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Health and Safety Research Division

**NUCLEAR FACILITY DECOMMISSIONING
AND
SITE REMEDIAL ACTIONS
A SELECTED BIBLIOGRAPHY
Volume 10**

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Remedial Action Program Information Center
Biomedical and Environmental Information Analysis

Date of Issue—September 1989

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

Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831-6285
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84OR21400

MASTER

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ABSTRACT

The 576 abstracted references on nuclear facility decommissioning, uranium mill tailings management, and site remedial actions constitute the tenth in a series of reports prepared annually for the U.S. Department of Energy's Remedial Action Programs. Citations to foreign and domestic literature of all types—technical reports, progress reports, journal articles, symposia proceedings, theses, books, patents, legislation, and research project descriptions—have 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 Radionuclides, (5) Uranium Mill Tailings Remedial Action Program, (6) Uranium Mill Tailings Management, (7) Technical Measurements Center, and (8) General Remedial Action Program 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, subject category, 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 FTS 624-7764 or (615) 574-7764.

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 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 Projects Office
Lead Technical Contractor—UNC Geotech, Inc.

RAPIC, which is part of the Biomedical and Environmental Information 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 576 abstracted references constitute the tenth 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 (UMTRA) Program section contains information pertinent to UMTRA management or to the 24 UMTRA 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 UMTRA.

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.

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. A subject category index (white pages) is provided for the sections on Surplus Facilities Management Program, Nuclear Facilities Decommissioning, Uranium Mill Tailings Remedial Action Program, and Uranium Mill Tailings Management because of the size and diversity of these sections. The subject categories are: 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. 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, $NaIO_3$ (for example) means $NaIO_3$.
3. $10(E+3)$ or $X(E-3)$ (E denoting exponent) means 10^3 or X^3 .
4. Cubic or square dimensions of measurements are shown as, for example, 6 cu cm for 6 cubic centimeters or 3 sq km for 3 square kilometers.
5. The following prefixes have been used to indicate multiples or subdivisions of units of measurement:

a	atto	(10^{-18})
f	femto	(10^{-15})
p	pico	(10^{-12})
n	nano	(10^{-9})
u	micro	(10^{-6})
m	milli	(10^{-3})
c	centi	(10^{-2})
d	deci	(10^{-1})

da	deca	(10^1)
h	hecto	(10^2)
k	kilo	(10^3)
M	mega	(10^6)
G	giga	(10^9)
T	tera	(10^{12})
P	peta	(10^{15})
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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ACKNOWLEDGMENTS

The authors wish to acknowledge Mark A. Phillips and G. Sidney Thurmer for abstracts contributed to this publication and Richard D. Swaja and John K. Williams, Health and Safety Research Division, for time contributed in reviewing this report.

SAMPLE REFERENCE

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

1—Chapter Heading

2—Record Number

(Sequential Number of Reference)

3—Author(s)

4—Corporate Affiliation

5—Document Title

6—Publication Description

7—Publication Date

8—Abstract

¹NUCLEAR FACILITIES DECOMMISSIONING

²191

³Anderson, R.C., and D. T. Dexheimer

⁴Bechtel Power Corporation, San Francisco, CA

⁵INCORPORATING DECOMMISSIONING REQUIREMENTS INTO THE DESIGN PROCESS FOR NUCLEAR POWER PLANTS

⁶CONF-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.

⁷(1980)

⁸As 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.

SURPLUS FACILITIES MANAGEMENT PROGRAM

1

Bates, L.D., J.B. Berry, G.E. Butterworth, S.P. du Mont, C.A. Easterday, A.H. Geisler, L.G. Hill, C.M. Kendrick, L.E. McNeese, T.E. Myrick, R.E. Pudelek, P.S. Rohwer, T.F. Scanlan, L.E. Stratton, J.R. Trabalka, and E.L. Youngblood, Oak Ridge National Laboratory, Oak Ridge, TN

ORNL Long-Range Environmental and Waste Management Plan: Detailed Management Plan

ORNL-6446/R1; 448 pp. (1988, April)

The primary purpose of this report is to provide a thorough and systematic planning document to reflect the continuing process of site assessment, strategy development, and planning for the current and long-term control of environmental issues, waste management practices, and remedial action requirements. The document also provides an estimate of the resources required to implement the current plan. This document is not intended to be a budget document; it is, however, intended to provide guidance as to the near order of magnitude of the resources (primarily funding requirements) and the time frame required to execute the strategy in the present revision of the plan. As with any document of this nature, the near-term (one to three years) part of the plan is a realistic assessment of the current program and ongoing capital projects and reflects the efforts perceived to be necessary to comply with all current state and federal regulations and DOE orders. It also should be in general agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication. This is intended to be a living document with annual revision to reflect the continuing evolution and development of environmental and waste management processes, characterizations, remedial actions, regulations, and strategies for the establishment and conduct of a comprehensive environmental and waste management program designed to be in compliance with state and federal regulations and guidelines designed to protect human health and the natural environment.

2

Bauer, R.G., Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Contaminated Concrete Scabbing at the Shippingport Station Decommissioning Project

DOE/SSDP-0067; 12 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (p. 67); Transactions of the American Nuclear Society 59:67 (1989, June)

The Shippingport Atomic Power Station was the first commercial nuclear power plant in the United States, joining the Duquesne Light Company (DLC) grid in December 1957. The Shippingport Station was shut down in October 1982 and defueled in preparation for dismantling. On September 6, 1984, the Shippingport Station Decommissioning Project Office (SSDPO) of the DOE assumed responsibility for the site. At turnover, there were several areas in the plant where radioactive contamination was entrained in concrete surfaces. This paper will give further background to the engineering decisions, concrete decontamination practices, and experience.

3

Bechtel National, Inc., Oak Ridge, TN

Niagara Falls Storage Site Annual Site Environmental Report - Calendar Year 1988

DOE/OR/20722-219; 123 pp. (1988, April)

The monitoring program at the Niagara Falls Storage Site (NFSS) measures radon concentrations in air; external gamma radiation levels; and uranium and radium concentrations in surface water, groundwater, and sediment. To verify that the site is in compliance with the DOE radiation protection standard and to assess its potential effect on public health, the radiation dose was calculated for a hypothetical maximally exposed individual. Based on the conservative scenario described in this report, this hypothetical individual receives an annual external exposure approximately equivalent to 6 percent of the DOE radiation protection standard or 100 mrem/yr. Results of the 1988 monitoring show that the NFSS is in compliance

with applicable DOE radiation protection standards.

4

Beigquist, D.J., U.S. Department of Energy, Office of Counsel, Idaho Operations Office, Idaho Falls, ID

Monticello, Utah CERCLA Agreement: Evolution and Lessons Learned

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 2-99 - 2-101) (1988, October)

Given are: (1) a brief description and history of the DOE-owned uranium mill tailings site and vicinity properties at Monticello, Utah; (2) a chronology of events leading to EPA and state involvement in cleanup actions; and (3) a chronology of events leading to CERCLA section 120 interagency agreement between the Department of Energy, the Environmental Protection Agency, and the state of Utah.

5

Blanke, J.A., R.T. Johnson, and W.F. Stanley, Bechtel National, Inc., Oak Ridge, TN

Performance Monitoring Report for the Niagara Falls Storage Site Waste Containment Structure Calendar Year 1987 and January - June of 1988

DOE/OR/20722-208; 89 pp. (1989, January)

A performance monitoring program has been developed for the Niagara Falls Storage Site (NFSS) Waste Containment Structure (WCS). The WCS contains 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 purpose of the performance monitoring program is to verify that the WCS main engineering elements are functioning to minimize infiltration of rainfall; prevent pollution of groundwater; preclude formation of

leachate; and prevent radon emanation. This report presents the findings of performance monitoring conducted at the WCS during calendar year 1987, and January through June of 1988. This report includes a summary of performance monitoring results for 1987 and 6 months of 1988, with data for surface, subsurface, and environmental monitoring; conclusions based on walkover surveys; comparisons with previous data; and actions required. The vibrating wire pressure transducer (VWPT) pore water pressure readings have been expressed as hydraulic head and are plotted in Appendix A for 1987 and for the first half of 1988. Due to technical difficulties, data for the entire period could not be collected. The pneumatic pressure transducer (PPT) pore water pressure readings have been converted to hydraulic head and are presented in Appendix B. Appendix B compares the PPT data to the VWPT data. The comparison shows how failure of the VWPTs was detected.

6

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

Marine Transportation and Burial of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank Package

DOE/SSDP-0073; 18 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 69-71); Transactions of the American Nuclear Society 59:69-71 (1989, June)

The Shippingport Station Decommissioning Project (SSDP) is a Department of Energy (DOE) project to dismantle the Shippingport Atomic Power Station. One of the more significant and challenging technical aspects of the project, which is being managed for DOE by GE-Nuclear Energy, is the marine transport of the Reactor Pressure Vessel (RPV) and its associated Neutron Shield Tank (NST) to the government owned Hanford Reservation near Richland, WA.

7

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

Physical Decommissioning of the Shippingport Atomic Power Station

DOE/SSDP-0045; 4 pp.; CONF-880903; Spectrum '88: Nuclear and Hazardous Waste Management, Proceedings of a Topical Meeting, Pasco, WA, September 11-15, 1988 (1988, August 31)

The Shippingport Station Decommissioning Project (SSDP) is being managed for the U.S. Department of Energy (DOE) by the General Electric Company and its integrated subcontractor, Morrison Knudsen-Ferguson (MK-F) Company. The objectives of SSDP are to: (1) Demonstrate a safe and cost effective dismantlement of a large scale nuclear power plant, and (2) Provide useful data for future decommissioning projects. This paper presents the current status of the physical decommissioning work, which started September 1985. The controlling path and parallel work activities are described through June 1988 along with the Project's cost and schedule status. The total SSDP is estimated to cost \$98.3 million and the project is scheduled for completion in April 1990. As the first commercial nuclear power plant decommissioning project, the SSDP is expected to set the standard for safe, cost effective reactor decommissioning. SSDP is on schedule. At the end of June 1988, approximately 77% of the Project had been completed. All work to date has been done within the approved DOE budget and the current prognosis is that the project will be ahead of schedule and under budget.

8

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

Shippingport: Overall Project Progress

DOE/SSDP-0070; 16 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (p. 64); Transactions of the American Nuclear Society 59:64 (1989, June)

The Shippingport Atomic Power Station (SAPS)

consisted of the Nuclear Steam Supply System and associated radioactive waste processing systems, which were owned by the United States Department of Energy (DOE), and the Balance Of Plant, owned by the Duquesne Light Company. The station is located at Shippingport, Pennsylvania, on seven acres of land leased by DOE from Duquesne Light Company. The Shippingport Station Decommissioning Project (SSDP) is being preselected subcontractor, MK-Ferguson Company, as the Decommissioning Operations Contractor (DOC). This paper describes the decommissioning work which has been accomplished since July 1988, and the Project's cost and schedule status.

9

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

Shippingport Decommissioning Nears Completion

Nuclear Europe 8(10):31 (1988, October)

General Electric Nuclear Energy's Advanced Nuclear Technology Operation's Decommissioning Service Group is decommissioning Shippingport [PWR, 90 MW(e)], the world's first commercial nuclear power plant. This key project is the first entire decommissioning of a large, commercial-size nuclear power plant in the world, and is being completed safely and cost effectively using existing dismantling practices. The Shippingport Decommissioning Project has consisted of two distinct phases: a surveillance, maintenance, and operation phase; and a decommissioning phase. The former, also known as the caretaker phase, was completed by the end of 1984. Following a detailed operational preparatory review, decommissioning began during September 1985. Nonfuel-bearing irradiated core components were removed from the fuel-handling canal and placed into the reactor pressure vessel. The water level was then lowered to allow the drainage of water from the reactor coolant system pipes and components. At the same time, the electrical system was shut down, asbestos was removed, external surfaces were decontaminated, and the systems were drained. During 1987, all reactor coolant system pipes and components were removed. Early in 1988, the reactor pressure vessel

and neutron shield tank (RPV/NST) was shielded and prepared for one-piece removal. The removal of the fuel-handling canal and nonradioactive concrete and structures is now well advanced. At present there are no major technical issues remaining. The project is expected to be completed with less than 200 man-rem exposure which is one-fifth of the radiation exposure that the U.S. Department of Energy has estimated for the decommissioning.

10

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

Progress in the Release of the Shippingport Atomic Power Station Site for Unrestricted Use

DOE/SSDP-0065 (Abstract only); 1 p. (1989, June)

The end product of the Shippingport Station Decommissioning Project will be the return of the seven acre site leased until 1994 by the Department of Energy (DOE) back to its owner, the Duquesne Light Company, in a condition fit for unrestricted use. The site release criteria of "100 mrem/year plus ALARA" was established by the DOE in December 1986. This paper describes the establishment of plans for implementing these criteria, and the experience gained from putting those plans into action. The first step was to define all of the exposure scenarios to be considered and the methodology for the application of the ALARA philosophy. Then pathway analyses were employed to calculate the concentrations of residual radioactive material allowed without causing the annual dose (and ALARA values) to be exceeded. These were called limiting conditions. Finally, radiological surveys were conducted (and documented) to verify that the conditions on-site were compliant with the limiting conditions. The final conditions at the site are projected, based on the completion of more than 95% of the required surveys. This projection shows that the dose to a future resident will be less than 5 mrem/year and that any further effort at reduction will not be cost-beneficial.

11

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

Progress in the Release of the Shippingport Site and Materials

DOE/SSDP-0065, 18 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 66-67); Transactions of the American Nuclear Society 59:65-67 (1989, June)

The decommissioning of the Shippingport Atomic Power Station involved not only the disassembly of the nuclear side of the plant, but also the disposition of the site structures and equipment by release or by disposal as radwaste. The simple burial of all of this material would have been prohibitively expensive. Furthermore, it would have been unnecessary since the vast majority of the material had little (if any) contact with radioactivity. To save these costs, as well as to protect the public, the materials had to be classified so that the clean materials could be released from the site (or with the site) for unrestricted use. Two separate programs were developed and implemented during the Shippingport Station Decommissioning Project (SSDP) to do just this. One was for the release of material (most notably steel) from the site. The second program was for the disposition of the soil and concrete which would remain and be released with the site.

12

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

The Statistical Basis of the Survey Program for the Release of Material During the SSDP

DOE/SSDP-0064 (Abstract only); 1 p. (1989, June)

A major effort is required to verify that the large volume of clean material encountered during decommissioning is indeed free of radioactive materials before it is released from the site. To do

less is to cause both unnecessary expense and waste of limited disposal capability. A material survey program was developed to achieve this verification with a high degree of assurance for a minimum of cost. The program is incorporated in the Shippingport Station Decommissioning Project (SSDP) Radiological Controls Manual. Implementation of the program has been developed based on direction from the Department of Energy and other supporting information. DOE has designated the values in Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors" for use at SSDP and has established the level of assurance required. This paper describes the program used at the SSDP for demonstrating that the Regulatory Guide values are met with the desired degree of assurance before materials are released from the site for unconditional use. The major features of the program for any set of materials are (1) consideration of the history of its use and results of past radiation surveys, (2) a survey for the release of the material from radiologically controlled areas on-site, and (3) a documented radiation release survey prior to the removal of the material from the site itself. Thus, this program provides for two independent surveys before material in a controlled area can be released from the site or a single survey for materials which have never been inside of a controlled area.

13

U.S. Department of Energy, Weldon Spring Site Remedial Action Project, St. Charles, MO

Geophysical/Geotechnical Investigation Sampling Plan

DOE/OR/21548-014 (Rev. 1); 235 pp. (1988, July)

This sampling plan presents a rationale and procedures for further geotechnical and geophysical investigations of the Weldon Spring Site (WSS). The proposed investigation will gather the additional data necessary to derive required geotechnical design parameters and evaluate suitability of the WSS for constructing a long-term waste disposal facility. This document reviews data from the previous geotechnical and geophysical investigations for adequacy and sufficiency. The plan then describes additional geotechnical and

geophysical investigations required to fully characterize the proposed disposal facility site. The proposed investigation categories are: (1) surface geophysical surveys; (2) geotechnical drilling and sampling; and (3) geotechnical laboratory testing. The surface geophysical surveys will integrate various techniques to characterize soil and bedrock units. Geotechnical drilling and sampling will provide information to correlate geophysical measurements with known subsurface conditions. The disturbed and undisturbed samples collected during geotechnical drilling will be tested for a broad range of engineering parameters. These data will be used for engineering design of the disposal facility and to demonstrate suitability of the site.

14

Handy, J.W., Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project Site Release Protocol

DOE/SSDP-0068; 24 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 65-66); Transactions of the American Nuclear Society 59:65-66 (1989, June)

The Richland, Washington field office of the DOE and its Remedial Actions Contractor, GE, took possession of the SSDP site in September 1984. In February of the following year, DOE-HQ issued "Guidelines for Residual Activity at Remote Surplus Facility Management Program Sites," generic, site independent guidelines taken from existing radiation protection standards. Basic generic dose limits were English equivalents of 1 mSv (100 mrem) per year averaged over the lifetime of any individual member of the general public. Hot-spot limits were given. Occupied or habitable structures were limited to 5.2×10^{-9} C/Kgh (20mR/hr). Surface contamination was limited to those of NRC Regulatory Guide 1.86, Table 1, plus average and maximum contact dose rates of 2 micro-Gy (0.2 mrad) per hour and 10 micro-Gy (1 mrad) per hour respectively. In addition, "all exposures...were to be limited to levels that (were) as low as reasonably achievable

(ALARA).^a Authorized limits higher than these guidelines were allowed under given exceptional circumstances. Using the draft "Manual for Implementing Residual Radioactivity Guidelines" (a supplement to the guidelines by T.L. Gilbert et. al.), GE determined, with SSDPO concurrence, the allowable radionuclide concentrations that could remain in soil and included rubble, and not dose the resident farmer to more than 1 mSv (100 mrem) per year. Under more conservative scenarios, however, exposures were controlled for buried, potentially occupationally occupiable, concrete substructures, to souvenir items, or to be buried, but potentially exposed, concrete slabs. GE incorporated the scenario's pathways into a document implementing specific site release criteria which cannot be exceeded if the site is to be released unconditionally.

15

Hughes, M.C., R.K. Wahlen, and R.A. Winship, Westinghouse Hanford Company, Richland, WA

Hanford Surplus Facilities Program Plan, Fiscal Year 1989

WHC-EP-0231-1; 95 pp. (1989, March)

The Hanford Surplus Facilities Program is responsible for the safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities at the Hanford Site. The management of these facilities requires a surveillance and maintenance program to keep them in a safe condition and development of a plan for ultimate disposition. Criteria used to evaluate each factor relative to decommissioning are based on the guidelines presented by the U.S. Department of Energy-Richmond Operations Office, Defense Facilities Decommissioning Program Office, and are consistent with the Westinghouse Hanford Company commitment to decommission the Hanford Site retired facilities in the safest and most cost-effective way achievable. This document outlines the plan for managing these facilities to the end of disposition.

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Jacobs Engineering Group, Inc., St. Charles,

MO

Decommissioning and Remedial Action Progress at the Weldon Spring Uranium Feed Materials Plant

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 567-572) (1988)

The Weldon Spring Uranium Feed Materials Plant played a key role in U.S. Uranium production during the years 1957-66. The facility was closed and the 89 hectare (ha) site lay virtually abandoned until 1986. The Department of Energy was given responsibility for the demolition and cleanup of both the plant and quarry areas in 1985. In 1986, the DOE formally began the Weldon Spring Site Remedial Action Project. Although the first few years of the project will be primarily devoted to regulatory actions through both the NEPA and CERCLA processes, interim remedial activities have already begun. These include identification and removal of RCRA and TSCA wastes which are not radiologically contaminated, thus avoiding questions concerning mixed waste disposal. These RCRA and TSCA wastes will be removed and disposed of off-site at a licensed facility. (Most of the inventory consists of asbestos, PCB oils and a wide variety of containerized chemicals.) Efforts to stem the off-site release of uranium in surface water flow are also being initiated. The complicated hydrogeology of the area allows easy surface and groundwater interaction. The fractured limestone bedrock beneath both the plant and the quarry allows rapid conduit flow to transport the contaminants off-site over relatively great distances. Multiple groundwater springs over two kilometers from the site exhibit significantly elevated uranium concentrations. This migration is being mitigated by the construction of surface impoundments and diversion ditches to reduce the surface runoff over contaminated areas of the plant site, which reduces the amount of surface water reaching the groundwater. A status report of the activities at the DOE site is given. Characterization data and its relation to mixed waste issues are discussed. Interim remedial actions to reduce the risk to both the environment as well as on-site workers during the period until the regulatory processes are

complete are presented.

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Jacobs Engineering Group, Inc., St. Charles, MO

**Weldon Spring Site Remedial Action Project:
Baseline Risk Assessment Protocol Document**

DOE/OR/21548-047; 22 pp. (1988, October)

The Weldon Spring Site (WSS) is a former explosives manufacture and uranium feed materials processing plant, currently controlled by the U.S. Department of Energy (DOE). The Weldon Spring Site comprises two separate areas: (1) the raffinate pits and chemical plant (approximately 220 acres), and (2) the quarry. Although the two areas are considered to be one site for compliance purposes, a separate risk evaluation is being prepared for the quarry. This document does not address the quarry. The U.S. Environmental Protection Agency (EPA) has placed the Weldon Spring Site on the National Priorities List. A Baseline Risk Assessment is required for compliance with the Comprehensive Environmental Response, Compensation, and Liability Act. The purpose the Baseline Risk Assessment is to assess the potential risks to public health and the environment in the absence of remedial action. This Protocol document explains how the Baseline Risk Assessment for the raffinate pits and chemical plant area will be conducted. Specifically, the Protocol document: (1) provides EPA risk assessment guidelines appropriate for the Weldon Spring Site; (2) identifies the site-specific data to be used in the analysis; (3) provides a preliminary list of indicator contaminants; (4) identifies populations near the site; (5) identifies general exposure pathways; (6) describes how Applicable or Relevant and Appropriate Requirements (ARARs) will be identified; and (7) provides the framework for presenting the potential risks due to radiological and chemical contaminant exposures.

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Koegler, S.S., K.H. Oma, and J.M. Perez, Pacific Northwest Laboratory, Richland, WA

**Vitrification Technologies for Weldon Spring
Raffinate Sludges and Contaminated Soils:**

Phase I Report - Development of Alternatives

PNL-6704; 35 pp. (1988, December)

This engineering evaluation was conducted to evaluate vitrification technologies for remediation of raffinate sludges, quarry refuse, and contaminated soils at the Weldon Spring site in St. Charles County, Missouri. Two technologies were evaluated: in situ vitrification (ISV) and the joule-heated ceramic melter (JHCM). Both technologies would be effective at the Weldon Spring site. For ISV, there are two processing options for each type of waste: vitrify the waste in place; or move the waste to a staging area and then vitrify. The total time required to vitrify raffinate sludges, quarry refuse, and contaminated soil is estimated at 5 to 6 years, with operating costs of \$65.7M for staged operations or \$110M for in-place treatment. This estimate does not include costs for excavation and transportation of wastes to the staging location. Additional tests are recommended to provide a more in-depth evaluation of the processing options and costs. For the JHCM process, about 6.5 years would be required to vitrify the three waste types. Total operating costs are estimated to be \$73M if the glass is produced in granular form, and \$97M if the glass is cast into canisters. Costs for the excavation and transportation of wastes are beyond the scope of this study and are not included in the estimates. Additional tests are also recommended to better define technical issues and costs.

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Land, R.R., Bechtel National, Inc., Oak Ridge, TN

Bulk Water Treatment Options: A Case Study

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 4-37 - 4-51) (1988, October)

Remedial action and construction activities at the Department of Energy's (DOE) Niagara Falls Storage Site (NFSS) and vicinity properties located in northwestern New York resulted in the collection of substantial amounts of construction waste water. Slurry transfer operations and

radioactive pitchblende residue dewatering activities generated additional large quantities of contaminated waste water. This presentation addresses the bulk water treatment options which were investigated and the selected treatment protocols and techniques utilized to remove radioactive and chemical trace element contaminants in order to achieve final site closure.

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MacDonell, M.M., J.M. Peterson, and I.E. Joya, Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL

Engineering Evaluation/Cost Analysis for the Proposed Management of Contaminated Water in the Weldon Spring Quarry

DOE/OR/21548-039; 147 pp. (1989, January)

This engineering evaluation/cost analysis (EE/CA) report has been prepared to support the proposed removal action for management of contaminated water in the Weldon Spring quarry, located near Weldon Spring, Missouri. The water became chemically and radioactively contaminated as a result of contact with various wastes that were disposed of in the quarry between 1942 and 1968. The EE/CA report is required to document the proposed removal action because the action is not a time-critical response (i.e. it need not be implemented within 6 months). The objectives of the EE/CA report are to identify the cleanup as a removal action, to document the selection of response activities that will mitigate the potential for release of radioactive or chemical contaminants from the quarry water into the nearby environment, and to address environmental impacts associated with the proposed action. Pursuant to the evaluation of potential alternatives in this report, it is proposed that the water be pumped from the quarry pond to a newly constructed treatment plant to remove contaminants of concern. This removal action is necessary for and consistent with the overall response action being planned to minimize potential threats to the public and the environment associated with the current contamination at the quarry.

