URANIUM MILL TAILINGS MANAGEMENT WASTE DISPOSAL

577

Armstrong, A., Ranger Uranium Mines Pty. Limited, Jabiru, Northern Territory, Australia

Rehabilitation at Ranger

Environmental Planning and Management for Mining and Energy, P.J.R. Broese van Groenou and J.R. Burton (eds.), Proceedings of the Tenth North Australian Mine Rehabilitation Workshop, Darwin, Australia, June 7, 1986, 301 pp.; (pp. 264-279) (1986)

The Ranger uranium mine produces about 3,000 tons of yellowcake annually. During operation, about 5.8 million tons of rock are mined from its No. 1 open cut. Of this approximately 2.5 million tons is ore grade material. The balance of 3.3 million tons is waste rock containing less than 0.02% U₃₀₈ which is disposed of on the waste rock dump or is used in construction of the tailings dam walls. Tailings are produced at a rate of approximately 1.275 million cubic meters per year, and are pumped to the tailings dam for storage.

578

Davis, A., and D.D. Runnells, Camp Dresser and McKee, Inc., Denver, CO; University of Colorado, Department of Geological Sciences, Boulder, CO

Geochemical Interactions Between Acidic Tailings Fluid and Bedrock: Use of the Computer Model MINTEQ

Applied Geochemistry 2(3):231-241 (1987, May-June)

Contamination of groundwater in domestic water wells has been documented in the vicinity of a uranium mill. Acidic tailings fluid (raffinate) was passed through a core collected from the subjacent calcite-bearing sandstone to evaluate the effect of interactions between the raffinate and bedrock on the fluid pH, and on the mobility of Al, Ca, Cl, Fe, Mn, SO₄, and Zn. The results were modeled using the mass transfer computer program MINTEQ. Comparison between the experimental effluent and groundwater metal concentrations downgradient from the site are in general agreement. Specifically, SO₄ appears to be the best indicator of the encroaching front of acidic contaminants in the subsurface. The general

concurrence between the observed experimental results, the computed model predictions, and the downgradient groundwater metal concentrations indicate that mass transfer models such as MINTEQ are useful in predicting the interaction between bedrock and acidic tailings fluid.

579

Hunt, C.D., Rhode Island University, Marine Ecosystems Research Laboratory, Narragansett, RI

Fate and Bioaccumulation of Soil-Associated Low-Level Naturally Occurring Radioactivity Following Disposal into a Marine Ecosystem - Final Report

PB-87-204-822; 169 pp. (1986, October 1)

The fate of radium (Ra) and other naturally occurring uranium-series isotopes associated with soils disposed in seawater was examined using the Marine Ecosystem Research Laboratory (MERL) controlled marine ecosystems. Thirty-seven kilograms of a soil containing approximately 400 pCi Ra-226/g from an inactive uranium ore processing plant site in Middlesex, New Jersey were added to each of two mesocosms over five days in mid-September 1984. Radionuclide activity in these and two control mesocosms was observed for three months after the soil additions. Radioactivity in the soil appeared to be confined to discrete soil particles rather than being distributed equally on the soil particles, suggesting the source of the radioactivity was remnant ore particles.

580

Marshallman, I.W., Queensland Mines Limited, Nabarlek, Northern Territory, Australia

Radiation Characteristics of Sub-Aerially Deposited Uranium Tailings

CONF-850844; Proceedings of the Australian Radiation Protection Society Tenth Annual Conference, Melbourne, Australia, August 19, 1985; (pp. 55-59); Radiation Protection in Australia 5(2):55-59 (1987, April)

The radiation emitted from the surface of uranium tailings that had been deposited by the sub-aerial deposition

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technique has been investigated. The investigation involved depositing six layers of tailings in a test tank by the sub-aerial method and monitoring the radiation emitted from the tailings surface as the layers settled and dried. Radon gas concentrations were measured virtually continuously at 75 mm above the tailings surface for the six layers. The radon concentration and exposure rate variation with height was investigated on the sixth layer. Radon daughter working levels were monitored for the fifth and sixth layers. From this investigation a prediction is made of the radiation levels to be encountered in the tailings pit if this sub-aerial deposition method is carried out.