21

Marutskv, S.J., R. Colby, and L.S. Cahn, UNC Technical Services, Inc., Grand Junction, CO

Radiologic Characterization of the Weldon Spring, Missouri, Remedial Action Site

DOE/ID/12584-22; UNC/GJ-HMWP-4; 234 pp. (1988, February)

The U.S. Department of Energy (DOE) established the Weldon Spring Site Remedial Action Program in February 1985 to effect remedial action at the Weldon Spring Chemical Plant site and the Femme Osage Slough Vicinity Property. This radiologic characterization of the Weldon Spring Site was performed at the request of the DOE/Oak Ridge National Laboratory, Weldon Spring, because additional data were needed to complete the Environmental Impact Statement in compliance with the National Environmental Policy Act and because no broad data collection effort of radiologic contamination in the Chemical Plant area had been performed. The field work was conducted by UNC Geotech, operating contractor for the DOE/Grand Junction Projects Office, during the period April through July 1987. This report includes descriptions of the in situ measurement methods, data reduction, sampling techniques and sample analytical methods, and data summaries. The report is not meant to serve as an analysis of the information derived from the conduct of this characterization effort, but rather as a presentation of the scope of the field activity, the measurement methods, and a compendium of the sample results.

22

McCracken, S.H., U.S. Department of Energy, Weldon Spring Site Remedial Action Project Office, Washington, DC

NEPA/CERCLA Compliance at the Weldon Spring Site Remedial Action Project (WSSRAP)

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 2-103) (1988, October)

The WSSRAP environmental compliance strategy has two significant components. First, the bigger decision of chemical plant remediation and waste disposal will follow an integrated approach for compliance with NEPS and CERCLA. The document to be prepared is called an RI/FS-EIS and it is expected that a Record of Decision will be issued in April of 1991. The RI/FS-EIS is in accordance with the latest HQ-EH guidance for integrating NEPA and CERCLA and it will be accomplished by incorporating EIS requirements into the format of an RI/FS. Second, during the period that the RI/FS-EIS process is being carried out, a number of expedited response actions will take place. These are activities which will improve site conditions and site safety, reduce release of contaminants, etc., but which by their implementation will not bias the RI/FS-EIS decision. These activities include vicinity properties cleanup, asbestos abatement, chemical disposal, building demolition, water treatment, and more. The compliance document is called an Engineering Evaluation and Cost Analysis (EECA) and the complexity (length) of the document is generally consistent with the complexity of the task. Another important activity that is planned prior to the RI/FS-EIS decision is removal of bulk waste from the Quarry to an interim storage area at the chemical plant. The compliance approach will be to prepare a focused RI/FS-EA. The Work Plan which outlines the above compliance strategy has been completed and will be distributed to the public within the next few weeks.

23

McKernan, M.L., Westinghouse Hanford Company, Shippingport Station Decommissioning Project Office, Shippingport, PA

Shippingport Station Decommissioning Project Technology Transfer Program

DOE/SSDP-0066; 18 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 71-72); Transactions of the American Nuclear Society 59:71-72 (1989, June)

The U.S. Department of Energy (DOE)

Shippingport Station Decommissioning Project (SSDP) decommissioned, decontaminated, and dismantled the world's first, nuclear fueled, commercial size, electric power plant. SSDP programmatic goal direction for technology transfer is documentation of project management and operations experience. Objective is to provide future nuclear facility decommissioning projects with pertinent SSDP performance data for project assessment, planning, and operational implementation. This paper presents a working definition for technology transfer. Direction is provided for access and availability for SSDP technology acquisition.

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Meyer, R.D., P.H. Horton, and H.H. Neely, Rockwell International, Rocketdyne Division, Canoga Park, CA

Building 059 - Phase I Pipe Chase Room Remediation

ETEC-89-3 (1989, June 23)

This report documents the Phase I activities and results of the Building 059 Remediation Project. The Project consisted of removing, packaging, and shipping approximately 30 linear feet of 5-ft-diameter activated steel vacuum duct and supports, over 100 tons of activated sand, and miscellaneous other radioactive waste for burial at the DOE radioactive burial site in Hanford, Washington. A total of 4562 cubic feet of low specific activity waste was disposed of during the project. Following removal of the activated materials, the region of water intrusion into the Pipe Chase Room was identified and sealed. All technical objectives of the Phase I portion of the project were achieved.

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Miller, R.L., Westinghouse Hanford Company, Richland, WA

Tools and Techniques Used in U.S. Department of Energy Decommissioning Programs

WHC-SA-0417; CONF-8810239; Remedial

Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 4-113) (1988, October)

In recent years the U.S. Department of Energy (DOE) has relied almost completely on innovative uses of commercially available tools to perform many tasks on decommissioning projects. Extensive research and development work has not been necessary for the decommissioning of DOE facilities with few exceptions. Since the decommissioning projects are located at various sites across the United States, a centralized technology transfer program was established to ensure that information on new technologies and techniques developed to support specific tasks is available to all contractors performing similar decommissioning work. This article discusses several of the tools and techniques that have been successfully used for various tasks during the course of decommissioning nuclear facilities.

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MK-Ferguson Company, St. Charles, MO

Phase I Water Quality Assessment

DOE/OR/21548-003; 132 pp. (1987, December)

Numerous previous investigations and studies at the Weldon Spring Site (WSS) have been directed toward providing data for a specific purpose. No attempts have been made to assess the overall quality of groundwater and surface water at the WSS. The Phase I Assessment was developed to supply this baseline water quality information. This information will, in turn, be used to guide further investigations and characterization activities at the WSS. The Phase I Assessment consisted of sampling 50 monitoring wells and 23 surface water locations. Groundwater samples were analyzed for the complete Hazardous Substance List, nitroaromatics, certain inorganic anions, water quality indicators, and radionuclides. Surface water samples were analyzed for radionuclides, certain inorganic anions, water quality indicators, and CLP metals at selected locations. Significant findings drawn from the Phase I Assessment include the following: (1) Raffinate Pit No. 3 appears to be contributing nitrate and dissolved metals to the groundwater; (2) Raffinate Pit No. 4 appears to be

contributing sulfate to the groundwater; (3) nitroaromatics are present in the groundwater at high concentrations (400 ug/L total) under the northeast corner of the Weldon Spring Chemical Plant (WSCP); (4) general low-level nitroaromatic contamination is present over most of the WSCP/Weldon Spring Raffinate Pits; (5) water with radiologic and nitroaromatic contaminants is migrating from the Weldon Spring Quarry (WSQ); (6) the Femme Osage Slough is impacted by groundwater migration from the WSQ; and (7) three lakes on the August A. Busch Memorial Wildlife Area directly or indirectly receive radiologically contaminated runoff from the WSS.

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MK-Ferguson Company, St. Charles, MO

Waste Assessment Raffinate Pit Sampling Plan Weldon Spring Site: Revision 1

DOE/OR/21548-010; 98 pp. (1988, May)

The purpose of this sampling plan is to provide a summary of existing data and to define the rationale for collecting the complement of data necessary to fully characterize the waste contained in the Weldon Spring Raffinate Pits (WSRP). For complete characterization of the WSRP, combined data from radiological, chemical, and physical analyses must be evaluated. The existing data base provides limited characterization analyses to address the radiological and chemical parameters. Additional physical, chemical, and radiological testing of the sludge/sediment in the WSRP must be performed. This additional data is needed for sludge/sediment treatability studies which in turn are necessary for the development/evaluation of remediation alternatives, design of the selected alternative, and verification of remedial effectiveness. This sampling plan will deal primarily with the sampling and analysis of the sludge/sediments in the WSRP. The section on previous studies includes sufficient chemical characterization data to evaluate remedial alternatives for the water ponded on the raffinate pits.

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MK-Ferguson Company, St. Charles, MO

**Weldon Spring Site Remedial Action Project:
Remedial Investigation Quality Assurance
Program Plan**

DOE/OR/21548-011; 52 pp. (1988, December)

The Remedial Investigation Quality Assurance Program Plan (RIQAPP) for Weldon Spring Site Remedial Action Project (WSSRAP) is distinguished by purpose from the WSSRAP overall Quality Assurance/Quality Control Program Plan (QAPP). The RIQAPP is focused only on meeting U.S. Environmental Protection Agency requirements under CERCLA whereas the QAPP is designed to meet quality assurance program requirements for nuclear facilities. The RIQAPP specifically addresses factors, methods and criteria presented in Section 300.68 of the National Oil and Hazardous Substances Pollution Contingency Plan. Specific QC procedures are contained in existing documents incorporated into the plan by reference. These include Standard Operating Procedures, laboratory QA procedures, and activity level sampling plans. Most of the sampling and analysis activities rely heavily upon guidance in SW-846E.

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M/K-Ferguson Company, St. Charles, MO

**Appendix: Buildings Characterization Work
Plan, Weldon Spring Site**

DOE/OR/21548-021 (Appendix); 103 pp. (1988, April)

The following tables and location diagrams are furnished to assist the contractor in identifying and locating known Asbestos-Containing Materials (ACM) and potential ACM. Each location listed on the tables and shown on the diagrams represents the presence of a major concentration of ACM. Not every location of ACM at the WSCP is listed, two buildings (108 and 403) have not been surveyed, and portions of several buildings were inaccessible. However, the tables reflect all ACM that can be identified at the site prior to the dismantling of buildings.

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M/K-Ferguson Company, St. Charles, MO

**Buildings Characterization Sampling Plan
Weldon Spring Site**

DOE/OR/21548-021; 269 pp. (1988, August)

The purpose of this document is to provide a systematic approach to characterizing radiological, asbestos, and chemical contamination in and around the buildings and structures at the Weldon Spring Chemical Plant Site (WSCPS). The buildings Sampling Plan is designed to: determine the magnitude of radiological, asbestos and chemical contamination in and around the buildings and structures at the WSCPS; document uncontaminated areas; and identify radiological, asbestos and chemical concentrations in quantitative terms. This information will be used to plan salvage, removal or disposal options for the structures and equipment at the WSCPS. This sampling plan reviews historical information. It also identifies data needs, outlines sampling procedures, quality assurance, data documentation and reporting requirements for the buildings and equipment characterization at the Weldon Spring Site (WSS). The scope of this plan is limited to the buildings, structures, and equipment from the previous operation of the WSCPS.

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M/K-Ferguson Company, St. Charles, MO

**Electrical Power Line and Pole Removal
Radiological Survey Completion Report:
Weldon Spring Site Remedial Action Project -
Revision 0**

DOE/OR/21548-038; 81 pp. (1988)

The following radiological survey completion report was prepared as an overview of the radiological measurements performed for the now completed work package WP018, Electrical Power Line and Pole Removal. Because of the dangers presented by the deteriorating state of the power poles an interim remedial action was initiated. The purpose of this report is to summarize the plan for the radiological survey of the power poles and lines and to document the amount of material released from the Weldon Spring Site for unrestricted use.

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MK-Ferguson Company, St. Charles, MO

**Weldon Spring Site Remedial Action Project
Respiratory Protection Program**

DOE/OR/21548-057; 22 pp. (1989, January)

This document sets forth standards, regulations, and minimum requirements applicable to respiratory equipment and its on-site use at the Weldon Spring Remedial Action Project (WSSRAP). The document is intended to serve as a reference source for Project Management Contractor (PMC) Environmental Safety and Health personnel and other personnel responsible for implementation of the Weldon Spring Site (WSS) Respiratory Protection Program. Unless otherwise noted, the standards, regulations, and requirements stated herein apply specifically to personnel of the U.S. Department of Energy (DOE), PEER Consultants, Inc. (consultant to DOE), the PMC (MK-Ferguson Company), and the PMC's integrated subcontractor (Jacobs Engineering Group). Requirements for other subcontractors are explained in Section 7.0 of this document.

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

**Weldon Spring Site Remedial Action Project
Chemical Soil Investigation Sampling Plan for
the Weldon Spring Chemical Plant/Raffinate
Pits**

DOE/OR/21548-013; i. / pp. (1988, May)

The purpose of this Chemical Soil Investigation Sampling Plan is to provide a systematic approach for chemically characterizing soils at the Weldon Spring Chemical Plant/Raffinate Pits (WSCP/WSRP) areas in support of the overall Site Characterization Plan. The Chemical Soil Investigation Sampling Plan is designed to determine the extent and magnitude of chemically contaminated soil, evaluate contaminant migration pathways, document uncontaminated areas, and identify soil contaminant concentrations in qualitative and quantitative terms.

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

Hydrogeologic Investigations Sampling Plan

DOE/OR/21548-020; 260 pp. (1988, November)

The goal of this sampling plan is to identify and develop specific plans for those investigative actions necessary to: (1) characterize the hydrologic regime; (2) define the extent and impact of contamination; and (3) predict future contaminant migration for the Weldon Spring Site (WSS) and vicinity. The plan is part of the Weldon Spring Site Remedial Action Project (WSSRAP) sponsored by the U.S. Department of Energy (DOE) and has been developed in accordance with U.S. Environmental Protection Agency (EPA) Remedial Investigation (RI) and Data Quality Objective (DQO) guidelines. The plan consists of a sequence of activities including the evaluation of data, development of a conceptual model, identification of data uses and needs, and the design and implementation of a data collection program. Data will be obtained to: (i) confirm the presence or absence of contaminants; (2) define contaminant sources and modes of transport; (3) delineate extent of contaminant migration and predict future migration; and (4) provide information to support the evaluation and selection of remedial actions.

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

**Electrical Power Line and Pole Removal
Radiological Survey Completion Report for the
Weldon Spring Site Remedial Action Project,
Weldon Spring, Missouri**

DOE/OR/21548-038 (Rev. 2); 83 pp. (1989,
February)

Every electric power pole, all wire, cross members, and attached hardware were radiologically surveyed and removed. The survey procedures did not conform in every respect with the planned procedures because the actual work differed from the removal plan. The survey showed that all

contamination was fixed. Certain poles that were suspected of being contaminated with Th-230 were cut off one foot above ground level and left on-site. Each truck load of materials was checked at the access point to ensure it met release criteria. Wood samples were taken from all the poles at Building 403 and 5% of all the rest and analyzed for U-238 and Th-232. Only U-238 was detected. Approximately 1903 bundles of wire (95,150 ft) were released, and 76 bundles (1520 ft) were found to be contaminated. Approximately 7163 ft of power pole material were released, and 1484 ft were contaminated. A comprehensive quality assurance/quality control program was applied to this work.

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

**Army Vicinity Property No. 7, Post-Remedial
Action Report: Weldon Spring Site Remedial
Action Project**

DOE/OR/21548-043; 22 pp. (1988, September)

This report documents remedial action efforts of the Project Management Contractor (PMC) in January, 1988 at Army Vicinity Property No. 7 (VP7) at the Weldon Spring Site Remedial Action Project (WSSRAP). Soil sample results and gamma radiation measurements made before, during, and after the remedial action are included in Appendix A of this report. The results of soil samples and gamma radiation measurements made during and after the remedial action indicate that VP7 now meets the U.S. Department of Energy guidelines for residual radioactive material and the PMC recommends that it be released for unrestricted use.

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

**Chemical Soil Data Report to Support Interim
Response Actions, Construction Staging Area,
and Administration Building for the Weldon**

**Spring Site Remedial Action Project, Weldon
Spring, MO**

DOE/OR/21548-051; 83 pp. (1989, February)

Five activities are planned to improve environmental conditions or to improve facilities at the Weldon Spring Site. Each activity must be evaluated for potential environmental impacts. Chemical soil contamination was potentially present in each affected area. A sampling program was designed and implemented to evaluate chemical soil conditions. Samples were analyzed for nitroaromatic compounds, metals, inorganic anions, semi-volatile and volatile organic compounds, pesticides, and PCBs. This investigation documented low concentrations of semi-volatile organic compounds, pesticides, PCBs, and nitroaromatics. Higher concentrations of nitrate, sulfate and some metals were also detected. The contaminants detected are consistent with past operations at the WSS. The concentrations of contaminants do not significantly impact the proposed activities. Data from this investigation has been incorporated into the planning and documentation activities for each activity.

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

**Plan for Estimating the Average Uranium
Concentration of the Weldon Spring Chemical
Plant Overhead Piping Insulation**

DOE/OR/21548-052; 19 pp. (1989, January)

From November 1988 through March 1989 an interim response action will be conducted to remove asbestos from the Weldon Spring Chemical Plant overhead pipeline. Previously conducted radiological monitoring has shown that in areas where woven cladding around the asbestos on the overhead pipeline has deteriorated, the asbestos has elevated concentrations of uranium (3 to 15 pCi/g as U-238). The purpose of this plan is to document the method for sampling and radiometrically assaying the asbestos associated with the overhead piping system in order to estimate the true mean radionuclide concentration. The resulting average concentration will be used to

evaluate disposal alternatives for the asbestos.

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

**Chemical Soil Investigation Report for the
Weldon Spring Chemical Plant/Raffinate Pits,
Phase II**

DOE/OR/21548-061; 72 pp. (1989, August)

This report presents data and interpretation from the Phase II Chemical Soil Investigation at the Weldon Spring Chemical Plant/Raffinate Pits. This investigation was performed to provide data in support of the Remedial Investigation and Baseline Risk Assessment. The investigation consisted of both biased and unbiased sampling programs designed to detect contamination from previous operations. Very small amounts of nitroaromatic compound contamination were detected in former ordinance production areas. Metals and inorganic anion contamination was observed in numerous locations related to both explosives and uranium production. Small amounts of semi-volatile organic, pesticide, and PCB contamination were also detected. No volatile organic contamination was observed. The data collected in this investigation was of sufficient quality and quantity to characterize the on-site chemical soil contamination. Additional investigations may be required to support remedial design. Numerous minor conclusions have been drawn in the interpretation of the data. These minor conclusions lead to the following major conclusions: (1) All chemical soil data indicate that there are no large source areas of nitroaromatic compounds observed in groundwater during the Phase I Water Quality Assessment and subsequent monitoring appear to be related to wastewater releases and contamination from the Weldon Spring Ordinance Works (WSOW). It appears that no significant soil source for this contamination now exists on the site. (2) In general, the horizontal and vertical extent of nitrate and sulfate contamination is generally limited and does not represent a source for groundwater contamination. Exceptions are sulfate contamination in soils near TNT Production Line No. 1 and nitrate soil contamination adjacent to, and underlying, the Raffinate Pits. (3) No volatile

organic soil contamination is present in WSCP/WSRP soils. Low-Level semi-volatile organic contamination is present in isolated areas related to coal storage or burning areas. No effects on groundwater or surface water were observed in previous investigations, and none are expected in future monitoring. (4) No significant polychlorinated biphenyl (PCB) or pesticide contamination was observed. Minor amounts of PCB contamination are present adjacent to the transformer pads. (5) Isolated areas of metal contamination exist throughout the WSCP/WSRP. These areas are related to both WSOW and Weldon Spring Uranium Feed Material Plant (WSUFMP) processes and do not represent potential sources for groundwater contamination. (6) Soil underlying buildings, roads, and paved areas will not require additional characterization as indicated by the general lack of significant chemical soil contamination. (7) The statistical objectives of the sampling plan were met.

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

**Waste Assessment Radiological
Characterization of the Weldon Spring Site
Raffinate Pits**

DOE/OR/21548-062; 72 pp. (1989, August)

As part of the remedial investigation efforts conducted at the Weldon Spring Site Remedial Action Project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of waste in the Weldon Spring Raffinate Pits (WSRP) was necessary to evaluate treatment and disposal alternatives. A sampling plan was developed, therefore, which detailed sample locations, sample parameters, and sampling techniques. The sampling effort consisted of collecting 145 samples from 42 locations. The sampling locations were evenly distributed across each of the four raffinate pits in terms of both area and depth. The samples were analyzed for long-lived radionuclides from the natural uranium and natural thorium transformation series. The average, standard deviation, minimum, and maximum were determined for the selected radionuclides for each pit. The data were then

evaluated and interpreted specific to each pit and for each radionuclide. At a later date the surface waters of each pit were sampled and similarly analyzed. This type of information is available for nonradiological parameters in a companion report titled "Waste Assessment Chemical Characterization of the Weldon Spring Site Raffinate Pits, 1989."

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

Waste Assessment Chemical Characterization of the Weldon Spring Site Raffinate Pits

DOE/OR/21548-092; 72 pp. (1989, August)

As part of the remedial investigation efforts conducted at the Weldon Spring Site Remedial Action Project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of wastes in the Weldon Spring Raffinate Pits (WSRP) was necessary to evaluate treatment and disposal alternatives. A sampling plan was developed, therefore, which detailed sample locations, sample parameters, and sampling techniques. The sampling effort consisted of collecting 145 samples from 42 locations. The sampling locations were evenly distributed across each of the four raffinate pits in terms of both area and depth. The samples were analyzed for nitroaromatics, metals, inorganic anions, volatiles, semi-volatiles, PCBs/pesticides, oil and grease, total organic halogens, total organic carbon, cyanides and phenols. The data were then evaluated specific to each pit. At a later date the surface waters of each pit were sampled and similarly analyzed for metals. Samples were also analyzed for radiological contaminants. Information regarding radiological characterization is available in a companion report titled "Waste Assessment Radiological Characterization of the Weldon Spring Site Raffinate Pits, 1989." This investigation was designed to provide a summary of data necessary to fully characterize the wastes contained in the Weldon Spring Raffinate Pits. Several preliminary conclusions can be made from the data presented in this report. These conclusions are: (1) Sample analyses indicate no nitroaromatic contamination in the raffinate pits. (2) There appears to be contamination in the pits from all inorganic anions

and metals analyzed for. (3) In general, Pit 4 had lower detectable levels of anions and metals as shown by sample analysis. Pit 4 also has the lowest volume of sludge. (4) The sludge appears to be homogenous with respect to metals and anion contamination even though the range may be wide for individual chemicals. Pit 4 appears to be the only pit with great inhomogeneity. (5) There appears to be no contamination from semi-volatile compounds as indicated by sample analyses. (6) There appears to be no contamination from cyanides shown by sample analyses.

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Morford, R.J., Westinghouse Hanford
Company, Richland, WA

Evaluation of the Source Term for the Decommissioning of the Shippingport Reactor

CONF-890408; WHC-SA-0395; Advances in Nuclear Engineering Computation and Radiation Shielding, Proceedings of a Conference, Santa Fe, NM, April 9, 1989; (13 pp.) (1989, January)

An experimental, pressurized, light water reactor was operated at Shippingport, Pennsylvania from 1957 to 1982 to generate power for a public utility. The facility is being decommissioned and the reactor vessel, neutron shield tank, and radioactive internal hardware will be shipped by barge for burial on the Hanford site in Washington state. Shipping regulations require that the radioisotope inventory of the package be defined and that radiation dose rates be predicted for normal and accident conditions. Monte Carlo calculations and actual gamma-ray measurements were made to support the design of the package and aid in the preparation of the shipping documents. Calculational methods are described together with their results.

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Morford, R.J., W.L. Bunch, L.L. Carter, J.W. Daughtry, R.A. Schwarz, and W.P. Stinson, Westinghouse Hanford Company, Richland, WA

Source Term and Shielding Calculations to Support Decommissioning of Shippingport Reactor

WHC-SA-02(6); CONF-880906; Radiation Shielding, Proceedings of the Seventh International Conference, Bournemouth, United Kingdom, September 12-16, 1988; (13 pp.) (1988, June)

An experimental pressurized light water reactor was operated at Shippingport, Pennsylvania from 1957 to 1982 to generate power for a public utility. The facility is being decommissioned and the reactor vessel, neutron shield tank, and radioactive internal hardware will be shipped by barge for burial on the Hanford site in Washington state. Shipping regulations require that the radioisotope inventory of the package be defined and that radiation dose rates be predicted for normal and accident conditions. Monte Carlo calculations and actual gamma-ray measurements were made to support the design of the package and preparation of paperwork for the shipment. Methods of calculation are described together with the results.

44

Murphie, W.E., U.S. Department of Energy, Washington, DC

Decommissioning Program Experience by the United States Department of Energy's Surplus Facilities Management Program

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp.43-49) (1988)

The U.S. Department of Energy's Remedial Action Programs are identified and the role of the Surplus Facilities Management Program (SFMP) highlighted, including the SFMP long range plan. The paper focuses on programmatic experience within the SFMP that has influenced program policy, including influences due to environmental compliance and inadequate project planning. This is provided from the programmatic versus project

specific perspective. Finally, the relevance of current SFMP projects to future large scale commercial decontamination and decommissioning activities are discussed, specifically highlighting the relevance of the Shippingport Project.

45

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

Decision Process Involved in Preparing the Shippingport Reactor Pressure Vessel for Transport

DOE/SSDP-0078; 5 pp.; CONF-890736; Proceedings of the 30th Annual Institute of Nuclear Materials Management Conference, Orlando, FL, July 9-12, 1989 (1989, July 10)

The most significant part of the Shippingport Station Decommissioning Project was the one-piece removal and shipment of the reactor pressure vessel (RPV). Implicit in the RPV transport was the task of qualifying the RPV as a waste package acceptable for shipment. Soon after physical decommissioning began on September, 1985, questions regarding the packaging certification and transport of the RPV from Shippingport, Pennsylvania to the U.S. Department of Energy (DOE) Hanford waste burial site necessitated reexamination of several planning assumptions. A complete reassessment of the regulatory requirements governing the RPV shipment resulted in a programmatic decision to obtain a Type B(U) Certificate of Compliance and abandon the originally planned U.S. Department of Transportation (DOT) low specific activity (LSA) shipment. The decision process resulting in this conclusion was extensive and involved many organizations and agencies. Incidental to this process, several subtle certification issues were identified that required resolution. Some of these issues involved the definition of LSA material for large packages; interpretation and compliance with DOE, DOT and U.S. Nuclear Regulatory Commission (NRC) regulations for the transport of radioactive material; incorporation of the International Atomic Energy Agency (IAEA) regulations by the Panama Canal; and DOE policy requiring advance notification to States of radioactive waste shipments.

46

Nelson, R.A., Jacobs Engineering Group, Inc., St. Charles, MO

Decommissioning and Remedial Action Progress at the Weldon Spring Uranium Feed Materials Plant

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 4, 374 pp.; (pp. 1115-1126) (1988, October 3)

The Weldon Spring Uranium Feed Materials Plant (WSUFMP) played a key role in U.S. uranium production during the years 1957 - 1966. Prior to its use for uranium production, the area was used by the Army to manufacture TNT during WW II. The 217-acre site has been virtually abandoned until 1986. An associated limestone quarry about six kilometers south of the plant was used by the Army for TNT and wastes. The Department of Energy (DOE) was given responsibility in 1985 for the demolition and cleanup of both plant and quarry areas. In 1986, the DOE formally began the Weldon Spring Site Remedial Action Project (WSSRAP). Although the first few years of the project will be primarily devoted to regulatory actions through both the CERCLA and NEPA processes, some remedial action activities have already begun. These include identification and removal of RCRA and TSCA wastes which are not radiologically contaminated, thus avoiding questions concerning mixed waste disposal. Efforts to stem off-site release of uranium in surface water flow are also being initiated. The complicated geohydrology of the area allows easy surface and groundwater interaction. Multiple groundwater springs more than two kilometers from the plant site exhibit elevated uranium concentrations. This migration is being mitigated by the construction of surface impoundments and diversion ditches to reduce the surface runoff over contaminated areas of the plant site, which reduces the amount of surface water reaching the groundwater. A status report of the activities at the DOE site is given. Interim remedial actions are presented to reduce the risk to the environment and to on-site workers during the period before regulatory process completion.

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O'Donnell, J.P., and R.C. Culbertson, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Waste Management (Truck and Rail Shipments to Hanford)

DOE/SSDP-0043 (Preprint); 5 pp.; CONF-880903; Spectrum '88: Nuclear and Hazardous Waste Management, Proceedings of a Topical Meeting, Pasco, WA, September 11-15, 1988 (1988, August 31)

As part of the physical decommissioning of the Shippingport Power Station, Shippingport, PA, a large volume of Low Specific Activity (LSA) radioactive waste was accumulated. The waste, which consisted primarily of radioactive reactor plant components, piping, contaminated asbestos, tanks, building rubble, sludge, and ion exchange resins, was packaged and prepared for shipment. The waste was transported by truck and rail from Shippingport, Pennsylvania, to the Department of Energy burial ground at Hanford, Washington, a journey of 2329 miles. This presentation will discuss the successful management of over 2600 packages weighing in excess of 3600 tons of radioactive waste from the cradle-to-the-grave, that is, from the time it was generated during the decommissioning process until its final burial at the Hanford, Washington burial site. Containers to be used for packaging were designed on-site. Approval for the packaging with specific contents was obtained through the burial ground operator. Once the containers were procured and received at the Shippingport site, each container was sequentially numbered according to the container type. Subsequent to assigning the control number or Process Control Inventory (PCI) number, Quality Assurance personnel would inspect each container and certify that the container complied with all established requirements. Truck shipments were prioritized based upon factors such as the decommissioning schedule, scarcity of space and weather conditions. Most truck shipments had between 60 and 80 drums which were palletized and each drum had corresponding PCI forms and Radiation Control Surveys. On shipments of the standard 86 cu ft boxes, either eight or nine boxes could be loaded on a truck. The package loading configuration would be determined prior to each shipment based upon balancing the weight of the

load and minimizing radioactive dose rate to the truck, material handlers and the public. Twenty-one of the whole piece components were shipped December, 1987 by rail using eight gondola railcars. These components consisted of tanks, heat exchangers and main coolant pumps weighing as much as 140,000 lb. Excluding the barge shipment of the Reactor Pressure Vessel and Neutron Shield Tank Package, 95 percent of the radioactive waste for the project has been delivered to the Hanford Burial Ground. The transportation of waste activity of the project has been extremely successful as there have been, as of April 30, 1988, 182 truck and 8 railcar shipments made without incident.

48

Peterson, J.M., M.M. MacDonell, L.A. Haroun, F.K. Nowadly, W. 'night, and G.F. Vajda, Argonne National Laboratory, Energy and Environmental Systems Division, Argonne, IL

Work Plan for the Remedial Investigation Feasibility Study-Environmental Impact Statement for the Weldon Spring Site, Weldon Spring, Missouri

DOE/OR/21548-033; 209 pp. (1988, August)

The Weldon Spring site consists of four raffinate pits, an inactive chemical plant, and a contaminated quarry. This document presents an RI/FS-EIS work plan (essentially an RI/FS work plan prepared in accordance with EPA guidance), which (1) is typically prepared prior to detailed site characterization activities, (2) summarizes existing information regarding the site, and (3) serves to integrate the site characterization and analysis of alternative phases of the remedial action process. This document also augments the information given in the body of the RI/FS-EIS work plan and contains information necessary to ensure compliance with DOE procedures for preparation of an EIS. Finally, this document contains responses to the major issues raised during public review of the draft EIS.

49

Mullee, G.R. and A.R. Schulmeister, General Electric Company, Nuclear Energy Business Operations, Shippingport, PA

Waste Management for the Shippingport Station Decommissioning Project

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, Tucson, AZ, March 1-5, 1987, 833 pp.; (pp. 453-435) (1987)

The Shippingport Station Decommissioning Project (SSDP) is being performed by the U.S. Department of Energy with the objectives of placing the station in a radiologically safe condition, demonstrating safe and cost effective dismantlement and proving useful data for future decommissioning projects. The authors describe the development of the waste management plan which is being used for the accomplishment of the SSDP. Significant aspects of the plan are described, such as the use of a process control and inventory system. The current status of waste management activities is reported. It is concluded that SSDP has some unique aspects which will provide useful information for future decommissioning projects.

50

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

Shippingport Decommissioning: Final Progress Report

CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 64-72); Transactions of the American Nuclear Society 59:64-72 (1989, June)

The Shippingport atomic power station (SAPS) consisted of the nuclear steam supply system and associated radioactive waste processing systems, which were owned by the U.S. Department of Energy (DOE), and the balance of plant, owned by the Duquesne Light Company. The station is located at Shippingport, Pennsylvania, on 7 acres of land leased by DOE from Duquesne Light Company. The Shippingport Station Decommissioning Project (SSDP) is being performed under contract to the DOE by the

General Electric Company (GE) and its preselected subcontractor, MK-Ferguson Company, as the decommissioning operations contractor (DOC). This paper describes the decommissioning work that has been accomplished since July 1988, and the project's cost and schedule status. As the first decommissioning of a commercial, full-scale nuclear power plant, the SSDP is expected to set the standards of future nuclear power plants.

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Selsley, I.A., Bettis Atomic Power Laboratory, West Mifflin, PA

Light Water Breeder Reactor Fuel Module Disassembly at the Shippingport Atomic Power Station (LWBR Development Program)

WAPD-TM-1552; 76 pp. (1987, October)

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport Atomic Power Station. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel and prepared for shipment to disposal sites or to the Naval Reactors Expended Core Facility in Idaho for examination, further disassembly, and final disposal. Fuel modules were partially disassembled at Shippingport. Seed module support shafts, reflector module seal blocks, and blanket module support tubes, seal blocks, and guide tube extensions were removed. This partial disassembly was required to enable the fuel modules to fit in M-130 shipping containers. No significant problems occurred during disassembly operations. Radiation and personnel exposure levels were carefully controlled.

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Selsley, I.A., Bettis Atomic Power Laboratory, West Mifflin, PA

Shipment of the Light Water Breeder Reactor Fuel Assemblies from the Shippingport Atomic Power Station to the Extended Core Facility (Idaho) (LWBR Development Program)

WAPD-TM-1553; 71 pp. (1987, October)

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport Atomic Power Station. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel and prepared for shipment to disposal sites or to the Naval Reactors Expended Core Facility in Idaho for testing or further disassembly. Three M-130 shipping containers were modified to accept LWBR seed, blanket, and reflector fuel modules for rail shipment to the Expended Core Facility. Thirty-nine LWBR fuel modules were transferred in 10 shipments. All shipments were completed successfully, without significant problems. Radiation and personnel exposure levels were carefully controlled.

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Shack, W.J., O.K. Chopra, and H.M. Chung, Argonne National Laboratory, Argonne, IL

Shippingport Aging Studies: Results and Plans

CONF-8810155; Water Reactor Safety, A.J. Weiss (ed.), Proceedings of the 16th Information Meeting, Gaithersburg, MD, October 24-27, 1988, Vol. 1, 558 pp.; (29 pp.) (1988, October)

The objective of this program is to develop an understanding of the metallurgical phenomena that may occur in nuclear reactor structural materials as a consequence of extended service at operating temperatures within and outside of the radiation environment and to assess the impact of these phenomena on structural integrity. Although many aging phenomena such as the embrittlement of cast stainless steel, low-temperature sensitization of austenitic stainless steels, and radiation embrittlement of pressure vessel steels have been studied in the laboratory, most of the studies have been based on simulation of actual reactor conditions. The Shippingport reactor offers a unique opportunity to validate and benchmark the laboratory studies, and thereby, provide a sound basis for evaluating the integrity of structural components near the end of the projected life of the plant. Additional work will be undertaken to identify the possibility of new, previously unknown mechanisms of component degradation.

54

Smith, W.H., W.J. Munyon, G.D. Mosho, M.J. Robinet, and R.A. Wynveen, Argonne National Laboratory, Radiological Survey Group, Technical Support Section, Environment, Safety, and Health Department, Argonne, IL

Cursory Radiological Assessment: Battelle Columbus Laboratory Decommissioning and Decontamination Project, Columbus, Ohio

ANL-ESH/TS-88-102; 144 pp. (1988, October)

This document reports on the results obtained from a cursory radiological assessment of various properties at the Battelle Columbus Laboratory, Columbus, Ohio. The cursory radiological assessment, which also included a chemical assessment component, was performed at the King Avenue and West Jefferson sites by Argonne National Laboratory personnel as part of a preliminary investigation for the Battelle Columbus Laboratory Decommissioning and Decontamination Project. The radiological assessment of the two sites included conducting interior and exterior building surveys and collecting and analyzing air, sewer system, and soil samples. Direct radiological surveys were made of floor, wall, and overhead areas. Smear surveys were made on various interior building surfaces as well as the exterior building vents. Air samples were collected in select areas to determine concentrations of radon-222, radon-220, and radon-219 daughters, in addition to any long-lived radioactive particulates. Radon-222 concentrations were continuously monitored over a 24-hr period at several building locations using a radon gas monitoring system. The sanitary sewer system at King Avenue, West Jefferson-North, and West Jefferson-South were each sampled at select locations. All samples were submitted to the Argonne Analytical Chemistry Laboratory for various radiological and chemical analyses. Environmental soil corings were taken at both the King Avenue and West Jefferson sites to investigate the potential for soil contamination within the first 12-inches below grade. Further subsurface investigations at the West Jefferson-North and West Jefferson-South areas were conducted using soil boring techniques. A total of twenty bore holes were drilled, using 3-inch hollow stem augers, to depths down to 12-ft below grade. Split-spoon samples were taken from these bore holes at continuous 1-ft. increments and sent back to

Argonne National Laboratory for analysis. Each bore hole was also logged using a 2 X 2-inch NaI(Tl) detector and associated electronics.

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Shippingport Station Communications Program

DOE/SSDP-0046 (Preprint); 2 pp.: CONF-880903; Spectrum '88: Nuclear and Hazardous Waste Management, Proceedings of a Topical Meeting, Pasco, WA, September 11-15, 1988 (1988, August 31)

Early in 1984, General Electric Company (GE) was awarded the contract by the U.S. Department of Energy (DOE) to decommission the government-owned portion of the Shippingport Atomic Power Station. Similar to the problems that Duquesne Light and the AEC had faced in the mid-fifties, DOE and GE also found themselves as ground-breakers of another variety. The problem was how to gain understanding of, and support for a project of a magnitude that here-to-fore had never been accomplished or undertaken. Moreover, these operations were to be carried on in the home state of Three Mile Island. In fact, Shippingport is less than 200 miles from the location of the infamous Unit 2 nuclear power plant. At the Shippingport Station Decommissioning Project, the central idea of the communications that was developed for use was purposely designed to be as uncomplicated as possible. The central theme that was developed and communicated is that all nuclear plants will someday need to be retired and also decommissioned. The Shippingport Station, originally constructed as a demonstration nuclear power plant, was now being decommissioned as a demonstration to the world-wide nuclear industry that this evolution can be done in a safe and cost-effective manner. Furthermore, the technology currently exists to complete this process. The major public relations challenge yet remaining for the program is the plan to notify each of the states along the route of the shipment by barge of the Reactor Pressure Vessel/Neutron Shield Tank package. Although there is no legislated requirement for such notification, there is a common sense need to communicate the planning for this significant activity.

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U.S. Department of Energy, Assistant Secretary for Nuclear Energy, Office of Remedial Action and Waste Technology, Washington, DC

Program Plan FY 1989: Surplus Facilities Management Program

DOE/NE-0096; 72 pp. (1988, November)

The Program Plan is a key document of the Surplus Facility Management Program (SFMP). The Program Plan describes the program's mission and objectives; describes the program approach to decommissioning; describes the management approach; outlines program documentation; and presents current program baseline information. The Program Plan does not address, in detail, the project-level activities conducted by participating U.S. Department of Energy (DOE) Operations Offices. Each Operations Office is responsible for organizing, managing, and conducting their activities in accordance with DOE guidance and directives in support of the SFMP mission and objectives. Three appendixes are included within this Program Plan. Appendix A gives a listing of past and current surveillance and maintenance tasks. Appendix B provides a description of current SFMP facilities that have been identified for disposition (i.e. projects) at sites throughout the United States. Appendix C shows the current SFMP Project Cost and Schedule Baseline. Other key program documents include the Resource Manual and the Yearly Management Plan. These documents are subordinate to the Program Plan. The Resource Manual details program requirements, provides pertinent DOE references and guidance, and supplies the pertinent forms used to manage the decommissioning of surplus facilities. The Yearly Management Plan focuses on the established annual milestones, planned and achieved accomplishments, and baseline costs and schedules.

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Voorhees, L.D., L.A. Hook, M.J. Gentry, P.T. Owen, K.A. Newman, R.A. McCord, M.A. Faulkner, and J.L. Bledsoe, Oak Ridge National Laboratory, Oak Ridge, TN

Data and Information Management System for the ORNL Remedial Action Program

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988; (23 pp.) (1988)

A Remedial Action Program (RAP) was established in FY 1985 at Oak Ridge National Laboratory (ORNL) to provide corrective measures at areas contaminated with radioactive and/or hazardous chemical wastes. To achieve this goal, numerous and varied studies are being conducted to characterize the waste disposal sites. Environmental data collected in support of other programs at ORNL are also of use to RAP. Collectively, these studies are generating a voluminous amount of data on a scale unprecedented for ORNL. A computerized Data and Information Management System (DIMS) was developed to provide a centralized repository for data pertinent to RAP and to provide support for the investigations and assessments leading to the long-term remediation of contaminated sites and facilities. The current DIMS and its role in supporting RAP are described. The DIMS consists of three components: (1) the Bibliographic Data Base, (2) the Records Control Data Base, and (3) the Numeric Data Base. This paper/poster emphasizes the Numeric Data Base, including its development and organization, and also summarizes the status of other activities associated with management and use of such data (i.e. bibliographic information, records control, geographic information, and quality assurance). The types of data currently available have been summarized, and a synopsis of the contents of the RAP numeric data base has been compiled in a menu-driven program available on PC diskettes. The synopsis will be demonstrated at the conference.

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

Shippingport Station Decommissioning Project - Asbestos Removal Topical Report

DOE/SSDP-0033; 56 pp. (1988, July 6)

This topical report is a synopsis of the asbestos insulation removal performed at the Shippingport Station Decommissioning Project (SSDP). The information is provided as a part of the Technology

Transfer Program to document the removal of asbestos insulation at a nuclear power station decommissioning project. The report covers the scope of work, regulations, engineering decisions, removal methods, lessons learned, and summaries from the detailed data base including man-hours, asbestos removal volumes, radiation exposures, and airborne asbestos concentrations.

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

Shippingport Station Decommissioning Project Contaminated Concrete Removal - Topical Report

DOE/SSDP-0047; 31 pp. (1989, May 15)

This Topical Report is a synopsis of the removal of contaminated concrete from the Shippingport Station Decommissioning Project (SSDP). The information is provided as a part of the Technology Transfer Program to document the decontamination activities in support of site release in the decommissioning of a nuclear power reactor.

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

Shippingport Station Decommissioning Project FY 1988 Annual Progress Report Fiscal Year Period October 1, 1987 Through September 30, 1988

DOE/SSDP-0061; 44 pp. (1989, May 9)

This report presents progress on the Shippingport Station Decommissioning Project of FY 1988. 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, economical, or scheduler considerations.

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

Shippingport Station Decommissioning Project Preparation of the Reactor Pressure Vessel

DOE/SSDP-0062; 25 pp. (1989, June 8)

This report is a synopsis of the preparation of the Reactor Pressure Vessel (RPV) at the Shippingport Station Decommissioning Project (SSDP). The reactor vessel head was first installed to provide shielding and to allow early draining of the reactor vessel cavity. Surface contamination on the head was fixed by painting the surfaces with latex paint. The engineered fill for the reactor vessel cavity, tank annulus, and void areas was a highly fluid, lightweight, and slightly expansive grout. A diesel-driven grout pump placed the 264 cubic feet of grout used. Quality assurance procedures for each batch included flow measurements and sample tests with final water amounts being added and mixed at the time of site delivery. Plasma arc cutting techniques were applied in segmenting stainless steel piping and nozzles. Contaminated smoke was controlled by way of localized contaminants enclosing the cutting areas. Exhausts from these contaminants was HEPA filtered.

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Preparation, Lifting & Loading of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank Package

DOE/SSDP-0074; 16 pp.; CONF-890604; Proceedings of the 1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 67-69); Transactions of the American Nuclear Society 59:67-69 (1989, June)

The Shippingport Atomic Power Station (SAPS) has provided many "firsts" for the nuclear industry. In 1957, Shippingport demonstrated the safe peace-time use of nuclear energy as the first

nuclear power plant to produce electricity for a public utility; In 1976, following reactor conversion to a Light Water Breeder Reactor (LWBR), Shippingport demonstrated that the breeder principle can be safely applied in a light water reactor. In 1985, following end-of-life testing and defueling, the Shippingport Station Decommissioning Project (SSDP) commenced physical decommissioning to demonstrate that the final stage of a nuclear plant lifecycle, decommissioning, can be performed both safely and cost effectively. The shipment of the shielded irradiated Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) Package from Shippingport, PA to Richland, WA by barge as a single package was the largest non-military radioactive shipment ever made. This paper discusses the basis for the one piece removal option, describes how the RPV/NST was prepared to comply with government regulations for shipping radioactive material, and the methods utilized to lift the RPV/NST and load it onto a barge for its subsequent shipment to Richland, WA.

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Preparation and Transport of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank Package

DOE/SSDP-0044 (Preprint); 3 pp.; CONF-880903; Spectrum '88: Nuclear and Hazardous Waste Management, Proceedings of a Topical Meeting, Pasco, WA, September 11-15, 1988 (1988, August 31)

The Shippingport Station Decommissioning Project is a Department of Energy (DOE) project to dismantle the Shippingport Atomic Power Station. One of the more challenging technical aspects of the Project, which is being managed for DOE by GE Nuclear Energy, is the one-piece removal and shipment of the Reactor Pressure Vessel (RPV) and its associated Neutron Shield tank (NST) to the government owned Hanford Reservation in Richland, Washington. One-piece removal by barge was selected for the following reasons: (1) it was the safest, most cost effective method; (2) it reduced the duration of the project by 1 year; (3) it reduced the cost by \$4 million; and (4) it resulted in a radiation exposure savings of 150 man-rem. The package has been demonstrated to comply with federal regulations for a Type B(U) Package and is capable of withstanding any credible accident to which it may be subjected during its transport with insignificant radiological consequences to the public or the environment. This is the first application of one-piece removal and barge transport of an irradiated commercial nuclear reactor pressure vessel. Its potential application to future decommissionings appear to provide significant cost, schedule, and radiation exposure savings over the more conventional segmentation methods.

NUCLEAR FACILITIES DECOMMISSIONING

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A Tentative Pact on Decommissioning

Nuclear News 31(10):66 (1988, August)

A tentative pact on decommissioning was signed in Moscow on June 28 by France's Framatome and the National Research Institute for Nuclear Power Plant Operation of the USSR Ministry of Atomic Energy. The Soviet signatory, Institute director Arman Abagyan, was acting also in the name of the International Association of Scientific and Technical Assistance for Nuclear Power Plant Dismantling. Signing of Framatome was Dominique Degot, senior vice president-international operations. The agreement covers collaboration in engineering, equipment design, and preparatory work for dismantling. This autumn, the two parties are to assess the possibilities for real cooperation in this field. Framatome noted that the agreement confirms the desire of Soviet and French industry to cooperate in the nuclear power field, for which their experiences may be concordant and complementary.

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Abudaka, M., and P.S.J. Crofton, Imperial College Science and Technology, London, United Kingdom

Abrasive Water Jets for Controlled Demolition and Dismantling

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 63-67) (1988)

Abrasive water jets offer an efficient high speed cutting tool for hard materials such as reinforced concrete, tool steel, and armor plate. Cutting by abrasive water jets is often described as a cold cutting operation since no heat is developed and any increase in local temperature is immediately cooled by the water jet. Moreover no sparks are generated to ignite a potentially flammable atmosphere. Mass flow rates of water and abrasive are small (typically 4 liters/min water and 1 kg/min abrasive) and hence are easy to collect and to

dispose of. For these reasons abrasive water jets offer certain advantages in cutting difficult materials in hazardous environments such as in the nuclear industry, offshore oil rigs, and petrochemical plant. Available portable cutting systems are described and the advantages of using abrasive water jets are discussed as well as some of the parameters involved in the cutting operation. Finally a description is presented of some typical applications of abrasive water jet cutting.

66

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Taming Windscale's Piles

Professional Engineering 2(1):10-12 (1989, January)

The options as to what to do with the Windscale Piles are being assessed before a final decision on decommissioning is made. Both Piles were shutdown in 1957 following the fire in the Pile number 1. Pile 1 still contains 22 tons of natural uranium fuel. The details of graphite moderator content, biological shielding and other components and containment are given. The fuel and isotope channels in Pile 2 have been examined and the air and water ducts have been inspected. The chimneys of both Piles are contaminated and all entrances have been sealed. Before any work starts the air outlet ducts will be sealed from the chimney and a ventilation system installed. A manipulator is being prepared to remove the remaining fuel elements from both Piles. The proposed decommissioning program for both Piles is outlined.

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Adorni N., Germani G., Parmeggiani A., Possa G., and Turricchia A.

Underwater Plasma-Arc Cutting as a Powerful Dismantling Tool for Water Reactors

Energia Nucleare 17(12):695-706 (1970, December)

Studies of the feasibility of underwater plasma-arc cutting are described. The design, construction, and

testing of a machine for the underwater dismantling of the thermal shield of a reactor is reported. Plasma-arc cutting is suitable for the underwater dismantling of radioactive stainless steel structure. No particular difficulty was found with a water head of up to about 7M, the main difference to cutting in air being the increased power requirement. Stainless steel plates up to 76.2 mm thick were successfully cut.

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Ahmed, A., H. Klein, G. Paul, and V. Koester, Badische Stahl-Engineering, Badische Stahlwerke, Federal Republic of Germany

Remote Controlled Lance Manipulator for Scrap Cutting, Oxygen Blowing and Slag Foaming in an Electric Arc Furnace

Iron Steel Engineering 65(1):46-55 (1988, January)

From detailed mill measurements and analysis, and by the adoption of low cost technological improvements, D&I gage tolerance is being produced from an older five-stand tandem cold mill. The keys have been a feed-forward, speed-controlled, automatic gage control system and the development of considerably tighter specifications on backup rolls supported by accurate measurement systems. Currently, a mathematical model of the mill is being developed as the basis for computer-assisted mill setup.

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

Decontamination Technology: A US Perspective

PNL-SA-14675; CONF-871018; Decommissioning, G.A. Tarcea (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987; (11 pp.) (1987, February)

This paper provides an overview of advances and applications to provide a U.S. perspective for the decontamination technology and applications

presented at the 1987 Symposium.

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Analytical Resources, Inc., Sinking Spring, PA

TMI-2 Equipment Decontamination Facilities Evaluation

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988; (pp. 493-495) (1988)

Two principal facilities, the 328 sq-ft decontamination facility (which is located in the radiological controlled area of the TMI-2 auxiliary building), and the 7000 sq-ft stand-alone waste handling and packaging facility, (WHPF)-provide the wide variety of equipment decontamination services necessary to support the Three Mile Island Unit 2 (TMI-2) cleanup program. Each facility was designed, and is operated, to achieve the maximum amount of on-site waste reduction while improving the overall ability of the plant operations staff to control large volumes of contaminated material. In mid-1987, decontamination personnel at TMI-2 began collecting data on equipment decontaminated by these two facilities since January 1987. The data was then used to evaluate the performance of each individual decontamination process, and to assess the relative effectiveness of each facility.

71

Andersen, C.B.

Comparison Between Laser, Plasma, Waterjet, Oxygen Cutting and Other Mechanical Cutting Processes for Low Thicknesses (0.5 to 5 MM)

Welding World 25(5-6):88-95 (1987)

A comparative study is made of different cutting processes: oxygen cutting, plasma cutting, laser cutting, water cutting high pressure, shearing, punching, and nibbling. The quality of cuts obtained and their economy and industrial hygiene, notably for waterjet cutting, are considered.

72

Andersen, C.B.

Applying Laser, Plasma Arc, Water Jet, Oxygen and Other Mechanical Methods for Cutting Low Thickness Materials (0.5-5 MM)

Zavarivac 33(1):19-24 (1988)

A synthetic comparison between different cutting methods is presented, including laser beam, plasma arc, oxycutting, water jet, shearing, etc. Application fields are outlined for plain carbon (e.g. St37-2, St42, St52-3) unalloyed and low alloyed steels, stainless steels, Al and its alloys and plastics. Quality of cutting (heat-affected zone) is noted. Economical aspects are emphasized, taking into account both preparation and cutting time. Conditions to select a specific cutting method are given, concerning the surface quality of the plate and its flatness. Effects of different cutting techniques on the properties of the material in the affected zone are compared (deformation, residual stresses, hardening, nitrogen absorption). Problems of labor safety and pollution (especially noise level) are briefly pointed out.