581

Metzner, A.

Ranger Factors

Mining Monthly (8602):36-39 (1986, February)

The management and operation of the Ranger Uranium Mine in the Northern Territory of Australia is discussed. The disposal of water from the milling operation is one of the major problems facing the mine management. Background information is given on the company operating the mine, Energy Resources of Australia, and its relationship with the Australian government.

582

Sadowski, G.R., L.G.F.S. de Mello, A.H. da Conceicao, and S.C. Calixto

Conceptual Design and Interpretation on the Behavior of Mina do Cercado's Tailings Dam

IAEA-SR-110; Management Options for Low and Intermediate Level Wastes in Latin America, Proceedings of a Seminar, Rio de Janeiro, Brazil, October 13, 1986. International Atomic Energy Agency, Vienna, Austria; (pp. 474-509) (1986)

The deposition of solid and liquid wastes generated by the industrial processing of uranium ores at the Mina do Cercado in Pocos de Caldas, in an area adjacent to the Processing Plant, required specific and judicious studies. Such wastes usually required a suitable chemical treatment to reduce their respective radioactivity to the limits accepted by the controlling entities. They also demand for a strict study of the groundwater system and geotechnical behavior of the impoundment area. Special attention should be stressed on the seepage through the mass of the dam and its foundation, as well as through the natural borders of the reservoir. Other aspects taking in account the stability and risk analysis against natural hazards like earthquakes, floods, etc. are usually also taken in consideration.

URANIUM MILL TAILINGS MANAGEMENT GENERAL STUDIES

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UMTRAP Vicinity Properties

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 59-79) (1987)

Photographs are presented for the purpose of reviewing the vicinity property case study as presented at the Annual Remedial Action Program Meeting held in Grand Junction, Colorado, on April 29, 1987. The slides were presented as a means of displaying the remedial actions performed on one vicinity property from the start of remedial actions to completion. The photos display remedial action states associated with a Strabane, Pennsylvania, vicinity property located near the Canonsburg Uranium Mill Tailings Remedial Action (UMTRA) site. Two hundred and seventy-six cubic yards of residual radioactive materials were excavated, removed, and encapsulated within the Canonsburg disposal cell. Remedial action included exterior excavation covering approximately 70% of the outdoor surface area and a small amount of interior excavation with the basement. This vicinity property was certified as having met EPA standards on April 17, 1987.

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Hester (K.D.) and Associates, Oakville, Ontario, Canada; Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Ontario, Canada

Practical Considerations of Pyrite Oxidation Control in Uranium Tailings

INIS-mf-11157; 269 pp. (1984, May)

The problems posed by the oxidation of pyrite in uranium tailings include the generation of sulfuric acid and acid sulfate metal salts. These have substantial negative impacts on watercourse biota by themselves, and the lowered pH levels tend to mobilize heavy metals present in the tailings. The oxidation of pyrite at lower pH levels is catalyzed by sulfur and iron oxidizing bacteria present in soils. No clear solution to the problems came from this study. Exclusion of air is a most important preventive measure against bacterial catalysis of oxidation. Bactericides, chemically breaking the chain of integrated oxidation reactions, maintaining anaerobic conditions, or maintaining a neutral or alkaline pH all reduce the oxidation rate. Removal of pyrite by flotation will reduce but not eliminate the impact of pyrite oxidation. Controlled oxidation of the remaining sulfide in the flotation tails would provide an innocuous tailing so far as acidity generation is concerned.

585

Landa, E.R., U.S. Geological Survey, Reston, VA

Influence of Ore Type and Milling Process on Rn-222 Emanation Coefficients of U Mill Tailings

Health Physics 53(6):679-683 (1987, December)

This report describes a laboratory study in which uranium (U) ore samples of distinct mineralogies, rather than composite mill feeds, were subjected to both acid- and alkaline-leaching for U extraction. In this way, both the ore type and extraction process serve as experimental variables, and the problems in obtaining a matched set of ore and its resultant tailings at mills processing at rates of several hundred to several thousand tons per day are avoided.