73

Arndt, K.D., F.W. Bach, B. Boedeker, and F. Krieger, Salzgitter AG, Federal Republic of Germany; Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany; Hannover University, Institut fuer Werkstoffkunde, Hannover, Federal Republic of Germany; Noell GmbH, Wuerzburg, Federal Republic of Germany

Technology for Disposal of Cuttings from the Underwater Plasma Fusion Cutting of Austenitic Nuclear Components, Final Report

INIS-mf-11844; 122 pp. (1985, August)

The cutting waste products from underwater plasma cutting that arise both in the water and in the air were collected and passed through selected air and water storing filters. Then the concentration and particle size distribution of the dust contained in the raw gas and particles suspended in the raw water were measured. Parallel measurements were made in the same way with the pure gas and water. The obtained results permitted the degree of

separation and the storing capacity of the chosen filter systems to be determined. The tests have shown that for air filtration, submicron particulate air filters (box and drum type) are appropriate. With water filtration however, the degrees of separation and storing capacity typical of air filters could not be achieved. Here the 0.2 m and 0.45 m membrane filters were found to be the most suitable of the filters used. A proposal for disposal is the dismantlement inside the pressure vessel or the fuel element storage pool. Disposal of cuttings will be via air filtering system with suction bell, a single-stage filter and fan and water filtering system with suction, a device at the cutting torch, suction lines, and circulation pump.

74

Asay, R.H., and K.W. Edsinger, Radiological and Chemical Technology, Inc., San Jose, CA

Mechanical Decontamination of Primary Reactor Piping - Feasibility Study

CONF-8804174; Water Chemistry in Nuclear Power Plants - Operational Experience and New Technologies for Management, Proceedings of the 1988 JAIF International Conference, Ibaraki, Japan, April 19-22, 1988. Japan Atomic Industrial Forum, Tokyo, Japan, Vol. 2, 819 pp. (1988)

Mechanical decontamination by means of a Flex-Hone has been studied. The results indicate its use is a viable method that can, in some cases, replace chemical decontamination and hydrolasing. It also provides a smooth surface that may be useful for preconditioning of pipe.

75

Ashcroft, D.J., N.W. Collins, E.H. Perrott, and P.K.J. Smith, United Kingdom Atomic Energy Authority, Northern Research Laboratories, Risley, United Kingdom; Strachan and Henshaw, plc., Bristol, United Kingdom; United Kingdom Atomic Energy Authority, Northern Research Laboratories, Windscale, Seascale, United Kingdom

Engineering Design of the Windscale Advanced

Gas-Cooled Reactor Decommissioning Machine and Robotic Manipulator

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 229-240) (1988)

The paper reviews the background to the Decommissioning System and the stages through which it was developed before arriving at the final concept. Included is the steel materials radioactive inventory which gives radioactivity and weight of steel materials to be size reduced and handled by the System. A detailed description of the decommissioning machine and handling system is given. 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.

76

Atomic Energy Society of Japan, Tokyo, Japan

Present Status and Problems of Remote Systems Technology in Nuclear Industry

Japan Atomic Energy Society 31(2):239-254 (1989, February)

This reports the activities of Special Committee on Remote Systems Technology, Atomic Energy Society of Japan, during the period from October 1984 to September 1988. The Committee studied and reviewed the present status and problems of remote operation and maintenance in various fields of the nuclear industry. Reported items are: reactor operation, reprocessing, nuclear fusion, and decommissioning. It also reviews robotics and remote systems technology applied to space and marine development.

77

Augustin, X., J.C. Gauthey, P. Lourme, and T. Sala, Societe Technique pour l'Energie Atomique, Centre d'Etudes Nucleaires de

Saclay, Gif-sur-Yvette, France

French Processes for Waste Embedding - The Use of Epoxy Resin for Waste Containment

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (p. 240) (1988)

The low and medium activity waste generated by nuclear facilities when operating as well as during their decommissioning (dismantling, decontamination, etc.) are embedded for the purpose of obtaining a product suitable for disposal. Due to the varieties of waste produced it was necessary to resort to multi-purpose techniques to solve problems relating to their embedding. The process for waste embedding in thermosetting polymer (polyester, epoxy) developed by the French Atomic Energy Commission (CEA) and its subsidiary Technicatome is easy to operate and yields excellent results having regard to volume reduction and containment of radioisotopes (particularly Cesium). The industrial development of this process has led to the design of small, flexible, fixed or mobile, embedding stations. Examples illustrating the increasing use of this process during facility dismantling, are described in the presentation.

78

Austin, W.E., R. Blumberg, and J.H. Hayes, GPU Nuclear, Inc., Middletown, PA

Plasma-Arc Cutting Equipment for TMI-2 Defueling

Transactions of the American Nuclear Society 54:83-85; Proceedings of the American Nuclear Society 1987 Annual Meeting, Dallas, TX, June 7-11, 1987; (pp. 83-85) (1987)

An engineering effort is currently under way at Three Mile Island Unit 2 (TMI-2) to provide equipment to defuel the region of the reactor vessel below the core. This area is a stainless steel structure called the lower core support assembly (LCSA). As one of several options, the plasma-arc

cutting process has been selected to section the LCSA to provide large openings for debris removal from this region. Plasma arc is the only technique considered to be capable of cutting the LCSA in a reasonable time. Remote, underwater plasma cutting has been used previously for decommissioning and for modifications at operating reactors, such as St. Lucie. Cutting tests at a depth of 10.7 m (35 ft) on 5-cm (2-in.)-thick stainless steel established the feasibility of the TMI-2 application. These were performed for TMI-2 by EG&G under sponsorship of the U.S. Department of Energy (DOE).

79

Bach, F.W., and M. Jaeger, Hannover University, Institut fuer Werkstoffkunde, Hannover, Federal Republic of Germany; Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany

Development of a Plasma-Arc-Cutting Technology Like a Mechanical Saw for Atmosphere and Under Water for Dismantling Nuclear Components of Greater Thickness: Final Report

INIS-mf-11751; 134 pp. (1987, October)

Previously it has not been possible to cut steel which is thicker than 100 mm when using plasma arc cutting under water. In a depth of water of 20 m it is only possible to cut steel up to 80 mm. This is inadequate for dismantling technology. Plasma-arc cutting technology should be developed to enable cutting a plate independent of its thickness. A plasma-arc saw has been developed to use in thermal cutting of materials, similar to a mechanical saw. To develop and optimize the special nozzles of the plasma-arc saw, the submerged combustion burner has been developed similar to the arc-saw. Results: There are no problems in thermal cutting a steel independent of its thickness. The thickness of the plate depends only on the diameter of the saw disc. The water depth of 20 m reduced the cutting speed by 10%. The plasma-arc saw enables thermal cutting of a plate independent of its thickness in a water depth of 20 m without requiring a force. The remote controlled dismantling of a reactor vessel and other

components with greater wall thicknesses is possible.

80

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

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

Remote Systems Technology, Proceedings of the 34th Conference, Technology, Washington, DC, 1986 (1987)

A manipulator carrier system (MTS) for remote-operated maintenance was designed and fabricated for the reprocessing plant in Wackersdorf/Germany (WAW). The substantial construction characteristics were described. A robot control takes care of operating and monitoring the machine. A special manipulator was developed for dismantling the pressure tube reactor and is presently being tested in a mock-up. Function and first results are explained.

81

Baker, S.M., J.L. DeVary, R.P. Elmore, R.F. Lorang, A.J. Rossi, and M.D. Freshley, Westinghouse Hanford Company, Richland, WA

U1/U2 Uranium Plume Characterization, Remedial Action Review and Recommendation for Future Action

WHC-EP-0133; 71 pp. (1988, June)

Research topics include: the need for additional characterization of a uranium groundwater plume associated with the 216-U-1 and 216-U-2 cribs (U1/U2 cribs); regulatory requirements for cleaning up the plume beyond the cleanup already completed; the technical feasibility and cost of additional cleanup by pumping and processing groundwater. Conclusions resulting from these investigations include additional characterization of the uranium contaminant plume and other nearby contaminant plumes is required before resuming

groundwater pumping to cleanse the aquifer below the U1/U2 cribs, and future groundwater pumping to clean up the aquifer should not be performed without prior agreement with the U.S. Environmental Protection Agency and the State of Washington Department of Ecology. Specifically, negotiations with the regulatory agencies should establish the need for, and appropriateness of, any proposed groundwater pumping.

82

Bankard, M.G., and R.H. Mayhall, Daedalean Associates, Inc., Woodbine, MD

Redesign and Field Operation of a Self-Propelled Cavitating Concrete Removal System

FHWA/TS-84/207; 52 pp. (1984, May)

The objective of this program was to redesign, build and demonstrate a self-propelled concrete removal system that utilized water cavitation erosion technology to accomplish the work. This final report presents an in-depth discussion of the significant elements of the program; specifically the design considerations, the fabrication and laboratory testing, and finally the field demonstration. In addition, there are separate sections which include a cost analysis and system comparison, and the conclusions and recommendations that resulted from this program. This program has promoted the advancement of water cavitation technology and has demonstrated its cost effectiveness and feasibility for employment in large scale systems for concrete removal.

83

Bargagliotti, A., L. Caprile, F. Piana, and E. Tolle

Plasma Arc and Thermal Lance Techniques for Cutting Concrete and Steel

EUR-10402; 174 pp. (1986)

Tests performed on plasma arc and thermal lance cutting of concrete and metal (ASTM A508, ASTM A533, AISI 304 steels, Inconel 600, Al), of up to 150 mm thick (air) and 103 mm thick (underwater) are reported, and procedures for dismantling two

types of BWR reactors are examined. Two plasma arc torches (plasma-shaped electrode torch (WIPC) and the pointed electrode torch (DMC-GRUN)) were used, with Ar-N₂ and Ar-H₂ gas. Fume and dust emission depended on torch, cutting speed, metal, and was reduced 500 times underwater. Control measures included shields, remote control, and robots. Fume and pollutant gases are also produced by the more expensive thermal lance. Process equipment, procedures, parameters, fume observation and control methods are noted.

84

Baston, V.F., K.J. Hofstetter, and R.F. Karuhn, GPU Nuclear, Inc., Middletown, PA

Characterization of Reaction Gases and Aerosols from Underwater Plasma Arc Cutting Demonstration Tests at Three Mile Island Unit 2

Nuclear Technology 83(2):216-227 (1988, November)

Defueling operations at Three Mile Island Unit 2 involve underwater plasma arc cutting of reactor vessel stainless steel components. Sampling and analysis of released off-gases and aerosols during steady-state plasma arc cutting tests established a conversion fraction of nitrogen-to-nitrogen oxides, off-gas composition, and aerosol concentrations for engineering evaluations of potential health and safety and corrosion issues. The sample results indicate that: less than 1 volume % of N is converted to nitrogen oxides; the air-borne particulate concentrations for the major steel components (Cr, Fe, Ni, etc.) could exceed the threshold limit values without off-gas capability; the volume percent hydrogen could exceed its lower flammability limit without off-gas capability; and there is low corrosion potential for off-gas system components for the given torch operations.

85

Batista, E., I. Limpel, T. Urbas, and A. Vugrinec

Ecological Problems in Plasma Cutting of C4572 Stainless Steel

Varilna Tehnika 37(2):40-44 (1988)

In plasma arc cutting of 10-40 mm thick stainless steel C4572, fumes mixed with the Ar and hydrogen atmosphere were found to exceed permitted limits. This was greater still when using an air atmosphere. More ozone forms during cutting of thin materials than of thick. The evolution of nitrous oxides increases with thickness. The smoke particle size is principally greater than 3 μ m. The noise level is also greater than permitted.

86

Bauer, K.G., Hannover University, Hannover, Federal Republic of Germany

Thermal Cutting Under Water and Ensuing Radiological Effects

Nuclear Technology '87 (Jahrestagung Kerntechnik '87), Proceedings of a German Nuclear Society Annual Meeting, Karlsruhe, Federal Republic of Germany, June 2-4, 1987. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany; (pp. 671-674) (1987, June)

Explains that the demolition of primary circuits of decommissioned nuclear power stations is carried out by thermal cutting under water because of the high absorption of radiation in water. Plasma melting and electric arc cutting are suitable cutting procedures. The cutting debris includes contaminated particles from about 0.01 to 12 microns (dust), suspended in the water (about 3% of joint material).

87

Bauer, K.G.

Structure Vibrations in the Case of Explosive Break-Up of Concrete Structures When Demolishing Nuclear Stations

Nuclear Technology '87 (Jahrestagung Kerntechnik '87), Proceedings of a German Nuclear Society Annual Meeting, Karlsruhe, Federal Republic of Germany, June 2-4, 1987. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany; (pp. 679-682) (1987,

June)

The experimental verification of the demolition work with explosives provide raw data on acceleration where the frequency components above 100 Hz are predominant. The signals are filtered between 80 and 30 Hz by sensing the test plate which transmits the forces of the explosion to the investigated structure, and both the idealized and actual process are illustrated. Simulation is carried out with a beam and a bar, and the analysis is used to derive the vibration response.

88

Bauer, K.G., Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Simulation of Demolition by Blasting of the Biological Shield of the High-Pressure Reactor

Nuclear Technology '87 (Jahrestagung Kerntechnik '87), Proceedings of a German Nuclear Society Annual Meeting, Karlsruhe, Federal Republic of Germany, June 2-4, 1987. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany; (pp. 675-678) (1987, June)

This document shows that blasting is a convenient method for the demolition of an activated biological shield of a decommissioned nuclear power station. Tests (with 2.5 kg explosive) were carried out to investigate the behavior of the blast waves in air, their transmission into the structure, and the resulting debris and dust. The pressure rose by up to 1.4 bar near the blasting site. Each gram of explosive produced 1 to 3.8 kg of debris (average size 2.5 cm). The average size of dust particles was 0.0001 mm.

89

Beaumont, J., and D.P. Baillie, Thermic Limited, Blackpool Institution of Civil Engineers, London, United Kingdom

Specialist Cutting Techniques for Reinforced Concrete in the Construction Industry

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 136-143) (1988)

The widespread use of reinforced concrete in construction has of necessity led to the development of a number of techniques to enable it to be cut and demolished in a controlled way when the need arises. The basic methods have been refined to improve production, and new methods introduced to respond to environmental pressures and the need to alter existing structures without adversely affecting that which remains. These techniques need not be for solely destructive purposes, but when used imaginatively can be an aid to construction. For instance, a building can be constructed rapidly, without boxing out for services and other accesses, these being cut at a later date when the client's needs are finally developed. An analysis of specialist techniques follows describing not only the process, but guidance to the equipment, the normal limitations and how these limitations can be overcome in certain circumstances. The application of some of these techniques to the removal of the biological shield surrounding the heat exchangers of the Windscale Advanced Gas-Cooled Reactor is described.

90

Beddows, R.A., and J.R. Wakefield, United Kingdom Atomic Energy Authority, Northern Research Laboratories, Windscale, Seascale, United Kingdom

Development of a Packaging and Disposal System for the Windscale Advanced Gas-Cooled Reactor

CONF-881008; Decommissioning of Major Radioactive Facilities. Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 159-166) (1988)

The UKAEA are currently engaged in developing equipment and techniques for the dismantling of the 100 MW(Th) Windscale Advanced Gas-Cooled Reactor. As a consequence of decommissioning some 800 tons of steel, 300 tons of graphite, and 750 tons of concrete will need to be contained, transported and disposed of as radioactive waste. Of this, about 815 tons will be classified as Intermediate-Level Waste (ILW) and will be packaged and immobilized within a reinforced concrete container. The design and development of the concrete container to meet the approval of the appropriate Regulatory Bodies is the subject of this paper.

91

Bellanger, G., Commission de l'Energie Atomique, Paris, France

Surface Decontamination of Tritium Contaminated Metallic Parts and Device Using This Process

French Patent FR 2609352/A; 22 pp. (1988, July 8)

The contaminated equipment is connected to a DC generator to act as a cathode in an aqueous electrolyte after connecting an anode, a current density of 10 to 50 mA/sq cm is applied for cathodic loading with hydrogen. Tritium adsorbed on the surface of the equipment is replaced by hydrogen.

92

Bengel, T.G., Bechtel Eastern Power Corporation, Three Mile Island Nuclear Station, Middletown, PA

TMI-2 Auxiliary Building Elevator Shaft and Pit Decontamination

Remote Systems Technology, Proceedings of the 34th Conference, Technology, Washington, DC, 1986 (1987)

Decontamination of the elevator pit and shaft in the Auxiliary Building at Three Mile Island Unit 2 Reactor was performed to remove high radiation and contamination levels which prevented personnel

from utilizing the elevator. The goal for this effort was to decontaminate the shaft, pit, and elevator cab to the point where personnel could ride the elevator without protective clothing.

93

Bennett, D., and G. Holt, Nuclear Industry Radioactive Waste Executive, Harwell, United Kingdom; Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, United Kingdom

The Packaging and Transport of Large Items of Intermediate and Low-Level Decommissioning Waste - Construction Division

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 175-184) (1988)

Large quantities of decommissioning waste will be produced in the future from the dismantling of nuclear facilities. Many of these wastes will be large, heavy items requiring size reduction for transport and disposal. The preliminary design requirements for large packages have been identified and conceptual designs which meet these requirements have been developed. An alternative for some large waste items having low levels of internal contamination, e.g. Magnox reactor boilers, would be to transport and dispose of them intact. Techniques and commercially available equipment for handling and transporting Magnox boilers have also been identified.

94

Bergemann, L., M. Laser, and S. Halaszovich, Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen/Guenzburg, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Radiological Measurements for Decontrol in the Gundremmingen Nuclear Power Station,

Unit A

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 136-149) (1988, July)

The licenses for the decommissioning of the KRB-A for the first phase permit dismantling, decontamination, and radiological measurement of 100 tons of material, which for the most part was to be suitable for recycling. The difficulties encountered in the mass-specific radiological measurements for classification of the solid waste into the recycling category determined by the license provisions are explained, together with the special measuring methods developed for determining the surface contamination (digital pulse rate measurement).

95

Beyer, V.

Process and Device for Decontamination of Radioactive Surfaces

German Patent DE 3,603,708/A1; 5 pp. (1987, August 13)

The invention concerns a process for decontaminating radioactive surfaces, particularly metal ones, where the surface is ground by rotating hardened steel wire brushes and the ground off dust is continually extracted and collected, until the radioactivity of the ground off dust or the contaminated surface has fallen below a given value and a device suitable for this purpose.

96

Black, R.M., B.W. Spence, and C.W. Stewart, United Kingdom Atomic Energy Authority, Northern Research Laboratories, Risley, United Kingdom

Decommissioning and Demolition of Four Suites of High Active Chemical Analysis Cells at DNPDE

ND-R-1485(D); 32 pp. (1987, November)

The decommissioning and demolition of four laboratory suites of high active cells at Dounreay Nuclear Power Development Establishment (DNPDE) are described. All four suites had suffered drain leaks of high active liquor into underfloor ducts; the options available at the time and current policy for dealing with the resultant activity deposits are given. The decommissioning procedures are detailed to provide information for future similar exercises. Features to ease demolition of such facilities and to eliminate the possibility of long term activity deposition from drain leaks are highlighted for incorporation in future designs. The wastes generated and radiation doses received during the work are tabulated.

97

Blickwedel, H., B. Decker, H. Haferkamp, and H. Louis

Submerged Cutting With Abrasive Water Jets

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

Increasing offshore oil exploitation requires effort in the development of maritime technique, especially in submerged construction, maintenance and repair of oil platforms and pipelines. With abrasive water jets formed in a self-constructed abrasive cutting head, structural steel was successfully cut under water. The corresponding cutting kerf quality was compared with that belonging to thermal methods like flame cutting, laser cutting, and submerged plasma arc cutting. First tests were performed to study the influence of pressure, abrasive flow rate and nozzle sample distance on the geometry of the cutting kerf in Al. Finally, the possibility of submerged cleaning and surface improvement by abrasive jets is considered.

98

Blumberg, R., and J.H. Hayes, Bechtel Eastern Power Corporation, Three Mile Island Nuclear Station, Middletown, PA

TMI-2 Plasma Cutting Equipment

Transactions of the American Nuclear Society 57:544-546; CONF-881024; Nuclear Fission: Fifty Years of Progress in Energy Security and TMI-2 Accident: Materials Behavior, Plant Technology and Recovery, Proceedings of the American Nuclear Society 1988 International Conference, Washington, DC, October 30-November 4, 1988; (pp. 544-546) (1988)

In order to defuel the lower head of the reactor vessel, it is necessary to cut away large portions of the structure, called the lower core support assembly (LCSA). Five horizontal plates of varying thickness tied together with support posts and in-core guide tubes compose the structure to be cut. Access openings will be cut in this system first by a core drill apparatus and then by a plasma-arc system, the Automated Cutting Equipment Systems (ACES). The plasma-arc process is used industrially to cut metal shapes and has been adapted to several nuclear applications

99

Borroni, P.A., F. Salghetti, and F. Bregani, Centro Informazioni Studi Esperienze, Milan, Italy

Treatment of Exhausted Radwaste Solutions in Decontamination Processes

Water Chemistry of Nuclear Reactor Systems 4, Proceedings of the International Conference, Bournemouth, United Kingdom, October 13-17, 1986, Vol. 1; (pp. 231-232) (1986)

Handling and treatment of radwaste solutions coming from the decontamination of structural materials, such as AISI 304 stainless steel and/or carbon steel, is one of the most crucial, although, one of the not so well defined aspects in LWR decommissioning activities. In hard chemical decontamination, contaminated solutions are obtained that cannot be easily released for disposal. Among the principal possibilities to treat these solutions, chemical precipitation and flocculation were investigated taking into account the residual radioactivity and the principal radionuclides along the pH precipitations. Some indications for practical applications and use are suggested.

100

Boyd, N.G., Taylor Woodrow Offshore Limited, London, United Kingdom

Decommissioning of Offshore Structures

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 86-92) (1988)

This keynote paper presents a wide ranging overview of the removal and abandonment of offshore structures. The paper opens by reviewing the general background and then moves on to consider actual removal and abandonment operations. Brief outlines are given for the various activities during the preparatory stage and the execution stage. More detailed consideration is given to on-site removal methods and several alternatives are discussed. Two examples of demolition on-site, by toppling the platforms, are included.

101

Bradbury, D., C. Kirby, M.G. Segal, and W.J. Williams, Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, Gloucestershire, United Kingdom

Decontamination of Magnox Boilers

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 131-138) (1988)

Decontamination may have a significant role to play in the decommissioning of boilers from the UK Magnox stations. There are two possible roles of decontamination, namely dose reduction for the process of cutting (if necessary) and removal, or cleaning material removed for free release as nonradioactive scrap (since the boilers are only lightly contaminated). If decontamination is

worthwhile at all, present studies are suggesting that the most beneficial technique will probably be to decontaminate the whole boiler in situ, using engineering techniques already well established for decontamination of water reactors. Secondary decontamination of components may also be beneficial which, when coupled with advanced monitoring techniques such as assay by melting, would offer the possibility of reducing radioactivity levels below the free release limit of 400 Bq/kg. Secondary waste is an important issue which is also being addressed in the present studies.

102

Brant, A.W., WasteChem Limited, Bramhall, United Kingdom

Decommissioning of the Hermes Facility at AERE Harwell

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 304-311) (1988)

The contract for decommissioning the HERMES (Heavy Element and Radioactive Materials Electromagnetic Separator) Facility at AERE Harwell was the first contract of its type awarded to Private Industry by the Public Sector. The work required operatives to work in pressure suits for extended periods in decommissioning a heavily alpha contaminated facility. The work required the setting up of a temporary changeroom, waste posting facilities, air suit supplies and controls, and temporary ventilation for a completely self-contained site set-up. The Contractor had to provide and train his own operatives, provide all health physics supervision and control, and take full responsibility for all technical matters.

103

Brant, A.W., WasteChem Limited, Bramhall, United Kingdom

Nuclear Decommissioning - Practical Experience of the Private Sector

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 103-116) (1988)

There is a growing requirement for decommissioning of redundant nuclear facilities. This has led to a number of opportunities for private sector organizations to carry out the work. This paper, based on two actual projects in the United Kingdom, outlines the input required from private sector contractors in executing such work.

104

Bray, L.A., Pacific Northwest Laboratory, Richland, WA

Development of a Chemical Process Using Nitric Acid-Cerium (IV) for Decontamination of High-level Waste Canisters

PNL-6567; 68 pp. (1988, June)

A simple and effective method was developed at West Valley Nuclear Services Company, Inc. for decontamination of high-level waste canisters. This method of chemical decontamination is applicable to a wide variety of contaminated equipment found in the nuclear industry. The process employs an oxidant system [Ce(IV)] in nitric acid (HNO₃) solution to chemically mill a thin layer from the canister surface. Contaminated canisters are simply immersed in the solution at a controlled temperature and Ce(IV) concentration level. The spent solution is discarded to the high-level waste stream and added to subsequent glass hatches. The Ce(IV)/HNO₃ solution has been shown to be effective in chemically milling the surface of stainless steel, similar to the electropolishing process, but without the need for an applied electrical current.

105

Brosche, D., and H. Hollmann, Bayernwerk AG, Muenchen, Federal Republic of Germany; Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Legal and Technical Aspects of the Decommissioning of Nuclear Installations

Nuclear Technology '85, Technical Session on Topics of Atomic Energy Law and Radiation Protection Law in 1985 (Jahrestagung Kerntechnik '85, Fachsitzung Brennpunkte des Atom- und Strahlenschutzrechts '85), Proceedings of an German Nuclear Society Annual Meeting, Muenchen, Federal Republic of Germany, May 21, 1985. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany; (pp. 41-60) (1985)

Sufficient experience has been gained worldwide by now in this field, and also experts in the Federal Republic of Germany have been accumulating vast experience in the course of the decommissioning of several nuclear facilities. Practice has shown that there are no major problems to cope with on the technical side, but on the administrative side, there is a lack of established procedure sometimes allowing inadequate requirements to be made in the licensing procedure. Examining the past documentation, there is a noticeable trend to bridge the conceptual gaps in the licensing requirements by recourse to the regulatory provisions valid for construction and operation of a nuclear installation. This in fact leads to unnecessary complications in the licensing procedures that are not justified by standards of safety engineering or radiological protection.

106

Brown, J., M.J. Crick, M.D. Hill, M. Olast, and J. Sinnaeve, National Radiological Protection Board, Chilton, Didcot, United Kingdom; Commission of the European Communities, Luxembourg, Luxembourg

Effectiveness of Various Decontamination Techniques for Reducing External Radiation Doses to People Living in an Urban Environment

EUR-11408; CONF-8801124; Recent Trends in the Evaluation of Reactor Accident Consequences, Proceedings of an OECD-NEA/CEC Workshop, Rome, Italy, January 25, 1988; (pp. 323-332) (1988)

The NRPE has recently developed a dynamic model, EXPURT (EXPosure from Urban Radionuclide Transfer), that reflects the transfer processes that take place in the urban environment. Parameter values for the model have been derived from experiments performed in recent years in the United Kingdom and in Denmark. The model incorporates shielding properties of different types of buildings, and population habits to evaluate individual and population doses as a function of time after deposit. The original model has been extended to enable it to represent several techniques for decontaminating the various surfaces in the urban environment. These include hosing of impermeable surfaces, such as walls, roofs and paved areas, the removal or ploughing of soil/grass, and the replacement of building surfaces with new uncontaminated materials. The model has been used to examine the effectiveness of these various decontamination measures at reducing the external radiation doses to people living in urban areas. The importance of the time at which decontamination is performed is also discussed in this paper.

107

Buck, S., and A.P. Colquhoun, British Nuclear Fuels Limited, Sellafield, United Kingdom

Decommissioning of a Mixed Oxide Fuel Fabrication Facility

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 67-75) (1988)

A lead project in the decommissioning of a plant heavily contaminated with plutonium and other actinides is being used to test in situ assay and size reduction methods, and improvements in temporary containment and contamination control. The project is also yielding data on manpower requirements, personnel radiation uptake, and waste arisings to help in the planning of future schemes.

108

Buckton, G., Bradshaw, Buckton and Tonge,

United Kingdom

Dismantling of Central Electricity Generating Board Suspended Boiler Structures with Particular Reference to Drakelow C11 Boiler

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 220-225) (1988)

The reverse design philosophy applied to the dismantling of the 350 megawatt boiler Unit No. 11 at Drakelow "C" Power Station, Burton-on-Trent, Staffordshire is described. Included are the plant history, brief details of contract documents, an explanation of inspection, temporary works, and design checks carried out to ensure stability of the remainder while structural elements were removed, conclusions of the inspection work carried out to assess the reliability of structural connections which has been in service in an abrasive structural environment for some twenty years, and a description of the various sections of the boiler. The procedure adopted and measures taken for the protection of adjacent plant are described. Finally, some facts and figures are given.

109

Burbridge, R.N., Central Electricity Generating Board, Generation Development and Construction Division, Barnwood, United Kingdom

From Conception to Decommissioning-Servicing Nuclear Power

Nuclear Europe 8(5):12-13 (1988, May)

From its early participation in the development of the technology through the perseverance with gas-cooled reactor designs to the present new British PWR program, Britain has needed a substantial technical base to support its nuclear industry. A key component in that technical base is the Generation Development and Construction Division (GDGD) of the CEBG. The role of GDGD is not confined to the construction of new stations. In addition to providing a service

throughout a station's life, GDCD has the responsibility of developing suitable decommissioning techniques for dismantling each station at the end of its working life. The service is therefore provided from conception to decommissioning.

110

Caldwell, L.S., Duff & Phelps, Chicago, IL

The Funding of Decommissioning - Part 1

Nuclear News 31(15):32-33 (1988, December)

With the reduction in the construction of nuclear generating plants in the United States, technical and regulatory emphasis has shifted to operation and maintenance, and to ultimate shutdown and decommissioning of nuclear generating facilities. The controversy surrounding decommissioning addresses both how it will be done and how much it will cost. The vast majority of decommissioning experts feel that current cost estimates are too low. If a reasonable technology is developed, it could be less expensive than anticipated to actually apply that technology. The major concern is that decommissioning will be handled like construction and commissioning; that is, each participant will develop its own method and not be cost-effective.

111

Chamberlain, L.N., British Nuclear Fuels Limited, Risley, United Kingdom

Sellafield in the 1990s

Nuclear Europe 8(5):22-23 (1988, May)

During the 1990s BNFL will commission some 4000 million pounds for new plant at Sellafield which will change the character of the site dramatically. In addition to the vast construction program, the old buildings and plant will be decommissioned. Sellafield's famous skyline will be reshaped as the silver sphere of the Windscale AGR is dismantled and the tops of the 120-meter Windscale pile chimneys are removed.

112

Chavand, J., A. Gauthier, J.J. Lopez, and G. Tanis, Commission of the European

Communities, Luxembourg, Luxembourg

Cutting of Steel Components by Intergranular Fissuration

EUR-10037; 57 pp. (1985)

The present study relates to a new technique for cutting steel components of nuclear installations which virtually does not produce any secondary waste. This technique relies on a controlled intergranular fissuration produced by the introduction to the steel component of a molten metal in addition to the application of mechanical constraints. Cuttings have been carried out on various materials, including: 1) stainless steel sheet from a few mm to 50 mm thick and 2) mild steel plates from 20 mm to 60 mm thick. It would be possible to perform cutting on pieces of mild steel up to 100 mm thick. On the basis of experimental results, heating methods were selected and fissuration parameters for the materials and the various thicknesses were determined. In the case of thin stainless steel sheets (1-5 mm), cutting in various positions (flat position, cornice, etc.) was carried out by remote handling techniques. Moreover, a thermal measurement installation using an infra-red camera was used to find out the time variation of the thermal field created in the component. Associated with the three-dimensional computation code COCO developed by the CEA, this installation is able to predict the evolution of the mechanical constraints around the fissured zone when the cutting parameters vary, thereby being able to control the cutting mechanism.

113

Chen, S.Y., J.H. Opelka, W.C. Chambers, and J. Stavrou, Argonne National Laboratory, Argonne, IL

Technical Assessment of Environmental and Cost Implications of Superconducting Super Collider Decommissioning

ANL/EES-TM-347; 59 pp. (1988, July)

Potential environmental and cost implications of decommissioning the proposed Superconducting Super Collider (SSC) are examined. One decommissioning alternative is selected for general assessment. That alternative includes removal of

the major sources of radioactivity induced during operation and temporary entombment of remaining underground facilities. On the surface, the campus complex would be left in place for future use, but most other above ground features would be dismantled and removed. Because of the low level of radioactivity that would be induced in SSC components during system operation, potential radiological impacts to the environment from decommissioning would be benign, and the estimated total occupational radiation dose to workers would be less than 5 person-rem. Potential nonradiological impacts of decommissioning are not evaluated because of the lack of site-specific data. The total estimated cost of decommissioning operations is \$38 million. Although few current regulations are explicitly applicable, the SSC decommissioning operation should not encounter any difficulty in complying with potentially applicable regulatory constraints. Upon completion of decommissioning, the SSC site surface could be returned to unrestricted use, but it is recommended that a degree of institutional control and environmental monitoring be carried out for a short period following decommissioning.

114

Claes, J., L. Geens, and H. Meyers, Belgoprocess, Dessel, Belgium

Decommissioning Project of the Former Eurochemic Reprocessing Plant at Dessel, Belgium

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 77-85) (1988)

A general description of the decommissioning project of the former Eurochemic reprocessing plant located at the nuclear site of Mol-Dessel, Belgium, is given. The history of Eurochemic as well as the successive decisions taken since the shutdown in 1974 are outlined. The preliminary and ongoing detailed studies focus on the definition of the facilities to be dismantled and their degree of dismantling in relation to the present and future

nuclear activities on-site, the inventory of dismantling materials, the waste management options, planning and cost estimates. Updated information is presented on the present status of the pilot project, i.e. the dismantling of the former end product storage.

115

Clement, G., J.L. Rouyer, and A. Cregut, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Fontenay-aux-Roses, France; Commissariat a l'Energie Atomique, Centre de Marcoule, Bagnols-sur-Ceze, France

New Manipulator Under Development in France

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 209-213) (1988)

The paper presents a new manipulator under development in CEA, named RD 500. Its characteristics are directly derived from practical experience of remote operations in nuclear environment, which highlights the need for a more robust and reliable machine with a payload capacity of 500 N. Also, computer assistance will allow for a variety of control modes from fully manual to fully autonomous. As the first "Telerobot" specifically designed for nuclear applications, RD 500 broadens considerably the spectrum of operations that can now be performed remotely in this very constraining field.

116

Coleman, D.M., U.S. Army Engineer Waterways Experiment Station, Geotechnical Laboratory, Vicksburg, MS

Field Evaluation of the Water Wedge for Cutting Portland Cement Concrete Pavements for Repair and Restoration of Paved Surfaces

WES/MP/GL-86-5; 44 pp. (1986, January)

The Water Wedge 1200 device is 29 in. long, weighs 22 lb, and is manufactured from high strength steel. The explosive cartridge used to drive the Water Wedge is the Hudco WW120 industrial cartridge. This cartridge is actually a blank 12-gauge shotgun shell. To use the Water Wedge device, a 1 5/8-in.-diameter hole is drilled in the pavement, and the hole is filled with water. This study determined the suitability for cutting portland cement concrete (PCC) pavements in bomb damage repair situations. Test holes were made in an existing 12-in. PCC pavement, and a series of tests were conducted with two explosive charge cartridges. Results indicate that the Water Wedge is not an effective means of producing a smooth break in a 12-in.-thick PCC slab especially when used away from one or more free edges. The time required to accomplish the cut was also considered too long for the repair and restoration of paved surfaces (REREPS) project.

117

Collins, N.W., Institution of Civil Engineers, London, United Kingdom

Decommissioning Machine System for Windscale Advanced Gas-Cooled Reactor

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore. Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 312-319) (1988)

The paper reviews the system which has been engineered and is now being manufactured to remotely dismantle the Windscale Advanced Gas-Cooled Reactor and transport the waste generated to a waste packaging facility. A description of its operating sequence is also given.

118

Collis-Smith, J.A., M.R. Cundy, and R.J. Swanenburg de Veye, GEC Energy System Limited, Whetstone, England, United Kingdom

The Dismantling of Active Plant at the Petten High Flux Reactor

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 33-42) (1988)

The reactor vessel, support structure and other highly irradiated components at the Petten High Flux Reactor in the Netherlands were decommissioned over a period of seven months as part of an extensive upgrading program. Following preparation of a detailed vessel dismantling scenario, special tools for underwater cutting, debris control and visual aids were developed in a dummy pool and were proved by dismantling a spare vessel. Radiological exposure during dismantling was minimized by preliminary studies, underwater gamma-ray measurements during maintenance outages, and detailed pre-planning. Structural steel in the pool walls adjacent to the beam tubes and thermal columns turned out to be more highly activated than expected and operational radiation doses were kept to acceptable levels by a combination of permanent and temporary shielding.

119

Colquhoun, A.P., British Nuclear Fuels Limited, Risley, United Kingdom

Decommissioning at Sellafield

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 1, 375 pp.; (pp. 551-562) (1988, October 3)

This paper outlines the background to the initial Ten Year Plan for Sellafield and describes the decommissioning process for fuel cycle facilities and factors influencing the choice and timing of its stages indicated. The parallel ten year program of development work is outlined and some lead projects and associated development aspects highlighted. The projects being carried out at Sellafield are typical of the post Magnox workload and provides a feasible program in which the Company's decommissioning capability can be further developed. The ten year plan's mixture of end point objectives reflect constraints on the

extent to which it is currently practical to decommission. Nevertheless in conjunction with the integrated development program it provides a full scale proving ground for existing, modified and newer techniques and methodologies.

120

Commission of the European Communities, Directorate-General for Telecommunications, Information Industries and Innovation, Luxembourg, Luxembourg

The Community's Research and Development Programme on Decommissioning of Nuclear Installations: Third Annual Progress Report 1987

EUR-11715; 315 pp. (1987, December 31)

The third progress report describes the objectives, scope, and work program of the 69 research contracts concluded, as well as the progress of work achieved and the results obtained in 1987.

121

Commission of the European Communities, Luxembourg, Luxembourg

Long-Term Integrity of Buildings and Systems

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 1-16) (1989)

It has been proposed that the dismantling of nuclear installations be delayed for periods ranging from several decades to about a hundred years. Thereupon, the radioactivity having largely died away, dismantling would be easier and the radiation exposure of the dismantling personnel would be less. The objective of this project is to determine the measures required for maintaining shutdown plants in a safe condition and to assess the radiological consequences and costs. The work performed under the previous program (1979-1983) relates mainly to the following aspects: mode and pace of degradation of various materials as they exist in nuclear power plants; measures for

maintaining plants in a safe condition and for keeping the necessary ancillary systems operable; monitoring and inspection procedures; radiological consequences and costs of maintaining the plants. The work performed under the first five year program (1984-1988) should be complemented by further tests and the study of control methods relating to the aging of relevant plant materials and by exploitation of additional experience with shutdown nuclear installations. Three research contracts relating to this project were executed in 1988: (1) Deterioration Assessment of Nuclear Power Station Buildings; (2) Long-term Stability and Leak Tightness of Reactor Containments; and (3) Consequences of Suppression of Negative Pressure in the KW-Lingen Containment. Two of the research projects were completed during the year.

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Commission of the European Communities, Luxembourg, Luxembourg

Decontamination for Decommissioning Purposes

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 17-52) (1989)

The objective of this project is to develop and assess techniques for decontaminating surfaces of components and structures of nuclear installations that are past use. The main purpose of decontamination would be reduction of the occupational radiation exposure during dismantling of the contaminated item and/or reduction of the volume of radioactive waste. The following decontamination techniques researched under the 1979-1983 program have been developed and assessed: techniques based on the use of chemically aggressive decontaminants in liquid and gel-like form; electrochemical techniques; hydromechanical techniques (high-pressure water lance, erosion by cavitation); decontamination of concrete walls by flame spraying. Other activities were: investigation of the characteristics and distribution of contamination in nuclear power plants that are past use; economic assessment of decontamination for unrestricted release; collection of information on

the particular decontamination problems posed by accidental contamination, as in the case of the TMI-2 nuclear power plant. Under the 1984-1988 program, selected aggressive decontamination methods should be further developed with a view to their industrial application. Increased effort should be paid to the conditioning of spent decontaminants, where suitable techniques do not yet exist, and to the reduction of secondary waste arisings. Physical methods that limit the production of liquid effluents might be considered. An important new topic of the second program would be the decontamination of hot cells and equipment contaminated with plutonium and other transuranics for purposes of the decommissioning of fuel-cycle installations. The specific features of such installations (chemical nature of the liquids used during their operation, dimensions of the components, etc.) would be taken into account. The following research contracts related to this project were executed in 1988: (1) Complete decontamination of a primary steam piping of the Lingen BWR; (2) Aggressive chemical decontamination tests on valves from the Garigliano BWR; (3) Decontamination using chemical gels, electrolytical swab and jet, abrasives; (4) Development of an easy-to-process electrolyte for decontamination by electropolishing; (5) Optimization of filtering systems for various concrete decontamination techniques; (6) Economic comparison of decontamination and direct melting with a view to recycling of scrap; (7) Remote electrochemical decontamination for hot cell applications; (8) Decontamination with pasty pickling agents forming a strippable foil; (9) Rack-torch unit for remote decontamination of concrete; (10) Feasibility of concrete decontamination using a plasma-augmented burner; (11) Closed electropolishing system for decontamination of underwater surfaces; and (12) Development of vibratory decontamination with abrasives. Six projects were completed during the year.

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Commission of the European Communities,
Luxembourg, Luxembourg

Dismantling Techniques

EUR-12338; The Community's Research and Development Program on Decommissioning of

Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 53-136) (1989)

The objective of this project is the development of the special techniques needed for dismantling the large steel components (e.g. reactor pressure vessel) and reinforced-concrete structures (e.g. reactor shielding) of redundant nuclear installations, account being taken of the particular requirements due to radioactivity. The following techniques performed under the 1979-1983 program have been tested and developed: thermal techniques such as plasma-arc and oxygen cutting and laser beam cutting; mechanical techniques such as sawing; explosive techniques for the dismantling of concrete structures. Under the 1984-1988 program, the dismantling techniques needing further development should be chosen account being taken of the results of the first program. Particular emphasis will be laid on the minimization of secondary waste and contamination, and of occupational radiation exposure. The necessary equipment for the remote operation of dismantling and other decommissioning techniques will be an important new aspect for investigation under the 1984-1988 program. The following research contracts relating to this project were executed in 1988: (1) Ventilation and filtration techniques for thermal cutting operations; (2) Prefiltering devices for gaseous effluents from dismantling operations; (3) Dross and ultrafine particulate formation in underwater plasma-arc cutting; (4) In situ arc-saw cutting of heat exchanger tubes and of pipes from the inside; (5) Electrochemical technique for the segmenting of activated steel components; (6) Explosive techniques for dismantling of biological shield structures; (7) Explosive techniques for dismantling of activated concrete structures; (8) Prototype system for remote laser cutting of radioactive structures; (9) Investigations of applications of laser cutting in decommissioning; (10) Spreading and filtering of radioactive by-products of underwater segmenting; (11) Development of a prototype system for remote underwater plasma-arc cutting; (12) Adaptation of a robot and tools for dismantling of a gas-cooled reactor; (13) Remote measuring and control systems for underwater cutting of radioactive components; (14) Removal of concrete layers from biological shields by microwaves; (15) Adaptation of an existing air-tight and modular workshop for remote operation; (16) Adaptation of abrasive water jet to

cutting of radioactive steel and concrete; (17) Development of abrasive water jet for submerged cutting of steel; (18) Analysis of results obtained with different cutting techniques and associated filtration systems; and (19) Measurements of effluents from plasma arc and laser cutting.

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Commission of the European Communities, Luxembourg, Luxembourg

Treatment of Specific Waste Materials: Steel, Concrete and Graphite

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 137-168) (1989)

In the dismantling of nuclear installations, large amounts of radioactive steel, concrete and - in the case of gas-cooled reactors - graphite will result. This waste must be suitably conditioned for disposal. The following research has been performed under the 1979-1983 program: experiments on the melting of radioactive steel scrap including investigation of the possibility of decontaminating the melt; development and assessment of techniques for coating metal and concrete parts in order to immobilize the radioactivity; comparative assessment of various modes of treatment and disposal of radioactive graphite. Under the 1984-1988 program, melting of radioactive steel should be further investigated, on the one hand as a method for immobilizing contamination and reducing the volume of waste, and on the other hand as first step towards the possible recycling of the steel. The work on coating techniques should be continued with a view to the integration of this treatment into appropriate overall waste management and disposal schemes. Treatment techniques for graphite waste should be developed for at least one management mode, to be selected with due regard to the results of the assessment performed under the 1979-1983 program. The treatment of plutonium-contaminated steel and concrete from the dismantling of fuel-cycle facilities is a new aspect to be investigated under the 1984-1988 program. In all these investigations, due attention will be paid to the necessity of adapting the

treatment techniques to the final destination of the waste. The following research contracts relating to this project were executed in 1988: (1) Melting/refining of contaminated steel scrap from decommissioning; (2) Melting of radioactive metal scrap from nuclear installations; (3) Separation on stainless steel constituents using transport in the vapor phase; (4) Immobilization or contamination of large waste units by polymer coating; (5) Treatment of active concrete dust by slurry setting method; (6) Investigations into the melting of radioactive metal waste in a controlled area; (7) Behavior of actinides and other radionuclides that are difficult to measure, in melting of steel; (8) Conditioning and disposal of radioactive graphite bricks from reactor decommissioning; and (9) Separation of contaminated cement-stone and noncontaminated concrete aggregates.

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Commission of the European Communities, Luxembourg, Luxembourg

Large Transport Containers for Radioactive Waste Produced in the Dismantling of Nuclear Installations

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 169-182) (1989)

Radioactive waste resulting from the dismantling of major reactor components must be transported in larger units than those at present used for other types of radioactive waste, in order to reduce the amount of cutting required and consequently, the radiation exposure of personnel and the costs of decommissioning. A system study has been performed under the 1979-1983 program which made it possible to define the types of large transport and/or disposal container needed for bulky radioactive waste resulting from the dismantling of nuclear power plants. Under the 1984-1988 program, in regards to the above mentioned system study, large transport and/or disposal containers should be developed. The performances of the waste matrix container system under conditions representative of envisaged waste repositories should be studied. The control methods for verifying the suitability of the

containers for land storage, sea dumping, transport, etc., according to the specific technical requirements for the different utilizations, will be considered. The following research contracts related to this project were executed in 1988, of which two were completed: (1) Design and evaluation of large containers for reactor decommissioning waste; (2) Large waste containers made of fiber-reinforced cement; and (3) Large waste containers cast of low-level radioactive metal scrap.

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Commission of the European Communities,
Luxembourg, Luxembourg

Estimation of the Quantities of Radioactive Waste Arising from the Decommissioning of Nuclear Installations in the Community

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 183-208) (1989)

The low-level radioactive waste produced in the dismantling of nuclear installations will ultimately constitute a substantial part of the overall volume of radioactive waste generated by nuclear industry. The objective of the project is to estimate the quantities of various categories of radioactive waste that will arise from the decommissioning of nuclear installations in the Community. This involves the definition of reference strategies for decommissioning and is therefore to be regarded as a long-term task. The following research under the 1979-1983 program has been performed: analysis of concrete samples from various nuclear power plants in order to determine the composition and extension of long-lived radionuclides in shielding structures; analysis of steel samples in order to determine the composition of long-lived radionuclides in reactor components; preparation of a methodology for evaluating the radiological consequences of the management of very low-level waste produced in the dismantling of nuclear power plants: review of the measuring techniques required for the purpose of deciding whether or not material from the dismantling of a nuclear power plant is radioactive. Under the 1984-1988 program research would be performed in the following main areas: improved estimate of the quantities of

radioactive waste arising from the decommissioning of typical nuclear installations, account being taken of the results of the first five-year program; study of strategies for the decommissioning of nuclear installations and for the management of the radioactive waste arising therefrom, account being taken of the waste disposal facilities existing or being developed in various member countries; characterization of the radioactivity associated with components and structures of nuclear installations, with emphasis on long-lived radionuclides (analyses complementary to those performed under the first five year program); in situ measurement techniques for the localization and identification of radionuclides, including the case of mixtures of alpha, beta and gamma emitters; residual activity levels below which activated and/or contaminated parts could be re-used and corresponding measurement methods. The following contracts were executed in 1988, of which three were completed: (1) The assessment of low-level contamination from gamma-emitting radionuclides; (2) Development of methods to establish the curie content of radioactive waste from decommissioning; (3) Systems for contamination measurements on curved surfaces; (4) Optimization of measurement techniques for very low-level radioactive material; (5) Monitoring gamma radioactivity over large land areas using portable equipment; (6) Radioactive wastes arising from the dismantling of a commercial Fast Breeder Reactor; (7) Methodology for assessing suitable systems for management of reactor decommissioning wastes; and (8) Radiological evaluation of releasing very low-level radioactive copper and aluminum.

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Commission of the European Communities,
Luxembourg, Luxembourg

Influence of Nuclear Installation Design Features on Decommissioning

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 209-240) (1989)

The objective of this project is to identify and develop reasonable improvements in the design of nuclear installations with a view to

decommissioning. Research performed under the 1979-1983 program include activities on the following subjects which are in progress: control of the cobalt content of reactor steels and testing of cobalt free materials to substitute cobalt alloys; surface coatings to protect concrete against contamination; reactor shielding design features that facilitate decommissioning; documentation system for deferred decommissioning; review and catalog of design features facilitating decommissioning. Under the 1984-1988 program, Some of the subjects studied under the 1979-1983 program are expected to need continued development under the 1984-1988 program. In addition, design features of certain fuel-cycle installations (e.g. reprocessing plants) should be examined with a view to decommissioning. The following research contracts related to this project were executed in 1988: (1) Decontamination and remote dismantling tests in the ITREC reprocessing pilot plant; (2) Testing of cobalt-free valve seatings using a special test loop; (3) Pre-stressed concrete reactor vessel with built-in plan of weakness; (4) In situ sealing of concrete surface by organic impregnation and polymerization; and (5) Influence of design features on decommissioning of a large Fast Breeder Reactor.

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Commission of the European Communities,
Luxembourg, Luxembourg

Testing of New Techniques under Real Conditions

EUR-12338; The Community's Research and Development Program on Decommissioning of Nuclear Installations - Nuclear Science and Technology Series: Fourth Annual Progress Report 1988, 302 pp.; (pp. 241-294) (1989)

In the course of the progressive development of new techniques, ever greater importance will attach to the testing of these techniques under representative conditions, in particular the presence of radioactivity. Industrial decommissioning operations undertaken in Member States would offer valuable opportunities for such testing. Because of the importance of this subject, it has been added to the 1984-1988 program as a separate section. Research contracts relating to Section C were executed in 1988, of which three were completed: (1) Dismantling and decontamination

of a feedwater preheater tube bundle of Garigliano BWR; (2) Conditioning, transport and dismantling of very large plutonium glove boxes; (3) Large-scale application of segmenting and decontamination techniques; (4) Development of techniques to dispose of the Windscale AGR heat exchangers; (5) Pilot decommissioning of a mixed-oxide fuel fabrication facility; (6) Testing of new techniques in decommissioning of a fuel (U, Th) fabrication plant; (7) Decontamination and dismantling of the PIVER prototype vitrification facility; (8) Dismantling, partly in situ, of a glove-box structure of a mixed-oxide fuel plant; (9) Melting of radioactive metal scrap from the KRB-A plant; (10) Volume and plutonium inventories before and after dismantling of a mixed-oxide fuel plant; (11) Decontamination, before dismantling, of the primary coolant system of the RAPSODIE FBR; and (12) Automated measuring system for waste from dismantling of the KKN plant, to be released.