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Uranium Reference Materials

UNC/GJ-36(TMC); DOE/ID/12584-9; 12 pp. (1987, July)

The Technical Measurements Center has prepared uranium mill tailings reference materials for use by remedial action contractors and cognizant federal and state agencies. The reference samples were prepared with varying concentrations of radionuclides, using three tailings materials and a river-bottom soil diluent. All materials were ground, dried, and blended thoroughly to ensure homogeneity. The analyses on which the recommended values for nuclides in the reference materials are based were performed, using independent methods, by the UNC Geotech (UNC) Chemistry Laboratory, Grand Junction, Colorado, and by C.W. Sill (Sill), Idaho National Engineering Laboratory, Idaho Falls, Idaho. Several statistical tests were performed on the analytical data to characterize the reference materials. Results of these tests reveal that the four reference materials are homogeneous and that no large systematic bias exists between the analytical methods used by Sill and those used by TMC. The average values for radionuclides of the two data sets, representing an unbiased estimate, were used as the recommended values for concentrations of nuclides in the reference materials. The recommended concentrations of radionuclides (U-238, U-234, Th-230, Ra-226, and Pb-210) in the four reference materials are presented. Use of these reference materials will aid in providing uniform standardization among measurements made by remedial action contractors. Gamma spectroscopic measurement results for Th-228 during the Ra-226 analysis performed by the UNC Chemistry Laboratory, are also presented.

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George, J.L., UNC Geotech Inc., Grand Junction, CO

Procedure Manual for the Estimation of Average Indoor Radon-Daughter Concentrations Using the Filtered Alpha-Track Method

UNC/GJ-40(TMC); DOE/ID/12584-18; 18 pp. (1988, April)

One of the measurement needs of U.S. Department of Energy (DOE) remedial action programs is the estimation of the annual-average indoor radon-daughter concentration (RDC) in structures. The filtered alpha-track method, using a 1-year exposure period, can be employed to accomplish RDC estimations of the DOE remedial action programs. This manual describes the procedure used to obtain filtered alpha-track measurements and to derive average RDC estimates from the measurements. Appropriate quality assurance and quality control programs are also presented. The "prompt" alpha-track method of exposing monitors for 2 to 6 months during specific periods of the year is also briefly discussed in this manual. However, the prompt alpha-track method has been validated only for use in the Mesa County, Colorado area.

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Validation of the Prompt Alpha-Track Method

UNC/GJ-33(TMC); DOE/ID/12584-6; 71 pp. (1987, August)

The Technical Measurements Center has evaluated the reliability of using short-term exposures of alpha-track radon detectors to estimate annual-average radon-daughter concentrations (RDC) in structures in the Grand Junction, Colorado, area. This Prompt Alpha-Track Study was conducted from July 1985 to July 1986. Two sets of data were collected, each consisting of two-, three-, four-, five-, and six-month-long exposures of radon detectors manufactured by Terradex Corporation. 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 report discusses the results obtained using the Terradex detectors as well as some preliminary results obtained using Radtrak radon detectors marketed by Glenwood Laboratories.

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The Use of Atomic Absorption Spectroscopy to Measure Arsenic, Selenium, Molybdenum, and Vanadium in Water and Soil Samples from Uranium Mill Tailings Sites

UNC/GJ-38(TMC); DOE/ID/12584-14; 47 pp.
(1988, January)