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Italy

Decontamination of the In-Pile CART Loop for Decommissioning Purposes

Water Chemistry of Nuclear Reactor Systems
4, Proceedings of the International Conference,
Bournemouth, United Kingdom, October 13-17,
1986, Vol. 1; (pp. 285-292) (1986)

Since 1978 when the ESSOR reactor was put out of service, the CART loop was considered as an interesting tool to study the decommissioning procedures in nuclear power plants. It was in that year, in fact, that the Garigliano nuclear power plant (dual-cycle 150 MW BWR) was put out of service. Moreover, its design and operating characteristics and the tests carried out on it make this loop an interesting source of experience. Before its decommissioning, therefore, soft and hard decontamination tests were scheduled. To do so the plant was subdivided in such a way as to isolate the main components, which will be dealt with in a further step, from the pipes that connect them. The pipes were subdivided in turn into three areas,

in dependence on their operating temperatures. Each area is double and permits, therefore, a check of the effectiveness of several decontamination processes. This paper reports the first results of the research program which are concerned with oxide analyses, screening tests for the setup of the CISE soft decontamination procedure, application of corrosion monitoring probes, and full-scale tests on the CART loop using the CISE procedure.

130

Contre, M., Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Department de Technologie, Gif-sur-Yvette, France

Review of Electron Beam and Laser Process Use in the Nuclear Area

CEA-CONF-9381; Laser versus the Electron Beam in Welding Cutting and Surface Treatment, Proceedings of a Meeting, Reno, NV, November 1, 1987; (20 pp.) (1987)

New techniques using electron beams and lasers can be applicable in the areas of components realization, fuel fabrication, waste processing, maintenance, and dismantling because of their beam specificities and their ability to meet high performance expectations. The decisive factor in choosing a process for welding is low deformation, which has led to the use of the electron beam and laser for some applications. In dismantling, the low amounts of waste produced by laser cutting and the possibilities of automation will spur on the wide development of the process. Significant examples are given and a prospective review of future possibilities from present development is presented.

131

Conway, A.

Fresh Look at Decommissioning

Atom 387:16-17 (1989, January)

The UKAEA's chairman, John Collier, has told a large international conference of the opportunities that decommissioning presents. One of the priorities would be the cleaning up and first stage

decommissioning of Win'scale's No. 1 and No. 2 piles.

132

Cregut, A., Commissariat a l'Energie Atomique, Centre de Marcoule, Bagnols-sur-Ceze, France

Reactor Decommissioning Experience and Perspectives

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 63-66) (1988)

This paper first describes the existing market context and available techniques, then reviews the contribution of past and present operations and research. It concludes by discussing the future orientations necessary to develop the means (cutting tools, decontamination processes, telemanipulation and waste conditioning) required to improve the cost effectiveness of decommissioning nuclear power plants.

133

Cregut, A., and M. Montjoie, Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de la Vallee du Rhone, Marcoule, France

Decontamination, Decommissioning and Dismantling of Nuclear Power Plants

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5; (pp. 113-120) (1988)

This paper starts with defining the present context (existing market and technical resources), taking due account of the feedback of experience from operations and studies performed or now under

way. The authors review the efforts that need to be made and the directions followed to develop the technical means in the areas of cutting, decontamination, remote handling and waste disposal, which would permit an improvement in the cost of dismantling reactors producing electric power.

134

Cregut, A., and M. Montjoie, Commissariat a l'Energie Atomique, Direction Des Technologies, Bagnols-sur-Ceze, France; 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

Nuclear Robotics - An Alternate Scenario for Decommissioning Using Modular Operating Mobile Devices

NEA Cooperative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects, Proceedings of the Fifth Meeting, Paris, France, February 23-24, 1988; (15 pp.) (1988)

The debate on systematic use of remote systems and robotics for the dismantling of nuclear facilities has given rise to a new scenario for dismantling based on modular designed devices. This paper: (1) reviews the most commonly used dismantling scenario of today and the new suggested scenario, (2) comments on the technical advantages and disadvantages of each of them, (3) explains the research and development program that should be considered in case of the use of the new scenario, and (4) gives an example of a possible implementation of such a scenario concerning the project of dismantling the graphite gas reactor G2.

135

Cucchi, G., and V. Giacobbi, Comitato Nazionale per l'Energia Nucleare, Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA), Rome, Italy

Research Nuclear Reactor RB-1: Decommissioning Safety Report

ENEA-RT-SAG-87-1; 20 pp. (1988, March)

The induced radioactivity of the reactor structural elements was calculated and the values foreseen by the designers were compared with the ones directly measured on samples taken from the reactor. The induced radioactivity was calculated, taking into account the various lattices employed (Graphite, Orgel, Cirene, THO2-UO2). The radiological control consisted in gamma spectrometry activation measurements, in beta activation measurements and in fixed and removable contamination measurements. The activation measurements were conducted on samples taken from the reactor vessel, structural elements and graphite.

136

Dames and Moore, Golden, CO

Development of Site Specific Radiological Decommissioning Criteria for a High-Level Waste Processing and Vitrification Project

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988; (pp. 603-609) (1988)

In 1980, the United States Congress authorized the U.S. Department of Energy (West Valley Demonstration Project Act; PL-96-368) to solidify 2.1 million liters of liquid high-level radioactive waste (HLW) currently stored at the Western New York Nuclear Service Center (approximately 30 miles south of Buffalo, New York) into a form suitable for transport to and disposal in a federal geologic repository. The method chosen to accomplish this task is vitrification in borosilicate glass. These wastes were produced during the period 1966-72 when facilities at the center were used for the only commercial nuclear fuel reprocessing operation in the United States. These wastes contain approximately 30 million curies of mixed fission products and transuranic radionuclides and are presently being stored in two underground tanks at the West Valley site. This paper presents

the preliminary results of site specific environmental transport and pathway analyses that have been performed to establish radiological decommissioning criteria for final closure of high-level waste processing and treatment facilities

137

Daugherty, H.F., and C.E. Miller, Westinghouse Hanford Company, Richland, WA

The Decommissioning of Eight Graphite-Moderated Reactors

WHC-SA-0087; (32 pp.); CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 11-20) (1988, March)

The approximately 1450 sq km Hanford Site in southeastern Washington State was commissioned for the production of special nuclear material in 1943. Eight graphite-moderated, water-cooled reactors were constructed in five self-supporting complexes between 1943 and 1955. These reactors and their ancillary structures have been declared surplus and are in the process of being decommissioned by the U.S. Department of Energy (DOE) and its operations contractor, the Westinghouse Hanford Company. This paper describes the eight reactors to be decommissioned and discusses decommissioning alternatives, cost and schedules, estimated radiation exposure, and the experience leading up to this project.

138

Davies, I., C.C. Fleischer, and A.A. Paton

Developing Techniques for Removing Activated Concrete

Atomnaya Tekhnika za Rubezhom 1:29-31 (1988, January)

The technology, techniques and equipment to dismantle and remove massives and layers of radioactive concrete when taking nuclear devices

out of service are described. Mechanical, chemical and thermal methods of concrete destruction are considered. The main feature of the above methods is that the removal of activated concrete layers is performed in radiation shielding and concrete vessels with preliminary tension without disturbing external layers of nonactivated concrete thereby ensuring air-tightness.

139

Davies, I.L., Taywood Engineering Limited, Southall, United Kingdom

Decommissioning of Nuclear Systems

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 274-283) (1988)

This paper discusses why the dismantling of those structures in nuclear systems pose special problems. It outlines the general approach that will need to be adopted in the decommissioning of such nuclear systems and comments briefly upon the way in which radioactive decay may affect dismantling and demolition operations. The techniques available for the demolition of heavy structures are described and an assessment made of the effectiveness of and the problems arising from the use of each procedure.

140

de Souza Barros, I., Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte, Brazil

Aspects of Plasma Arc Cutting Process in the AISI 321 Type Stainless Steel

NUCLEBRAS-CDTN-517; 94 pp. (1985)

Some aspects of plasma arc cutting process in the AISI321 stainless steel, used in nuclear industry, are analyzed. The maximum values of the velocity of cutting and the minimum quantity of energy per unit of length necessary for the plasma were

determined. The localization of irregularities in the cut surface as a function of the velocity of cutting was investigated. The cut surfaces were evaluated by surface roughness, using as measurement parameter, the distance between the sharpest salience and the deepest reentrance of the sample profile. The width of layer from thermal action of the plasma was influenced by the velocity of cutting.

141

Decommissioning Research May Get More EEC Funds

Nuclear News 31(12):62 (1988, September)

The Commission of the European Economic Community (EEC) is proposing to spend another 60 million European currency units (ECU) (\$75 million) during 1989-93 to continue research on the decommissioning of nuclear installations. The increase in funding reflects the increased importance attached to this work, as the number of power plants and other installations being shut down increases. During the course of the next program, new techniques will be tested. The EEC Commission claims that the research it has supported in this field has already produced significant scientific and technical achievements. For example, ten years ago, 50 to 70 percent of the steel from the decommissioning of large light water reactor would have to be treated a radioactive waste. Now, as a result of various technical developments, including electropolishing and recycle melting, this has been reduced to 20 percent. In another program the EEC Commission is proposing to spend 40 million ECU (\$50 million) over five years for the development of new nuclear remote-handling equipment designs. An EEC statement draws attention to the need for improved remote handling equipment to deal with inspection, leaks, component failures, emergencies, and decommissioning.

142

Decommissioning Support Stopped - Is FBR Next?

Nuclear News 31(7):69 (1988, May)

Britain's Central Electricity Generating Board

(CEGB) has withdrawn its support for a decommissioning demonstration project, and in so doing has raised serious doubts about its future support for other long-term nuclear research projects, notably the fast breeder reactor program. The project to decommission the Windscale Advanced Gas-Cooled Reactor (WAGR), a small prototype reactor built and operated by the United Kingdom Atomic Energy Authority (UKAEA), started in 1982 as a 13-year project to demonstrate the techniques required to restore a nuclear power reactor site to a "green-field" state. In 1986, the CEGB agreed to support the project to the tune of 2.5 million pounds (\$4.5 million) a year for 10 years, with a one-seventh share of this contribution coming from the South of Scotland Electricity Board (SSEB). In this way, the utilities have provided 5 million pounds of the 20 million pounds thus far spent on the project, which is expected at the end of the day to cost around 53 million pounds. The idea was that the project would provide the two utilities with valuable information on many of the techniques they will eventually need for decommissioning the early Magnox gas-cooled reactors, which are nearing the end of their lives. The decision to halt the support has been linked to the CEGB's efforts to cut all nonessential costs in order to get its books in good order for the proposed 1990 privatization of the U.K. electricity industry.

143

Decommissioning Will Resume Next Year

Nuclear News 31(9):124 (1988, July)

Decommissioning will resume next year at Northern States Power Company's (NSP) closed Pathfinder unit, a prototype boiling water reactor that operated for 1964 through 1967. When the unit was retired, the fuel was removed and the nuclear island was put in safe storage condition; meanwhile, the rest of the plant was converted to fossil-fired generation. NSP has said that the plant will continue to burn fossil fuel for power after the upcoming phase of nuclear decommissioning, which is expected to cost \$14.6 million and take three years. Twenty-plus years of radioactive decay have helped make the decommissioning job feasible, and NSP expects all of what remains in the plant to be disposable as low-level waste. Once the utility receives the necessary license amendments from the

Nuclear Regulatory Commission, the pipes connected the reactor and recirculation pumps to the rest of the plant will be cut, and the openings on these components will be welded shut. A hole will be cut in the containment dome, and a crane will haul the reactor out through the hole and onto a rail car for shipment to the LLW disposal site at Richland, Washington.

144

Defaux, M.

Cutting With Water-Jet

Lamiera 24(12):70-73 (1987, December)

A synthetic presentation is presented of the new cutting methods applying high pressure water jet with or without abrasive addition. Principles of the method and equipment are described. Computer controlled machines are highly advantageous for cutting glass fiber reinforced plastics, special high strength plastics (Kevlar) and multilayer composites, using pure water at pressures of 3000-4000 bar. Cutting metal parts (e.g. Al, Ti, Cr steels) is possible as well, but for satisfactory results, the addition of abrasive particles to the jet is recommended. Data on materials, type and thickness, and cutting rates are quoted. Applications in aircraft, spacecraft, automotive industry, and electronic equipment are pointed out.

145

Deichelbohrer, P.R., and T.N. Veziroglu, Rockwell Hanford Operations, Richland, WA

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

CONF-851201; Alternative Energy Sources, Proceedings of an International Conference, Miami Beach, FL, December 9, 1985; (pp. 485-506) (1985)

A hand-held portable arc saw was demonstrated in 1982. Known as the Small Portable Arc Saw (SPARCS), it weighed less than 15-lb and could cut 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.

146

Dettmer, R.

Long Goodbye to Magnox

IEE (Institution of Electrical Engineers) Reviews 34(8):326-327 (1988, September 15)

Having operated for at least their planned lifetime of 20 years, the time has come to shutdown and decommission the Magnox power stations. The two reactors at Berkeley will be the first to be decommissioned, one in late 1988, one in early 1989. There are three perspectives to the decommissioning process. First, the practical problems, second the disposal of radioactive waste which arises, and third the financing of the operation. All three are covered briefly. The practicalities of decommissioning have already been planned. In stage 1 the fuel will be removed and sent for reprocessing. Stage 2 covers the removal of all plant and buildings outside the biological shields surrounding the reactor. Stage 3 involves

the removal of the reactors structures-graphite core, steel pressure vessels and reinforced concrete biological shields. Each stage will take 5 to 7 years. The low-level radioactive wastes will be sent to the Drigg site operated by British Nuclear Fuels (BNFL). Disposal of the intermediate-level wastes will have to wait until a suitable deep repository has been built. The costs of decommissioning are difficult to estimate accurately. This uncertainty has implications for the proposed privatization of the Electricity Supply Industry.

147

Deutsches Atomforum eV, Bonn, Federal Republic of Germany

Nuclear Technology '86: Technical Session on Aspects of Nuclear Power Plant Operation - Reactor Commissioning, Operational Enhancements, Decommissioning

Proceedings of an German Nuclear Society Annual Meeting, Aachen, Denmark, April 8, 1986. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany, 187 pp. (1986)

The seven contributions are concerned with the results of the nuclear commissioning of the THTR; the two-loop PWR, nuclear power station Muelheim-Kaerlich; and the Kalkar nuclear power station. A cost/benefit analysis is also made of modern core design and the fuel elements. Experience of back-fitting at the Obrigheim nuclear power station and the PWR and BWR plants of large output is supplemented by a strategy for shutting down nuclear power stations, which is being planned by the EVU.

148

Dibdin, T.

130-Year Shutdown

Environment Now 10:36-37 (1988, November)

The policy on decommissioning nuclear power stations is discussed. This is an urgent problem now that the Magnox stations such as Berkeley, are being closed down having come to the end of their service life. Decommissioning has three stages. Stage 1 is to remove the nuclear fuel and coolant.

Stage 2 is to remove the external plant and buildings but leave the reactor and shielding in the smallest volume possible. Stage 3 is to dismantle completely and remove all the radioactive material so the site can be returned to a green field state. A decision has to be made whether to go to stage 3 in 17 years or leave the reactor at stage 2 for 130 years. The problem of dismantling completely now is the disposal of a relatively large amount of high-level radioactive waste. It could be transferred to another site or left in situ. The second option is much cheaper especially if discounted cash flow is used which only needs a small outlay now to cover the cost of stage 3 in 130 years time.

149

Dismantling and Decontamination of the Tube-Bundle of a Feedwater Preheater of the Garigliano BWR

NEA Cooperative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects, Proceedings of the Fifth Meeting, Paris, France, February 23-24, 1988; (54 pp.) (1988)

In this progress report related to the period from January to June 1987, the following activities are reviewed: specific lab tests on decontamination by ultrasounds in chemical solutions both with wetting detergent and aggressive chemicals; the second in-scale testing on 21 tube specimens (40 cm long) from the preheater No. 4 of Garigliano BWR; and some radiometric measurements related to Fe-55, Ni-59, and Ni-63 radionuclides. The special ultrasonic machine supplied by "Pavesi s.n.c." for in-scale testing is also described.

150

Doerge, D.H., and D.R. Haffner, Westinghouse Hanford Company, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects - Summary Status Report: Three Mile Island Unit 2 Radioactive Waste and Laundry Shipments

NUREG/CR-4315 (Vol. 9, Rev. 1); 42 pp. (1988, June)

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 data information retrieval/manipulation system which permits extraction of specific information. This report covers the period of April 9, 1979 through April 19, 1987. Included in this report are: waste disposal site locations, dose rates, curie content, waste description, container type and number, volumes, and weights. This information is presented in two major categories: protective clothing (laundry) and radioactive waste. Each of the waste shipment reports is in chronological order.

151

Draulans, J., Belgonucleaire, Dessel, Belgium

Decommissioning in a Mixed Oxide Fuel Fabrication Plant

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 95-102) (1988)

Information is given concerning the different ways and techniques applied during the decommissioning of glove boxes and equipment inside the BELGONUCLEAIRE Mixed Oxide fuel fabrication plant. Ways and techniques have been selected on the basis of the glove box dimensions, the capability of being removed out of the building and/or being transported on the public road, the inner contamination level etc. Different techniques applied are explained.

152

Drews, P., and S. Effenberger, Technische Hochschule, Aachen, Federal Republic of Germany

Development of Measuring and Controlling Systems for Plasma-Cutting Underwater for Dismantling Nuclear Components

BMFT 02-S-7103; 156 pp. (1986, March)

The electrical through-cutting control, based on results of cutting tests of thin metal sheets (15 and 30 mm) in low depth (less than 0.5m), is developed. An underwater-camera system and an optical system for seam detection are also realized. An ultrasonic sensor and an inductive sensor for torch positioning are tested. Also, a control system for torch positioning and torch height control with an inductive sensor is realized. Drafts for sensor controlled torch movement and changing of torch wearing parts exist. A functioning system for thickness measurements is developed.

153

Eder, E., M. Laser, and S. Halaszovich, Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Munich, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Munich, Federal Republic of Germany

Reuse of Solid Waste from Repair and Dismantling Work - Administrative Aspects of the Practice Adopted in the FRG

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 1-11) (1988, July)

As the transitional process of radioactive waste, or replaced or dismantled components from nuclear facilities, becoming nonactive or decontaminated material is a process varying in time and many other parameters, there should be applied standard administrative, legal procedures of treating such material leaving the scope of atomic energy law due to loss of radioactivity. Regulatory control of the decontaminated material for reuse relies on dose calculations which in future should also take into

account the exposure pathway of radioactive solid waste material in addition to pathways of water and air. The proposed value for the individual dose limit, about 0.1 mSv/a, is regarded to be appropriate and feasible.

154

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

Technology, Safety and Costs of Decommissioning Nuclear Fuel Cycle Facilities: Classification of Decommissioning Waste

NUREG/CR-4519; PNL-5586; 55 pp. (1986, May)

The radioactive wastes expected to result from decommissioning nuclear fuel cycle facilities are reviewed and classified in accordance with 10 CFR 61. Most of the wastes from the MOX plant (exclusive of the lagoon wastes) will require interim storage (11% Class A, 49 cubic meters; 89% interim storage, 383 cubic meters). All of the wastes from the U-Fabrication and Uranium Hexafluoride plants are designated as Class A waste (U-Fabrication, 1090 cubic meters; Uranium Hexafluoride, 1259 cubic meters).

155

Electropolishing Reduces Exposure Levels

Nuclear Engineering International 34 (416):22-23 (1989, March)

A small U.S. company has developed two electropolishers specifically aimed at the nuclear industry; one is designed to cope with very large amounts of contaminants, while the other successfully avoids stripping the finish from irradiated components. Both systems reduce exposure levels.

156

Ellgas, R.A., Harvard University, Cambridge, MA

Monitoring and Surveillance of Decommissioned Nuclear Waste Repositories

(Radioactive, Sequential Analysis, Poisson Distribution, Trend Analysis, Groundwater)

Dissertation Abstracts International 47(03-B):1244-1795 (1986)

High-level nuclear wastes must be isolated from human exposure because of the health hazards they create. In the United States, the most likely disposal method will involve permanent emplacement in repositories in deep geological formations. After these repositories are decommissioned, a set of stresses on the waste isolation system can conceivably lead to groundwater migration and release of radionuclides to the biosphere in about 500-600 years. These releases could have serious consequences if they occur. Even if these scenarios are considered scientifically implausible, the public reassurance offered by potential detection and correction of waste isolation system failures could be the principal justification for including monitoring and surveillance systems as part of waste disposal system design. A monitoring and surveillance system is developed that could detect short-term failures, assess the consequences of biosphere releases, and compute the risks of erroneous decisions on the existence of radiocontaminants in groundwater. An original data acquisition protocol is proposed for detecting changes in background values of monitored parameters. This protocol includes detection system design (instrumentation and detector spatial distribution) and management (sample scheduling). A theoretical approach to interpretation of sequentially acquired data is developed based on the sequential probability ratio test (SPRT) applied to two simple hypotheses: the data represent background values, or the data represent a specific value greater than background. An extension to the SPRT is developed for testing trends in data. Statistical decision theory is used to evaluate erroneous acceptance of each of the above hypotheses. Based on monetary loss functions and the SPRT statistics, original risk functions are developed. The formulae are developed assuming Poisson-distributed frequency counts on monitored radioactivity. The theory is applied to a case study of groundwater radioactivity migration at Hanford Reservation, Washington. Decisions on actual data are assumed erroneous to evaluate their risks. Idealized plume lobe geometry and one-dimensional transport models are used to compute aquifer flux and biosphere entry concentrations, which are

compared to maximum permissible concentrations. Groundwater contamination mitigative technologies are detailed, as well as standardized unit monitoring and mitigation costs. The applicability of these techniques to monitoring and surveillance of hazardous waste repositories is discussed.

157

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

Decontaminating Device for Radioactive Metal Waste

Japanese Patent 63-33,700/A; Japanese Patent Application 61-176968; 4 pp. (1988, February 13)

A method is proposed to effectively remove oxides or paints from metal wastes discharged from nuclear facilities and to lower the radiation level of wastes to background level while reducing the formation of secondary wastes. An aqueous solution containing metal ions having multi-valent oxidized states is electrolyzed in an electrolytic vessel to form metal ions at high oxidized state from the metal ions at low oxidized state. The aqueous solution is then used as a decontaminating solution. The solution is applied using a decontaminating vessel having an ultrasonic wave oscillator which strips oxide layers or paints deposited to decontaminants by vibrations and dissolves and decontaminates the surface of the metal matrix of the decontaminants by the oxidizing effect when the metal ions at high oxidized state are converted into metal ions at low oxidized state. The metal ions which were converted into the low oxidized state can be regenerated as metal ions at high oxidized state by applying electrolysis again.

158

Engelhardt, G., G. Schneider, R. Marx, M. Laser, and S. Halaszovich, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany; IFM, Linkenheim-Hochstetten, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Results of Preparatory Planning for Assessment

of Waste from Decommissioning of the WAK

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 92-125) (1988, July)

From the preparatory planning work for the decommissioning of the WAK, this report explains the assessments with regard to decontamination and dismantling of contaminated components, the decontamination of hot cells and other structural members in the areas with high-level radioactivity, as well as the relevant waste management, including disposal and probable recycling. Keeping the radiation exposure of the personnel as low as low possible, and minimizing the accruing waste are two major goals. The planning results assessing the radioactivity and materials mass inventory, the radiological categorization of the waste materials, and the relevant maximum permissible contamination levels are explained.

159

Esposito, M.P., and R. Clark

Decontamination Techniques for Buildings, Structures and Equipment

Noyes Data Corporation, Park Ridge, NJ, 267 pp. (1987)

This book provides information on pollution protection. It describes decontamination process for such pertinent pollutants as asbestos, acids, explosives, cyanides, low-level radiation, pesticides, PCBs, and hazardous organic chemicals. The discussions include advantages, disadvantages, cost, effectiveness of the procedures and waste disposal.

160

Essmann, J., and G. Lukacs, Preussische Elektrizitaets Aktiengesellschaft, Hannover, Federal Republic of Germany

Experience and Strategy of Decommissioning

Nuclear Europe 8(10):34 (1988, October)

Unlike most industrial plants, nuclear power plants to be decommissioned are subject to particularly stringent rules and regulations. In addition, German electricity utilities are required, under a directive issued by the German Federal Ministry of the Interior, to prove the decommissioning capability of their plants even before these plants are commissioned. The utility companies worked on these problems already in an early phase of development and initiated relevant studies. Also, the costs associated with plant decommissioning were investigated, so that the necessary financial reserves could be set up. Of course, relevant practical experience already accumulated in some areas was taken into account in those studies.

161

European Atomic Energy Community, Ispra, Spain

Welding and/or Cutting Machine

European Patent Application 256 187 A1 (1986, August)

A welding and/or cutting machine for use on a workpiece formed by a pair of metal sheets in face to face contact is claimed. The machine comprises a movable carriage mounted on a pair of drive rollers which grip the metal sheets. The axes of rotation of the rollers are arranged so that, during rotation, forces are generated that cause the carriage to be pulled on to the workpiece. The carriage carries the welding apparatus (TIG welding torch) for lip-welding the sheets of the workpiece together or a cutting apparatus for removal of weld material. The equipment is used for making duct ports for a fusion reactor.