A laboratory intercomparison study conducted by the Technical Measurements Center (TMC), using soil and water samples from sites contaminated by uranium mill tailings, indicated large discrepancies in analytical results reported by participating laboratories for arsenic, selenium, molybdenum, and vanadium. The present study was undertaken to investigate the most commonly used analytical techniques for measuring these four elements, to ascertain routine and reliable quantification, and to assess problems and successes of analysts. Based on a survey of the technical literature, the analytical technique of atomic absorption spectroscopy was selected for detailed study. The application of flame atomic absorption, graphite furnace atomic absorption, and hydride generation atomic absorption to the analysis of tailings-contaminated samples is discussed. Additionally, laboratory sample preparation methods for atomic absorption spectroscopy are presented. The conclusion of this report is that atomic absorption can be used effectively for the determination of arsenic, selenium, molybdenum, and vanadium in water and soil samples if the analyst understands the measurement process and is aware of potential problems.

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Karp, K.E., UNC Geotech Inc., Grand Junction, CO

Comparison of Radon and Radon-Daughter Grab Samples Obtained During the Winter and Summer

UNC/GJ-29(TMC); DOE/ID/12584-7; 33 pp.
(1987, August)

The Technical Measurements Center (TMC), under the auspices of the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) program, is investigating short-term methods for estimating annual average indoor radon-daughter concentrations (RDC). A field study at 40 sample locations in 26 residen-

tial 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 short-term methods investigated as part of this study include ten-minute radon and radon-daughter grab sampling and hourly RDC measurements. The results of the field study indicate that ten-minute 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 location by the occupant is controlled and the ventilation rate is restricted. The grab sampling was performed under controlled occupied conditions. 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 concentration. The hourly RDC measurements were performed under three sets of conditions over a 72-hour period. The three sets of conditions were uncontrolled occupied, controlled occupied, and controlled unoccupied. Results of the hourly RDC measurements indicate that it is not necessary to relocate the occupants during the time of grab sampling. This report describes the procedures used and the results obtained during the 1985 winter and summer field study.

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Karp, K.E., UNC Geotech Inc., Grand Junction, CO

Detecting Buried Radium Contamination Using Soil-Gas and Surface-Flux Radon Measurements

UNC/GJ-41(TMC); DOE/ID/12584-23; 71 pp.
(1988, June)

The Technical Measurements Center (TMC) under the auspices of the U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology, has investigated the effectiveness of using radon soil-gas and surface-flux measurements to locate radium contamination that is buried sufficiently deep to be undetectable by surface gamma methods. At the first test site studied, an indication of a buried source was revealed by mapping anomalous surface-flux and soil-gas concentrations in the near surface overburden. The mapped radon anomalies were found to correspond in rough outline to the shape of the areal extent of the deposit as determined by borehole gamma-ray logs. The 5.9 pCi/g radium deposit,

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buried 2 feet below the surface, went undetected by conventional surface gamma measurements. Similar results were obtained at the second test site where radon and conventional surface gamma measurements were taken in an area having radium concentrations ranging from 13.3 to 341.0 pCi/g at a depth of 4 feet below the surface. The radon methods were found to have a detection limit for buried radium lower than that of the surface gamma methods, as evidenced by the discovery of the 13.3 pCi/g deposit which went undetected by the surface gamma methods.

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Lagner, G.H., Jr., and J.C. Pacer, UNC Geotech Inc., Grand Junction, CO; Pennsylvania Power and Light Company, Pittsburgh, PA

Protocol for the Estimation of Average Indoor Radon-Daughter Concentrations, Second Edition

UNC/GJ-09(TMC); DOE/ID/12584-19; 38 pp. (1988, May)

The Technical Measurements Center has developed a protocol which specifies the procedures to be used for determining indoor radon-daughter concentrations (RDC) 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 RDC. Proven in this case means that the methods have been determined to provide reasonable assurance that the average RDC within a structure is either above, at, or below the standards established for remedial action programs. The first edition of this protocol (GJ/TMC-09), released in June 1986, stated that "as new information concerning RDC measurement methods becomes available, the Method Selection section of this document may require revision." Since that time, several other methods have been developed and validated for use in Department of Energy remedial action programs that reduce the cost and time required for RDC verification. Hence this edition of the protocol has been produced to incorporate these additional methods and provide guidance with respect to method selection for a given situation.

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Pearson, M.D., UNC Geotech Inc., Grand Junction, CO

Procedure Manual for the Estimation of Average Indoor-Daughter Concentrations Using the Electronic Radon Progeny Integrating Sampling Unit (ERPISU) Method

UNC/GJ-39(TMC); DOE/ID/12584-15; 42 pp. (1988, March)

One of the U.S. Department of Energy (DOE) remedial action program measurement requirements is the estimation of average indoor radon-daughter concentration (RDC). This manual details the procedures for RDC estimation using Electronic Radon Progeny Integrating Sampling Units (ERPISU) in applying the RPISU method, described in 10 CFR 1020. Electronic RPISUs differ from standard RPISUs in that an Electronic RPISU measures radon-daughter concentrations using a solid-state alpha detector, rather than the thermoluminescent dosimeter employed by a standard RPISU. This procedure manual describes how to set up and operate a system for obtaining ERPISU measurements, and how to derive annual average RDC estimates from those measurements as well as RDC estimates for comparison against selected standards. This manual contains both procedures specific to the Eberline WLM-1A Working Level Monitor and general guidelines applicable to any type of Electronic RPISU that may be approved by DOE.

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Construction and Characterization of the TL/TH Thorium Calibration Pads

UNC/GJ-32(TMC); DOE/ID/12584-3; 59 pp. (1987, September)

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology has as one of its goals the standardization of field measurements made by its remedial action contractors throughout the United States. The Technical Measurements Center (TMC) was established at the DOE Grand Junction Projects Office (GJPO) Facility, Grand Junction, Colorado, in support of this goal, and was tasked with developing and/or rec-

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ommending measurement methods for use in support of remedial action programs. Since one aspect of this technical support is the provision of calibration facilities for standardization of field measurements, four sets of thorium-232 enriched pads (two pads per set) were constructed at the GJPO Facility for use by remedial action contractors in calibrating portable field instruments that are used to make direct, in situ measurements of radium-226, thorium-232, and potassium-40. This report presents the design, construction, and characterization data of the eight calibration pads.

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Steele, W.D., UNC Geotech Inc., Grand Junction, CO

Construction and Testing of a Blower-Door Assembly for Regulation of Air Pressure Within Structures

UNC/GJ-35(TMC); DOE/ID/12584-4; 46 pp.
(1987, September)

The Technical Measurements Center is evaluating several methods to decrease the time required to determine an annual average radon-daughter concentration in structures. One method involves stabilizing the air pressure within the structure at a constant pressure with reference to external atmospheric or soil-gas pressure. This report describes the construction and preliminary testing of a "blower-door" system to maintain a constant differential air pressure within a structure. The blower-door assembly includes a collapsible frame and a large fan to occlude a doorway, a damper with an actuator to control air flow, a controller to drive the damper actuator, and a pressure transducer to measure the differential pressure. Preliminary testing of the system indicates that pressure within the structure in the range of 1 to 20 Pascals (Pa) (1 Pa = 1/249-inch of water at 39.2 degrees F or 4 degrees C) can be held to within approximately plus or minus 1 Pa of the set point. Further testing of the blower-door system is planned to provide data on the applicability of this method to short-duration tests for annual average radon-daughter concentration estimates.

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**GENERAL REMEDIAL ACTION
PROGRAM STUDIES**

GENERAL REMEDIAL ACTION PROGRAM STUDIES

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American Nuclear Society, Fuel Cycle and Waste Management Division, Niagara Falls, NY; American Nuclear Society, Niagara-Finger Lakes Section, Niagara Falls, NY

Spectrum '86, Waste Management and Decontamination and Decommissioning

CONF-860905; Spectrum '86, Waste Management and Decontamination and Decommissioning. Proceedings of an American Nuclear Society International Topical Meeting, Niagara Falls, NY, September 14-18, 1986, Vols. 1 and 2, 2193 pp. (1987, July)