162

Evans, J.C., E.A. Lepel, R.W. Sanders, C.W. Thomas, and D.E. Robertson, Pacific Northwest Laboratory, Richland, WA

Long-Lived Activation Products in Light-Water Reactor Construction Materials: Implications for Decommissioning

Radioactive Waste Management Nuclear Fuel Cycle 11(1):1-39 (1988)

An experimental program assessed the problems posed to reactor decommissioning by long-lived isotopes produced by direct activation of major construction materials in the reactor internals, vessel, and bioshield. The materials were analyzed for up to 52 elements to develop a data base of activable major, minor, and trace elements. A thorough evaluation was made of all possible nuclear reactions that could lead to long-lived activation products. It was concluded that all major activation products have been satisfactorily considered in the decommissioning planning studies completed. As detailed series of calculations was carried out using average values of the measured compositions for the appropriate materials to predict the levels of activation products expected for pressurized water reactor (PWR) and boiling water reactor (BWR) geometries. A comparison was made between calculated activation levels and regulatory guidelines for shallow-land disposal according to 10 CFR 61. This analysis showed that PWR and BWR shroud material may exceed Class C limits and should, therefore, be considered as potentially unsuitable for near-surface disposal. The PWR core barrel material can also approach the Class C limits. That problem can, if feasible, be circumvented by single-piece removal of the vessel and internals during decommissioning. Most of the remaining massive components should qualify as either Class A or B waste, with the concrete bio-shield clearly Class A even at the highest point of activation. A limited radiochemical analysis verified the computer model. In particular, the presence of Nb-94 in activated stainless steel and Inconel at or above expected levels was confirmed.

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Ewen, K., I. Lauber-Altmann, and P. Barwig, Zentralstelle fuer Sicherheitstechnik, Duesseldorf, Federal Republic of Germany; Bonn University, Radiologische Klinik, Bonn, Federal Republic of Germany

Radioactivity on Decommissioning a Betatron

Roentgen Blaetter 41(4):156-157 (1988, April)

The authors report on the specific radioactivity of construction components of a 42 MeV betatron measured 28 days after the last run by means of a Ge spectrometer (ultra-pure germanium detector

employed in a semiconductor spectroscopic method) recording the gamma spectra of various components of the betatron. This examination served to find out which components would have to be considered as radioactive waste requiring special treatment in accordance with Federal German legislation on radioactive waste disposal (Paragraph 47 of the Radiation Protection Ordinance). The examination showed that such special treatment would be required only for the target (main material - platinum) and the Platiness-filter (chief constituent - lead) of the decommissioned electron accelerator.

164

Fairhurst, R.M., R.A. Heron, and D.H. Saunders

DIAJET - A New Abrasive Water Jet Cutting Technique

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

Direct Injection Abrasive Jetting (DIAJET) is a new method of producing a high velocity abrasive water jet which overcomes many of the inefficiencies and operational problems associated with present equipment. A cutting performance that previously could only be achieved at much higher pressures is now possible at relatively low pressure. The paper briefly outlines the system and describes low pressure cutting tests on a range of materials. Field trials with a production prototype system are also discussed. Predictions are made of cutting rates at high operating pressures and these are compared with the results from charged hose tests and a high-pressure prototype system.

165

Ferguson, J.S., Deloitte, Haskins and Sells, Dallas, TX

A Case For Internal Funding

Forum for Applied Research and Public Policy 2(4):18-19 (1987, Winter)

Economic uncertainty in the electric utility industry and the need to assure that funds are available regardless of a utility's future economic status are

the two most common justifications offered by state regulatory commissions that support external, segregated funding for nuclear power plant decommissioning. A separate fund must be established now, these commissions contend, to insure that sufficient amounts of money are available several decades down the road when expensive decommissioning projects are scheduled to begin. External funding will reduce a utility's cash flow over the life of a nuclear plant. Decreased cash flow might compromise its financial health. Under external funding, it is thus more likely that a utility will be at economic risk when decommissioning actually begins. A weakened economic state will raise the rate of utility borrowing. These increased costs, in turn, will be borne by the ratepayers. Capital provided by ratepayers, whether for recovery of invested capital, or for removal costs, reduces the magnitude of future borrowings. If regulatory commissions require utilities to place these collections in inaccessible accounts (as in external funding methods), then utilities will be denied the use of these funds. Ratepayers, in turn, will be denied both their usual interest credit and the cost-saving benefits afforded by utilities having readily accessible cash to use instead of having to resort to borrowing.

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Final Rule Sets 60-Year Limit, Unrestricted Use

Nuclear News 31(10):31-32 (1988, August)

The Nuclear Regulatory Commission's (NRC) rulemaking on decommissioning, more than 10 years in the making, has yielded a final rule that revises portions of 10 CFR Parts 30, 40, 50, 51, 70 and 72. Despite a heavy volume of comments on the proposed rule issued for comment in February 1985, the agency has held firm to its intent that the decommissioning of a licensed nuclear facility must entail bringing the site to a condition in which it could be released for unrestricted use. The rule also allows utilities to choose among three general options for decommissioning with immediate decontamination, deferred decontamination with safe storage until that time, or entombment with much of the radioactive material contained in place. It states that, whichever option is chosen, all decommissioning activities must be completed

within 60 years of the end of licensed activities, unless a longer interval is deemed necessary for the preservation of public health and safety. The rule was published in the federal register on June 27. It went into effect on July 27. The NRC has also issued its Final Generic Environmental Impact Statement on Decommissioning Nuclear Facilities (NUREG-0586). Copies were to be made available through the U.S. Government Printing Office, P.O.B. 37082, Washington, D.C. 20013-7082; phone 202/275-2060. The levels of radioactivity considered acceptable for release of a site for unrestricted use have not yet been determined, and the NRC is participating in an interagency working group intended to specify them. The group is headed by the Environmental Protection Agency.

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Flook, S.A., and H. Downs, Ministry of Defense, Atomic Weapons Establishment, Aldermaston, United Kingdom

Planning and Operational Experience of Decommissioning Transuranic Contaminated Radioactive Facilities at Atomic Weapons Establishment Aldermaston

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 87-93) (1988)

This paper describes recent experience at AWE Aldermaston of decommissioning redundant radioactive facilities. So far two major facilities have been decommissioned, a further one is well advanced and one other has been planned in detail. The paper briefly outlines decommissioning policy, strategy and the phased approach to decommissioning adopted at Aldermaston. The objective of decommissioning at AWE and the nature of the problem associated with transuranic alpha emitting contaminants are given. In order to undertake this work in a safe and effective manner managerial procedures for controlling the detailed planning and subsequent execution of decommissioning tasks have been set up. These are mainly concerned with the use of specialist

decommissioning contractors although the use of direct labor and an in-house decommissioning task force is described. The paper also covers the application of Quality Assurance techniques to decommissioning and the importance of adequate site preparation in advance of a contract decommissioning operation. Decommissioning costs, timescales and manpower requirements are given in outline with indications of the relative balance between intramural and extramural resources. The experience gained from the work carried out is discussed in some detail with indications of the lessons learned and pointers to the future.

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Friske, A., and D. Thiele, VE Kombinat Kernkraftwerke 'Bruno Leuschner', Betriebsteil Berlin, Greifswald, German Democratic Republic

Decommissioning of Nuclear Power Plants

Kernenergie 31(7):285-291 (1988, July)

The International Atomic Energy Agency classification of decommissioning stages is outlined. The international development hitherto observed in decommissioning of nuclear reactors and nuclear power stations is presented. The dismantling, cutting, and decontamination methods used in the decommissioning process are mentioned. The radioactive wastes from decommissioning are characterized; the state of the art of their treatment and disposal is given. The radiation burdens and the decommissioning cost in a decommissioning process are estimated. Finally, an evaluation of the trends in the decommissioning process of nuclear power plants is given.

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Fueloep, M., F. Minarik, A. Lahham, S. Krnac, V. Cierna, and F. Soos, Vyskumny Ustav Preventivneho Lekarstva, Bratislava, Czechoslovakia; Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia

Contamination of Piping from Disassembled A-1 Nuclear Power Plant Secondary Circuit

Jaderna Energie 34(6):227-230 (1988, June)

The method of estimating the average contamination by measuring external gamma radiation in the center of the pipe was used. Compared with the method of sampling by etching, this method was shown to be considerably more accurate and faster, and did not require any processing of pipes that were supposed to be discarded. The method can be used to determine contamination of pipes of 200 to 500 mm in diameter and 300 to 800 mm in length with a maximum error of 25%. The measurement time is about 10 seconds for a pipe of an average Cs-60 contamination of the order of 100 Bq/sq cm measured using a NaI(Tl) scintillator 100 mm in diameter and 100 mm in length. For experiments, NaI(Tl) scintillators with a two-channel measuring instrument are sufficient with one channel set to the Cs-137 photopeak and the other to the Co-60 photopeaks. In deriving the Cs-137 and Co-60 activities from pulse counts in the individual channels, the coefficients calculated by the Monte Carlo method can be used.

170

Gant, H.C., Power Cutting, Inc., Lake Bluff, IL

Thermal and Mechanical Cutting and Weld Prep Operations in Steam Generator Replacement Projects

Transactions of the American Nuclear Society 44:495-496; Proceedings of an American Nuclear Society Annual Meeting, Detroit, MI, June 12-16, 1983 (1983)

Prior to undertaking the first steam generator replacement program (SGRP), there were many nuclear proponents who maintained that an SGRP was too major an undertaking to be feasible. To date, four SGRPs have been completed. Mechanical and thermal cutting and weld preparation are major tasks in an SGRP. Power Cutting Inc. has completed these tasks in all four SGRPs to date, and completed Turkey Point Unit 4 in 75 percent of the scheduled time for 70 percent of the budgeted man-hours, and with a gross reduction in personnel exposure of 65 percent under Turkey Point Unit 3. The author discusses the lessons learned in the cutting and weld preparation work, which resulted in the above

record and reinforced the industry's high level of confidence that an SGRP can be done in a reasonable period of time and strictly in accordance with the ALARA (as low as reasonably achievable) principle.

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Gas-Graphite Reactors To Be Decommissioned

Nuclear News 31(7):69 (1988, May)

Electricite de France's (EdF) board of directors has approved a program to decommission all its natural uranium gas-cooled (Magnox) reactors by 1994. First to go will be St. Laurent-A1, in 1990, followed by St. Laurent-A2, in 1992. Bugey-1 will be shut permanently in 1994, as will Chinon-A3. Ironically, the Magnox unit planned to be decommissioned last, the Chinon-A3, is EdF's oldest existing nuclear unit, having begun operation in 1967. The reason it is being kept on line longer than the others has less to do with age than with its location. The western regions of France, especially the northwest, are short of generating capacity, and the Chinon site is crucial to a geographically balanced supply structure. EdF's Direction de la Production et du Transport (DPT, Transmission and Generation Directorate) is justifying its decommissioning proposal on economic grounds. New growth projections show French demand to be growing less rapidly than was expected a few years ago, and PWR capacity will be more than sufficient to meet anticipated demand during the 1990s. The GCRs are estimated to cost twice as much to operate as EdF's PWRs, and more than even some of its coal-fired plants. Furthermore, their continued operation obliges EdF to support an entire fuel cycle, notably fuel fabrication and reprocessing, that can be amortized over only four units.

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Gessner, R.F., D. Tundo, and R.E. Lawrence, West Valley Nuclear Services Company, Inc., West Valley, NY

Facility Decontamination for Reuse at West Valley

Transactions of the American Nuclear Society 59:78-79; CONF-890604; Proceedings of the

1989 Annual American Nuclear Society Meeting, Atlanta, GA, June 4-8, 1989, 388 pp.; (pp. 78-79) (1989, June)

The West Valley Demonstration Project has been created to decontaminate and decommission a civilian fuel reprocessing plant. This activity involves decontamination of the former facility for installation of high- and low-level liquid waste processing equipment. About 70% of the plant has been decontaminated and liquid waste processing equipment installed. The decontamination effort utilized both contact and remote practices and a variety of commonplace and unique tools and equipment. Lessons learned during the cleanup are reviewed.

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Ghosh, S.K., J.E. Beitialarrangoitia, and G.E. Garcia de Vicuna, North Staffordshire Polytechnic, United Kingdom

Some Physical Defects Arising in Laser, Plasma and Water Jet Cutting

Computational Methods for Predicting Material Processing Defects. Cachan, France, September 8-11, 1987 (1987)

Nowadays several modern technologies are employed in wide areas of manufacturing due to the new and extended possibilities and advantages offered over conventional techniques. Laser, plasma and water jets can be considered some of these advanced manufacturing techniques which offer the possibility of dealing with almost any kind of material. In the cutting and drilling processing of material with these technologies there are many variables and factors which are difficult to control and have to be optimized to obtain the required component quality. A review is presented of the most common effects/defects that appear in the manufacturing processes with each technique.

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Gibbons, P.W., Westinghouse Hanford Company, Richland, WA

Subassembly Duct Cutting in the FFTF/IEM Cell

Transactions of the American Nuclear Society 50:585-586; Proceedings of an American Nuclear Society Winter Meeting, San Francisco, CA, November 10-14, 1985; (pp. 585-586) (1985)

After irradiation in the Fast Flux Test Facility (FFTF), certain driver fuel assemblies (DFA) are selected for disassembly in the interim examination and maintenance (IEM) cell for further examination elsewhere. After sodium removal, the first step in disassembly is the removal of the outer duct. The duct must be cut free of the assembly nozzle and removed from the pin bundle. Swelling of the duct and pin bundle in the fuel region also requires slitting the duct vertically from its lower cut edge to the top of the fueled region; this allows the duct to expand over the swollen fuel bundle as it is withdrawn. The cutting procedure, risks, and precautions are discussed.

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Gibbons, P.W., and R.K. Greenwell, Westinghouse Hanford Company, Richland, WA

HT9 Duct Cutting-IEM (Interim Examination and Maintenance) Cell and Mockup Testing Experience at FFTF (Fast Flux Test Facility)

CONF-871101; Proceedings of the 1987 American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (7 pp.) (1987, September)

Disassembly of irradiated fuel test assemblies at the Fast Flux Test Facility (FFTF) Interim Examination and Maintenance (IEM) cell requires remote cutting of the test assembly's duct. During the recent disassembly of an advanced alloy fueled test assembly, unusual machining characteristics were experienced with the HT9 alloy duct. An intense development program involving extensive testing in-cell and on prototypic mockup equipment, was required to develop successful cutting parameters for this alloy.

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Goertz, R., R. Graf, H.D. Brenk, M. Laser, and S. Halaszovich, Brenk Systemplanung

Ingenieurbüro fuer Wissenschaftlich-Technischen Umweltschutz, Aachen, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany;

Development of a Model for Statistical Simulation of Individual Dose Distribution in the Population due to Recycling of Iron Alloys from Nuclear Installations

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 24-32) (1988, July)

Repair, backfitting, or dismantling of nuclear installations brings about considerable amounts of iron or steel scrap as residual material that can be recycled after decontamination to a suitably low level of radiation so that the population dose remains within the limits to be set. For this purpose, regulatory procedures and data are to be determined that have to be observed prior to recycling. The manifold variety of practical reuse, or exposure pathways, can be simulated by a stochastic model which takes into account, for instance, the characteristic data of the scrap processing steps and the materials flow involved, which is diluted, mixed, separated, or rejoined. The radiological conditions during the various steps are simultaneously simulated by the model.

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Gruebener, H., M. Laser, and S. Halaszovich, Siemens AG Unternehmensbereich KWU, Offenbach am Main, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany; Kraftwerk Union AG, Offenbach am Main, Federal Republic of Germany

Disassembly, Pre-Decontamination, and Conditioning of Scrap for Subsequent Melting

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings

of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 150-160) (1988, July)

Measuring methods hitherto applied for radiological decontrol of decommissioned reactor components required very much time and personnel. The paper in hand explains a new approach that has been tested on laboratory scale. The low-level radioactive metallic components (below 74 Bq/g) are disassembled by various methods into scrap pieces of the size fitting into commercially available 200 l waste drums, and are shipped for melting in a foundry where the first measured radiological data are compared with the radioactivity data measured in the melt, slag, and filter deposits. A computer code allows complete accounting of activities and materials prior to and after melting.

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Grave, M.J., NEI International Research and Development Company Limited, Newcastle-upon-Tyne, United Kingdom

Application of Decontamination to Decommissioning Contracts

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 117-125) (1988)

Decontamination processes can be used to some benefit in decommissioning projects but not in every case. The principles for selecting a decontamination process, including the use of an existing reference source are discussed and illustrated in the context of a high pressure water jetting application. Developments in waste disposal policy will govern the future for decontamination and the part it has to play in optimizing the volumes of radioactive decommissioning wastes produced.

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

Nuclear Decommissioning: Supplementary Contribution

Demolition of Special Structures, Proceedings of a One-Day Symposium, London, United Kingdom, September 20, 1984. Concrete Society, London, United Kingdom, 97 pp.; (pp. 85-87) (1985)

Planning studies for decommissioning the Magnox, then the advanced gas-cooled reactors, and much further in the future, the pressurized water reactors, are in progress. Decommissioning will be in three stages. The first stage is comprised of the defuelling, removal of waste, and decommissioning. This is done immediately as the station is shut down. The second stage is the removal of the plant and buildings outside the reactor biological shield. This includes the boilers. The final stage is the dismantlement of the reactor itself. The Magnox stations have graphite cores of over 2000 tons per reactor. There are also core supports, the pressure vessel, etc., all of which are active. An outline plan for decommissioning Sizewell-B to make decommissioning easier when the time comes is discussed briefly.

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Haerkoenen, H., and M. Nykyri, Imatran Voima Oy, Helsinki, Finland; Teollisuuden Voima Oy, Helsinki, Finland

Status of the Decommissioning Plans for the Finnish Nuclear Power Plants

ATS Ydintekniikka 2:14-17 (1988)

Revised decommissioning plans for the Finnish nuclear power plants were submitted to the regulatory authorities at the end of 1987. The plans cover the following topics: time schedules, dismantling techniques, waste conditioning and disposal, radiological safety, and cost estimates.

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Haffner, D.R., Westinghouse Hanford Company, Richland, WA

Evaluation of Nuclear Facility Decommissioning Projects (ENFDP): Program Status

WHC-SA-0443; CONF-8810155; Water Reactor Safety, A.J. Weiss (ed.), Proceedings of the 16th Information Meeting, Gaithersburg, MD, October 24-27, 1988, Vol. 1, 558 pp.; (11 pp.) (1988, October)

The Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) program was undertaken by the U.S. Nuclear Regulatory Commission (NRC) to compile and evaluate the activities of completed and ongoing decommissioning projects. This report discusses briefly, the status of those decommissioning projects selected for this study with emphasis on ongoing projects.

182

Hamanski, M., and M. Katsumura

Cutting a Way Through the Pressure Vessel Problem

Nuclear Engineering International 31(380):44

Processes developed at the Industrial Research Institute, Sikoku, Japan to aid decommissioning of underwater nuclear reactor pressure vessels are briefly described. A combined arc gouging and gas cutting torch which can cut, underwater, mild steel with stainless steel cladding up to 450 mm thick has been made and is under test (planned completion at the end of 1987). Conditions for cutting reinforced concrete with a laser (1.5 kW CO₂ in this case) have been investigated in order to find a means of demolishing activated reinforced concrete (radiation shield; biological shield contaminated to about 100 mm depth) without tool changing.

183

Hamasaki, M., Government Industrial Research Institute, Machinery and Metal Department, Shikoku, Takamatsu, Japan

Unitary Torch for Underwater Dismantling of Nuclear Reactor Vessels

Metal Construction 19(11):641-642 (1987, November)

Schematics of the apparatus and descriptions of the technique for cutting of stainless clad steel in thicknesses up to 450 mm are given. The technique is developed for the safe cutting of nuclear plant parts from decommissioned pressure vessels of nuclear plants. The technique uses gas-air mixtures to cut through the stainless cladding, followed by oxygen which melts the bare steel by an exothermic reaction. The unit can be set up to cut either plate or tubes. Radioactivity can be confined to the water pool and wire can be continuously fed into the torch to aid in cutting the stainless. Qualification tests should be completed in 1987 for the process.

184

Hamasaki, M., J. Sakakibara, and F. Tateiwa

Dismantling Commercial Atomic Reactor Pressure Vessels: A Combined Gouging and Gas Cutting Process Used Underwater

Welding Review Journal 3:52-54 (1982, August)

Difficulties in dismantling atomic reactor pressure vessels involve not only safety but also the fact that they are generally fabricated from solid 150-250 mm thick mild steel with a 6 mm cladding of 18/8 stainless steel inside. Safety reasons make it preferable to cut underwater from the inside, and a new method has been devised by the Japanese Government's Industrial Research Institute in Shikoku. Dismantling is from the inside, with gouging torches and gas cutting torches. In tests each operation has been conducted separately but in practice a combined torch would be used. Safety is assured, as new electrodes can be welded to previous ones, well above the radioactive pool. The stainless steel is first gouged out, followed by torch cutting of the mild steel. Results of experimental cutting and gouging underwater, and effects of water entrainment in the cutting oxygen are shown. A 300 mm thick mild steel test piece, clad with 8 mm 18/8 stainless steel (thicker than in today's reactors) was gouged and cut at 15 cm/min.

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Hamasaki, M., and F. Tateiwa

Gas and Dross in Underwater Cutting Using Consumable Electrode Water Jet Cutting

Technique

Journal of High Temperature Society 10(1):18-23 (1984, January)

A new consumable electrode water jet cutting technique is superior to the plasma-arc cutting technique in cutting ability and recoverability of dross and gas as an underwater cutting method for dismantling atomic reactor equipment. Cutting was carried out at a water depth of about 300 mm with stainless steel plate and mild steel wire as workpiece and electrode, respectively. Gases (H₂, N₂ and O₂) were released by arc heat. The quantity of gas increased with increasing current. The dross was an alloy made from melting stainless steel and mild steel wire. In fact nonmagnetic stainless steel changed to magnetic dross. Approximately 98.5-99.7% of the dross could be recovered easily by magnet.

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Hamasaki, M., F. Tateiwa, S. Hasegawa, M. Akasaka, H. Katoh, Y. Shinohara, F. Hasegawa, and Y. Yamazaki, Government Industrial Research Institute, Shikoku, Takamatsu, Japan

Gas and Dross in Underwater Cutting Using a Consumable Electrode Water Jet Cutting Technique: (2) - Cutting Conditions with High Current and Analytical Results of Dross and Gas

Koon Gakkaishi 10(4):152-157 (1984, July)

Gas and dross in underwater cutting using a consumable electrode water jet cutting technique has been documented in this journal before. With this technology, it is possible to cut a 140 mm thick stainless steel at 2000-4000A, where the cutting condition which is related to cut thickness, cutting current and cutting speed was examined. Also examined were gas contents, their percentage and recovery percentage of dross by magnet generating in underwater cutting were researched and the following results were obtained: (1) 140 mm thick stainless steel was cut at a 4000A current and a 10 cm/min; (2) gas contents generated at a 3500A current was 22 l/min; (3) gases generated were H₂, O₂, and N₂, and the majority of the gases were H₂; and finally, (4) the gases percentages were no different in cutting current value.

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Hamasaki, M., and P. Tateiwa

Underwater Cutting Using a Consumable Electrode Water Jet Technique at a Great Water Depth

Transactions of the Japan Welding Society 1:3-7 (1981, April)

A consumable electrode water jet cutting technique was developed as an underwater cutting method. Underwater cutting of mild steel and Al was carried out at a water depth up to 200 m. Welder used was a d.c. constant voltage and electrode wire was a 2.4 mm dia. steel wire. To obtain good cutting results at great water depth, arc voltage should be increased 0.5-1 V every 10 m. Underwater cutting of mild steel by Al wire was also achieved at water depth up to 90 m. Judging from the experiment cutting could be done at water depth up to 200 m and more.

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Harada, K.

Method of Cutting and Dismantling a Reactor Pressure Vessel

Japanese Patent 59-75,199/A/ (1984, April 27)

A tool was designed to enable workers to cut and dismantle a reactor pressure vessel reliably and stably by remote control. The tool charges water to the inside of the reactor pressure vessel at a level near the line expected to be cut. The outer wall steel plate of the pressure vessel is cut from the outer side thereof by using a gas cutting torch operated under remote control. Further, stainless clads appended to the inner side of the vessel can also be cut by the oxidizing heat generated. This method is suitable to needs because it employs oxygen-acetylene, a stable and reliable gas. Since the oxygen-acetylene gas cutting torch is light in weight compared to other cutters, remote control by a manipulator can be facilitated.

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Hardy, R.W., E.R. McKeehan, and H. Baudisch, General Electric Company, San Jose, CA

Advances in Waste Management: Plasma Arc Cutting and Supercompaction

Nuclear Europe 6(3):22-28 (1986, March)

General Electric Company's Waste Management Services organization is continuing to develop new products and services in support of utilities' needs to reduce the escalating costs for low-level waste management. The authors describe two new services recently introduced: a plasma arc cutter for volume reduction of irradiated hardware such as fuel channels and control rod blades; and supercompaction to reduce the volume of dry active waste such as paper, plastics, clothing and other items.

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Harris, M.R.R., and R.V. Bruin, Nuclear Services Group Limited, United Kingdom; Grove Consultants, United Kingdom

Decommissioning of Radioactive Facilities

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 284-291) (1988)

An overview is provided on the principal aspects of nuclear decommissioning which differ from those encountered in other industries. The requirement to produce adequate plans with safety assessments is also discussed. Worker training, control and monitoring together with the restrictive nature of waste management and the need to erect temporary containments and shielding are outlined. Relative costings between nuclear and nonnuclear operations are noted and the dominant cost of the specialist skills and services is identified.

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Hashish, M.