These proceedings contain the text of the papers presented at the American Nuclear Society International Topical Meeting on Waste Management and Decontamination and Decommissioning, held in Niagara Falls, New York, on September 14-18, 1986. The papers reported on a turning point which had been reached in the nuclear industry; all phases of waste treatment, as well as decontamination and decommissioning (D&D), had been demonstrated "commercially". In fact, systems that are in-place were cited as operating reliably with extended life cycles. Participants' papers describe their countries' and companies' progress and the "spectrum" of ingredients which were the basis for being able to report these achievements. The proceedings contain 195 papers from 600 attendees, 40% of whom represented foreign countries. Session topics included: the areas of solid waste treatment/incineration, remote handling equipment design, decontamination and decommissioning, existing technology demonstration, TRU waste management, regulatory aspects, economics, and environmental issues and impacts.

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Haywood, F.F., and J.A. Brown, Eberline Analytical Corporation, Oak Ridge, TN

Radiological Characterization - Strategy To Avoid Surprise

CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. IV.339-IV.349) (1987)

Radiological characterizations are designed to gather information about the current status of a property or site. Site, as used here, represents either a parcel of open land or one with improvements. This paper addresses radiological characterizations which were developed specifically for major remedial action programs. The principal objective of this work is to determine the distribution of contaminants within and around a site boundary. Results may be required as input for engineering assessments and for remedial action design. Inadequately planned and executed characterizations can lead to inaccurate estimates of waste volumes, to expanded field measurements, and to delays in construction. Since funding for all remedial activities is shared, there is a strong incentive to make efficient use of available resources. TMA/Eberline Analytical has over 15 years of experience in providing radiological support for remedial actions, including the cleanup of nuclear weapon test areas, uranium processing facilities, and other radiologically contaminated structures. The authors believe that careful consideration of the discussions presented in this paper will help to minimize surprises once remedial action begins.

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Matthews, M.L., J. Coleman, J.A. Caldwell, D. Lechel, B. Knight, P.J. Valenti, W. Murphie, and J. Gatreli, U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM;

Report from the Disposal Site Long-Term Surveillance and Maintenance Committee

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 215-221) (1987)

This group reviews surveillance and maintenance requirements, standards, practices, and costs in order to identify commonalities and differences, and explore adoption of common approaches. Topics considered are presented in a series of view graphs. They include applicable regulations and legal basis for programs, comparisons of program status, procedures and costs, and a summary of agreements and proposed future actions.

GENERAL REMEDIAL ACTION PROGRAM STUDIES

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Myrick, T.E., B.A. Berven, W.D. Cottrell, W.A. Goldsmith, and F.F. Haywood, Oak Ridge National Laboratory, Oak Ridge, TN; Bechtel National, Inc., Oak Ridge, TN; Eberline Analytical Corporation, Oak Ridge, TN

Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program

ORNL/TM-8600 (1987, April)

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 ORNL-RASA group for DOE's RASA program. The Procedures Manual insures that the organizational, administrative, and technical activities of the ORNL-RASA group conform properly to the requirements of the RASA program and that the procedures and techniques used by the ORNL-RASA group and contractor personnel meet the requirements of applicable governmental, scientific, and industrial standards. The Manual is sufficiently comprehensive for use by ORNL-RASA and other RASA contractor personnel in the planning, performance, and reporting of radiological surveys. The Manual provides formal procedures for conducting radiological surveys at remote sites and includes program planning, equipment operation, and quality assurance elements.

600

Oak Ridge National Laboratory, Oak Ridge, TN

Integrated Data Base for 1987: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics

DOE/RW-0006 (Rev. 3); 302 op. (1987, September)

The Integrated Data Base Program has compiled current data on inventories and characteristics of commercial spent fuel, and both commercial and U.S. government-owned radioactive wastes through December 31, 1986. These data are based on the most reliable information available from government sources, the open literature, technical reports, and direct contacts. The current projections of future waste and spent fuel to be generated through the year 2020 and characteristics of these materials are also presented. The information forecasted is consistent with the latest U.S. Department of Energy/

Energy Information Administration projections of U.S. commercial nuclear power growth and the expected defense-related and private industrial and institutional activities. The radioactive materials considered, on a chapter-by-chapter basis, are: spent fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, remedial action waste, and decommissioning waste. For each category, current and projected inventories are given through the year 2020, and the radioactivity and thermal power are calculated based on reported or estimated isotopic compositions. In addition, characteristics and current inventories are reported for miscellaneous, highly radioactive materials that may require geologic disposal.

601

Sena, R., and M.K. Tucker, U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM; U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

Report from the Vicinity Property Remedial Action Standards, Verification, and Certification Committee

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 203-213) (1987)

This committee is charged with reviewing procedures for conducting vicinity property remedial action and certification, verification and documentation processes, and identifying areas of commonality and differences. Topics considered are presented in a series of view graphs. They include summaries of directives, regulations and standards related to verification, certification, radiation assessment, radiological engineering, land surveying and mapping, performance contracting and excavation monitoring, and sampling.

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U.S. Department of Energy, Grand Junction Projects Office, Technical Measurements Center, Grand Junction, CO

The Remedial Action Programs Annual Meeting

GENERAL REMEDIAL ACTION PROGRAM STUDIES

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp. (1987)

The U.S. Department of Energy Grand Junction Projects Office hosted the 1987 Remedial Action Programs Annual Meeting. The notes of the proceedings include complete texts, view graphs, and summaries of the information derived from workshops, case studies, and ad hoc committee reports rather than formal proceedings. The order of the materials in this report follows the actual sequence of presentations during the meeting.

603

Voigt, W.R., Jr., U.S. Department of Energy, Office of Remedial Action and Waste Technology, Washington, DC

Remedial Action and Waste Technology Program Direction and Future

CONF-8704115; Proceedings of the Remedial Action Programs Annual Meeting, Grand Junction, CO, April 27-30, 1987, 244 pp.; (pp. 3-5) (1987)

The speaker reviews the history of the concerns which lead to the Remedial Action Program and outlines the challenges facing the program today. The challenges involve public and political interest in the program, funding, and communications. Each of these aspects is briefly discussed.

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Whelan, G., D.L. Strenge, B.L. Steelman, and K.A. Hawley, Pacific Northwest Laboratory, Richland, WA

Development of the Remedial Action Priority System: An Improved Risk Assessment Tool for Prioritizing Hazardous and Radioactive-Mixed Waste Disposal Sites

Management of Uncontrolled Hazardous Waste Sites, Proceedings of the Sixth National Conference, Washington, DC, November 4, 1985. Hazardous Materials Control Research Institute, Silver Spring, MD; (pp. 432-437) (1985)

The Remedial Action Priority System (RAPS) represents a methodology that prioritizes inactive hazardous and radioactive mixed-waste disposal sites in a scientific and objective manner based on limited site information. This methodology is intended to bridge the technology gap that exists between the initial site evaluation using the Hazard Ranking System (HRS) and the time-consuming process of actual field site characterization, assessment and remediation efforts. The HRS was designed as an initial screening tool to discriminate between hazardous waste sites that do not and those that are likely to pose significant problems to human health, safety and/or the environment. The HRS is used by the U.S. Environmental Protection Agency to identify sites for nomination to the National Priorities List (NPL). Because the HRS is not designed to evaluate sites containing radionuclides, a modified Hazard Ranking System (mHRS) addressing both hazardous and radioactive mixed wastes was developed by Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE). Neither the HRS nor the mHRS was designed to prioritize sites that are nominated to the NPL according to their potential risks. To provide DOE with a better management tool for prioritizing funding and human resource allocations for further investigations and possible remediations at its inactive waste sites, PNL is developing the risk assessment methodology called RAPS. Use of RAPS will help DOE ensure that those sites posing the highest potential risk are addressed first.

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