Cutting With Abrasive Waterjets

Carbide Tool Journal 5:16-23 (1984,

September-October)

Abrasive waterjets can be used to cut a variety of materials, including ceramics, Ti, glass, graphite, and metallic honeycomb structures without producing thermal or deformation stresses. Other advantages include minimal dust, high cutting speed, and multi-directional cutting capability. Equipment requirements are reviewed, and abrasive-jet cutting results are presented for steel, Al, ceramics, and advanced composites.

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Hashish, M.

Cutting With Abrasive Waterjets

Mechanical Engineering 3:60-69 (1984, March)

Abrasive waterjet cutting can be used on metals, ceramics, concrete, rocks, advanced composites, metallic honeycomb structures, glass, kevlar, graphite and bonding compounds without any delamination or inducement of thermal or deformation stresses along the cutting path. The advantages offered are outlined. The principle of abrasive waterjets and the abrasive system components are described. The performance parameters and results of abrasive waterjet cutting are presented with many examples on different materials. Economics of the process, comparison with other cutting methods, environmental considerations, industrial applications and benefits are also discussed. Metals cut by abrasive waterjet include stainless steels, mild steels, tool steels, Al 7075-T5, Ti, cast iron, Si, WC, bronze, Pb, and Cu.

193

Hawkins, P.J., Westinghouse Electric Corporation, Pittsburgh, PA

Severing of Tubes in a Steam Generator

U.S. Patent 4,753,008 (1988, June 28)

An apparatus is described for severing a primary tube of a steam generator in of a nuclear reactor plant, the primary tube being positioned in a confined region in a radioactive environment within the steam generator. The apparatus includes: tube-clamping means; remotely-actuated means connected to the tube-clamping means for actuating

the tube-clamping means to clamp and unclamp the primary tube; a tube cutter comprising a file having a cutting surface of generally cylindrical cross section; mounting means for the tube cutter for mounting the tube cutter wholly within the tube-clamping means so that the cutting surface is to be in cutting engagement with the tube; drive means connected to the tube cutter to rotate the file to cut the tube; and remotely-operable means, independent of the remotely-actuated means and connected to the mounting means for advancing the tube cutter to sever the tube as the tube cutter is driven.

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Hawthorne, J.R., and A.L. Hiser, U.S. Nuclear Regulatory Commission, Division of Engineering, Washington, DC; Materials Engineering Associates, Inc., Lanham, MD

Experimental Assessments of Gundremmingen RPV Archive Material for Fluence Rate Effects Studies

NUREG/CR-5201; 312 pp. (1988, October)

The 250-MW boiling water Gundremmingen reactor, KRB-A, in the Federal Republic of Germany (FRG) has been decommissioned by the utility owners. A joint United States/FRG/United Kingdom study, conceived by the U.S. Nuclear Regulatory Commission (NRC), is underway to evaluate material removed from the vessel by trepanning for a critical assessment of power reactor versus test reactor environmental effects. MEA, Staatliche Material Pruefungsanstalt (MPA), and United Kingdom Atomic Energy Authority Harwell are responsible for the experimental phases of the joint program. The reactor vessel operated at approximately 288 deg C; the inner wall fluence estimate at the time of decommissioning was about 1×10^{19} n/sq cm, E greater than 1 MeV. This report describes irradiation assessments of a welded forging segment believed to be archive material from the KRB-A vessel fabrication. Preirradiation verification tests of the material are also summarized. Charpy-V (Cv), compact tension (CT) and tension test specimens were irradiated in the 2-MW light water-cooled test reactor located at the Buffalo Materials Research Center. Five as-irradiated conditions and two post-irradiation annealed conditions were evaluated. With 288 deg

C irradiations, the elevation in 100 MPa/m temperature from fracture mechanics tests was found to match the elevation in 41-J temperature from Cv tests within 12 deg C. The latter elevation was predicted well by NRC's Regulatory Guide 1.99. The L-C orientation for the archive material versus the vessel trepans suggest a fluence-rate effect. The C-L orientation data, however, do not. A test orientation dependence of radiation embrittlement sensitivity, described by the trepan material but not the archive material, is responsible and is anomalous.

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Decontamination and Decommissioning of a Fuel Reprocessing Pilot Plant

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 139-144) (1988)

The Strontium Semiworks Pilot Fuel Reprocessing Plant at the Hanford Site in Washington State was decommissioned by a combination of dismantlement and entombment. The facility contained 9600 Ci of Sr-90 and 10 Ci of plutonium. Process cells were entombed in place. The above-grade portion of one cell with 1.5-m- (5-ft-) thick walls and ceilings was demolished by means of expanding grout. A contaminated stack was remotely sandblasted and felled by explosives. The entombed structures will be covered with a 4.6-m- (15-ft-) thick engineered earthen barrier.

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Hempelmann, W., W. Pfeifer, M. Laser, and S. Halaszovich, Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Harmless Utilization of Metallic Residual Materials

Juel-Conf-62; CONF-8711296; Reuse of

Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 185-198) (1988, July)

The paper discusses the various possibilities of treating metallic residual materials: (1) Crushing and compacting for direct ultimate disposal; (2) melting and conditioning for radiological decontrol and reuse; (3) decontamination for recycling in the conventional materials cycle. The conditions and requirements set in the licences for recycling and the methods applied for radiological measurements together with own work and results are presented.

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A Case for External Funding

Forum for Applied Research and Public Policy 2(4):14-17 (1987, Winter)

In financing the decommissioning of nuclear power plants, there are five basic criteria for choosing between internal and external funding methods: (1) the desire for financial assurance, (2) the cost of the assurance, (3) the degree of equity in the recovery program, (4) the program's ability to respond to changes, (5) the program's adaptability to different utilities. In March 1985 and April 1986, the Missouri Public Service Commission issued orders for the state's electric utilities with nuclear generating stations to establish external funds to cover the costs of decommissioning. If money targeted for decommissioning is used, as it is collected, for current corporate purposes (as is the case in the internal funding method), the utility is not likely to have sufficient funds available to cover the costs of decommissioning when decommissioning begins. It would then be forced to look for outside financing. If financing were unavailable or if borrowing costs were high, the utility, the regulator, and the ratepayer would all find themselves in difficult financial circumstances. To fulfill its obligations to protect long-term public interests, the Missouri Public Service Commission decided it had to assure, to the maximum extent possible, that sufficient decommissioning funds were available when needed.

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Hermetz, R.E., Monsanto Research Corporation, Mound Facility, Miamisburg, OH

Tools for Decontamination and Decommissioning of Nuclear Facilities

Remote Systems Technology, Proceedings of the 34th Conference, Technology, Washington, DC, 1986 (1987)

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

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Measurements of the Radioactive Inventory of the Old Effluent Pipe Line on the BNL Site

RD/B/6173/R89; 35 pp. (1989, March)

Nuclear Licensed sites which have underground drains used for radioactive effluent face the problem that when the drain is eventually retired from use it might be considered to be buried radioactive waste. Such drains may therefore be subject to a different regulatory regime to that in force when they were in use. It thus becomes important to know the inventory of such drains so that the radiological consequences of leaving them in situ may be assessed. If the radiological consequences are acceptable to the authorizing ministries it may be economically preferable to leave the radioactive drainage system underground during the period for which final dismantling of a nuclear power station is deferred. In certain cases parts of the radioactive drainage system lie underground to depths of up to 18 feet. Removal of this plant will be a complex operation which,

radiologically, might be best deferred to take advantage of natural radioactive decay. When BNL was built, a 3 inch cast iron pipe was laid to carry the radioactive effluent from the BNL effluent treatment plant to the power station for further treatment and/or discharge. In 1980/1981, a new pipe line was installed and since then the old line has remained unused. As part of the refurbishment of certain parts of the BNL site currently in progress, the majority of the pipe is to be dug up in two stages, although a small length of the pipe which runs under existing foundations will be left in the ground. This report gives the radioactive inventory of the pipe based on measurements made during the first stage of the removal. Samples from the trench dug to expose the pipe were taken before and after the removal of the pipe and analyzed to determine whether the pipe had leaked and the level of contamination caused by the pipe's removal. As a result the following conclusions can be drawn: (1) The radioactivity in the pipe has been measured by in situ gamma spectroscopy and by collecting samples for laboratory based gamma, alpha and X-ray spectroscopy and radiological analysis. From these measurements it was found that the radioactive inventory of the pipe is dominated by Cs-137. There is, however, an appreciable actinide inventory which will become dominant in terms of radioactivity after approximately 250 years. The total radioactivity in the pipe is approximately 2.59 GBq/t sub c beta-gamma, 16.7 MBq/t sub c alpha and 0.147 GBq/t sub c transuranics, as such the pipe is low-level waste. If the pipe is sent to Drigg in an iso container with other waste of negligible actinide content, then once the radioactive contents have been averaged over the total weight of the container and its contents it can be disposed of to Drigg. If the rust were to be removed from the pipe as part of a decontamination/waste volume reduction procedure, the resulting rust would have a total beta-gamma activity of approximately 74 GBq/te taking the waste over the upper limit for low-level waste into the intermediate-level waste category. The volume reduction factor from such a process could be as high as 40; however, to realize this the pipe must be decontaminated down to the free disposal limit which would require an unreasonably high decontamination factor of approximately 7000. (2) The decontamination factor achieved by the abrasive method used to remove a sample of the rust from the inside of the pipe was greater than 63. The procedure has the

potential, if tailored specifically for decontamination, of producing a much higher decontamination factor although further work would be needed to determine the limit of this method. (3) The amount of activity in the pipe and the isotopic ratios vary down the pipe. However, there are insufficient data to indicate any trends or draw any conclusions. (4) The Cs-137/Cs-134 ratio suggests an age between 14 and 17 years for the Cesium in the pipe and by implication the rest of the radioactivity. This age is however provisional as the pipe was in use for a period of years and the burn-up of the fuel from which the cesium came is not known. (5) There has been no detectable leakage of radioactivity from the pipe uncovered in Phase I. The measured radioactivity in the samples of material surrounding the pipe is consistent with fallout from atmospheric bomb tests and the Chernobyl accident. (6) Samples taken from the trench after the pipe was removed showed that contamination had occurred during the removal process. The degree of contamination was below the level at which the trench would have had to be made a C2 zone, i.e. less than 4 Bq/sq cm. However, it is important to note that some material which had been effectively contained in the pipe during and after its operational lifetime was released during the decommissioning operation.

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Criteria for Unrestricted Reuse of Waste Material Arising at Nuclear Facilities

CONF-880401; Radiation Protection in Nuclear Energy, Proceedings of an International Conference, Sydney, Australia, April 18-22, 1988. International Atomic Energy Agency, Vienna, Austria, Vol. 2; (pp. 277-284) (1988)

In the Atomic Energy Act of the Federal Republic of Germany the recycling of scrap material from nuclear installations is required, if it is possible from the radiation protection viewpoint and if it is not economically unjustified. In practice, four options for contaminated scrap material are used, depending on the degree of contamination: (1) storage in deep mines; (2) fabrication of shielding; (3) fabrication of containers for radwaste storage in

deep mines; and (4) unrestricted reuse. These options were investigated with regard to the optimization criterion of the ICRP. A fifth option, storage as industrial waste, was added but has not yet been used in the Federal Republic of Germany. Because the collective exposure depends upon the degree of contamination of the treated material, the total cost including the monetary equivalent for exposure as a function of contamination was evaluated. Thus it was possible to identify the optimum solution for each level of contamination. Individual dose limits which could be constraints for these evaluations were not considered in this first step of the evaluation in order not to restrict the optimization by constraints possibly influenced by political opinion. For the evaluation of collective dose commitment, the external exposure mainly caused by cobalt-60 was considered. The optimum solution for scrap with a contamination of less than 1000 Bq/kg is unrestricted use. Above 1000 Bq/kg storage as industrial waste is the best choice. Individual dose limits restrict such storage to levels of contamination below 14,000 Bq/kg. Beyond this level, storage in a deep mine is the best option. The politically preferred solution of controlled reuse in the nuclear industry is generally not an optimum solution in the light of cost-benefit analyses. Exceptions would be items of infrequent use (e.g. test weights) if a low level of control could be accepted.

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Holden, S.

The Plasma Cutting of Stainless Steel

Stainless Steel Industry 13(74):12-13, 25 (1985, July)

Earlier methods for profiling stainless steel including powder cutting' and flux cutting' are recalled. The main disadvantages of powder cutting stainless steel are summarized. The plasma arc process (temperature approximately 30000 deg C) is outlined and illustrated schematically. The several factors, necessary to obtain an optimum cut are specified. Comparisons between the plasma arc and gas cutting show that, for materials less than 31 mm thick, air plasma offers a speed advantage over A/H₂ mixtures and conventional oxy-propane cutting. The main advantages of plasma cutting as opposed to powder cutting are listed. Modification

of the process such as a water-injected torch and cutting in water are mentioned.

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Hot Cell Equipment Decontamination, Size Reduction and Disposal at the Pacific Northwest Laboratory

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 4-1 - 4-35) (1988, October)

The Pacific Northwest Laboratory (PNL) is currently engaged in a major program, sponsored by the U.S. Department of Energy (DOE), in which six radiochemical hot cells are being remotely cleaned out and decontaminated. The cleanout approach for each of the six hot cells is being tailored to each cell based upon the contamination level and type of contamination found in each cell, and the waste types found in the cell. The waste handling strategy is designed to minimize impact to the Hanford site burial ground, reduce overall program cost and minimize worker radiation exposure. Waste is characterized and segregated into waste types (LLW, TRU, and RMW) to minimize overall waste disposal costs. Size reduction and decontamination of metallic wastes is employed to minimize overall disposal costs and reduce staff exposure.

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JPDR Decommissioning Program

Nippon Genshiryoku Gakkaishi 29(7):584-592 (1987, July)

It is generally considered that the period of operation of nuclear reactors is 30 to 40 years. Therefore, the decommissioning measures after completion of the reactor's operation are very

important. The decommissioning program for the Japan Power Demonstration Reactor (JPDR) aims at developing the decommissioning techniques for dismantling and removing nuclear reactors, preparing for the decommissioning measures for commercial nuclear power stations in the future, and obtaining the general knowledge and experience on the decommissioning through the dismantling and removal of the actual facilities. The dismantlement and removal of the JPDR reactor were begun at Japan Atomic Energy Research Institute in December, 1986. This report describes the decommissioning program for the JPDR. In order to effectively use the vacated sites after the lapse of the period of tightly closed institutional management, or as shielding and isolation demand, decommissioned reactors are dismantled and removed as early as possible. From the viewpoint of the reduction of the radiation exposure of workers and of cost reduction, the development and improvement of the decommissioning techniques at the JPDR are advanced. The problems in the dismantling of nuclear reactors, the development of decommissioning techniques in the JPDR, a 90 MW(t) BWR used from 1963 to 1976, and the decommissioning program are described.

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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-EN; ISBN-92-825-6386-3; 136 pp. (1986)

The study considers the technical characteristics related to the measurements of very low radioactivities necessary to monitor decommissioned nuclear power plants. Geometry of materials and components and often inhomogeneous activity distribution prevent application of simple direct measuring procedures. Furthermore, elevated background irradiation may impede employment of direct on-site measurements even for flat components. Choice of detectors and measuring procedures depend greatly on the activity limits set for unrestricted release, and on the procedures

required by the competent authorities. These regulations do not yet exist in all countries. The existing regulations or specific authorizations are based on surface and/or mass activities. Surface activity limits of the order of one Bq/sq cm for beta emitters have often been used in different countries. Limits for alpha emitters are usually lower.

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TMI-2 Reactor Vessel Head and Plenum Removal

Transactions of the American Nuclear Society 57:491; CONF-881024; Nuclear Fission: Fifty Years of Progress in Energy Security and TMI-2 Accident: Materials Behavior, Plant Technology and Recovery, Proceedings of the American Nuclear Society 1988 International Conference, Washington, DC, October 30-November 4, 1988; (p. 491) (1988)

Describes the plans and the equipment used for the removal of the TMI-2 reactor vessel head and plenum. The use of the polar crane and hydraulic jacks by remote control is covered.

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A Process for Decontaminating Stainless Steels to Release Limits

Nuclear Technology 85(1):66-73 (1989, April)

A regenerative process involving the use of a dilute solution of nitric (0.5 to 1.0 wt.%) and hydrofluoric (0.05 wt.%) acids was developed for decontaminating stainless steels (Type 304) to release limits. The solution is regenerated using a strong acid cation exchanger and may eventually be disposed of after processing through a strong base anion exchanger. The waste management aspect of the decontamination is thus limited to the disposal of relatively small volumes of spent cation and anion exchange resins. Application of the acidic reagent for 1 h at 95 degrees C to the tray surfaces

of an obsolete irradiated fuel storage basket from Pickering Nuclear Generating Station resulted in the removal of metal exceeding 1 mu m and a residual (beta, gamma) contamination below a target limit of 0.1 mu Ci. A soak tank system with associated purification, vapor handling, and auxiliary systems is proposed for performing full-scale decontaminations of the baskets.

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Inside Disc Cutter System for Remote Cutting of Reactor Vessel Pipe

KHI Technical Review 89:112-113 (1985, July)

The problem of which techniques are to be used to dismantle nuclear reactors is an important item in research and development activities in the field of reactor decommissioning. An inside disc cutter system is described that is a remote cutting system for pipes connected to the reactor vessel and is expected to be a promising cutting technique. This system has been successfully modified as a pilot machine for remote cutting of stainless steel pipe four inches in diameter or more.

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Institution of Mechanical Engineers, London, United Kingdom; British Nuclear Energy Society, London, United Kingdom; Institution of Nuclear Engineers, London, United Kingdom

Decommissioning of Major Radioactive Facilities

CONF-881008; Proceedings of the IMechE International Conference, London, United Kingdom, October 11-12, 1988. Institution of Mechanical Engineers, London, United Kingdom, 252 pp. (1988)

The early nuclear fission reactors are coming to the end of their service lifetime and will soon have to be decommissioned. So far relatively few have been completely shut down and dismantled but safe techniques and practices are being developed now ready for the major decommissioning programs which will occur over the next 20-25 years. Thirty-three papers were presented at the

conference on several aspects of decommissioning and dismantling. Progress on reactor and fuel plant decommissioning which is either being undertaken or is in the advanced planning stages is reported. Development of special machinery (robots, manipulators, remote cutting systems) and waste processing and packaging techniques currently being investigated are described. Chemical decontamination is also discussed in seven of the papers.

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International Atomic Energy Agency, Vienna, Austria

Decontamination and Demolition of Concrete and Metal Structures During the Decommissioning of Nuclear Facilities

IAEA Technical Reports Series No. 286; 90 pp. (1988)

The objective of this report is to give a concise technical description of the techniques and equipment being used or developed for the decontamination and demolition of nuclear facilities in sufficient detail to assist Member States to plan decommissioning operations and make preliminary evaluations of techniques and equipment. This report also reviews new and/or different aspects which have not been well covered previously in readily available review documents or IAEA publications. This report is an up-to-date review of techniques and equipment being used or developed for decontamination or dismantling work during the decommissioning of all types of nuclear facility except mining and milling sites. Although the information presented is aimed at countries initiating decommissioning programs, it should also be useful to others who are responsible for or interested in the planning and implementation of decommissioning tasks. This report describes the relevant techniques and equipment, their areas of application and degree of development and the conditions in which they are used, when these details are known. However, this publication should be used in conjunction with other published technical information on these topics; experience gained as a result of previous decommissioning operations and the assistance of experts in the appropriate areas are required.

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International Atomic Energy Agency, Vienna, Austria

Factor Relevant to the Recycling or Reuse of Components Arising from the Decommissioning and Refurbishment of Nuclear Facilities

IAEA Technical Reports Series No. 293; 76 pp. (1988)

The objective of this report is to provide an up to date review of the engineering, social, scientific, and administrative factors relevant to the safe recycling or reuse of components arising from decommissioning or refurbishment of nuclear facilities. The topic is examined in the context of what is being done in industrial recycling, the need, practicality and viability of recycling in the nuclear industry and the availability of suitable tools, criteria and instrumentation. The information presented is intended to be of interest to those who are evaluating, planning or implementing the recycling or reuse of components as well as to those who are developing the regulations and/or radiological criteria required for this work. It should be considered in conjunction with other published information such as internationally accepted guidelines, and past experience.

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International Atomic Energy Agency, Vienna, Austria

Waste Management Research Abstracts No. 19

IAEA/WMRA/19; 540 pp. (1989)

The research abstracts contained in this issue have been collected October 1988 to identify and report on progress in the field of radioactive waste management. This report contains 20 project descriptions on decommissioning from the following countries: Canada, China, Finland, France, Great Britain, Japan, Korea, The Netherlands, Sweden, and United States. Entries also include descriptions of projects by the Commission of the European Communities and the International Atomic Energy Agency. An abstract from Canada covering uranium tailings operations and removal is also included.

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Dismantling of JPDR Internals Gets Under Way Using Plasma Arc Cutting

Nuclear Engineering International 33(40):27-28 (1988)

The Japan Power Demonstration Reactor (JPDR) decommissioning program was initiated in 1981 by the Japan Atomic Energy Research Institute (JAERI) under contract with the Science and Technology Agency in Japan. Technologies necessary for reactor dismantling were developed in the first stage of the program. Underwater plasma arc cutting was selected for dismantling the JPDR reactor internals because it provided the required superior cutting performance and precision control features needed for remote cutting in a high radiation environment. A robotic manipulator system was used with the cutting technique.

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Reactor Decommissioning in Japan: Philosophy and First Program

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5 (1988)

Based on the paper entitled "Long-term Program For Development and Utilization of Nuclear Energy," issued by the Japan Atomic Energy Commission in 1982, a research and development program concerning reactor decommissioning has been carried out to develop necessary techniques and demonstrate these technologies by dismantling the Japan Power Demonstration Reactor (JPDR) in the Japan Atomic Energy Research Institute. The JPDR Decommissioning Program consists of two major phases. Phase I, started in 1981, and now

almost completed, aims at the development of a set of techniques needed for reactor dismantling. Phase II, the actual dismantling of JPDR, followed consecutively after Phase I and will be completed by 1992. The paper describes the basic policy for reactor decommissioning in Japan and outlines the JPDR Decommissioning Program.

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Prospects of Remelting Metal Materials from Shutdown Nuclear Power Installations

INIS-mf-11312; Application of Radionuclide Methods in Metallurgy and Engineering, Chlobystina, E. and Strba, J. (eds.), Proceedings of a Conference, Vsetin, Czechoslovakia, June 2, 1987; (pp. 227-231) (1987)

The remelting of metal materials from decommissioned nuclear power installations may be used for several purposes. First, it can be used to reduce the volume of wastes. Second, melting can fix radioactivity by building contaminated wastes into matrices with extremely low leachability and immense mechanical strength or by combining them into the slag phase. Finally, melting can extract radionuclides from the melted metal into slag and make the metal recyclable by reducing the concentration of radionuclides by dilution to the level below that set by hygiene regulations. Metal recycling, especially the recycling of stainless steels is a very topical problem in the Czechoslovak nuclear program. This mainly concerns reducing the concentration of radionuclides, converting Co-60 and precipitating Cs-137 in the slag to below the levels permitted by hygiene regulations. The remelting methods used by the British Steel Corporation, Siempekamf Guss- und Reaktortechnik, and Seri-Renault are briefly described.

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Federal Republic of Germany, Gesellschaft fuer Nuklearservice, Essen, Federal Republic of Germany

Utilization of Metal Scrap for the Production of Waste Drums for Ultimate Disposal

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 246-261) (1988, July)

The contribution reviews the development history of the techniques for treatment of decommissioning scrap from the beginning of the 1980s onwards (decommissioning of the Niederaichbach and Gundremmingen nuclear power stations), together with the radiological measuring methods required for regulatory purposes. The advantages of recycling of metal scrap by means of melting, and of materials utilization for production of waste containers for ultimate storage are discussed together with product quality assurance criteria.

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Progress of JPDR Decommissioning Program: Third Progress Report (April - September 1988)

Report; 23 pp. (1989, January)

This is the third progress report for the Japan Power Demonstration Reactor (JPDR) decommissioning program conducted under a contract with the Science and Technology Agency. It describes the activities related to both the research and development of techniques needed for reactor dismantling and the actual dismantling of JPDR. The period of April through September, 1988 is discussed in this report. The dismantlement of JPDR, which began on December 4, 1986, and the development of dismantling techniques have both progressed as scheduled. During this period, a part of the activated reactor internals from JPDR was successfully dismantled by plasma arc cutting using a robotic manipulator. Data obtained from this dismantling work will greatly contribute to

decommissioning of commercial power reactors in the future. Also, research and development for the reuse of reactor decommissioning material was started with plans to build an induction furnace for investigating the behavior of radioactive metallic waste. The dismantling of JPDR is described in the chapter entitled "Progress in Dismantling" and several recently completed dismantling techniques are discussed in the chapter entitled "Topics".

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Progress of JPDR Decommissioning Program: Second Progress Report (August, 1987 - March, 1988)

Report; 24 pp. (1988, March)

In the near future, Japan must be ready to conduct the dismantlement of large nuclear power plants as their service life ends. To prepare 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), a 50 MW(t) boiling water reactor. The program is in accordance with the "Long-term Program on Nuclear Energy Development and Utilization" issued by the Japan Atomic Energy Commission. The JPDR Decommissioning Program consists of two phases. Phase I, already completed, began in 1981 to develop a set of techniques needed during Phase II, the actual decommissioning procedure. Phase II is now progressing on schedule with (1) the removal of components in the reactor enclosure building, (2) the removal of components in the dump-condenser building, and (3) the removal of the reactor internals by a robotic manipulator utilizing a plasma-arc torch cutting system.

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Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Annual Report of Japan Atomic Energy Research Institute, for Fiscal 1986

Nippon Genshiryoku Kenkyusho Nenpo

61:1-281 (1987, September)

In fiscal year 1986, the research on safety and the research and development of high temperature gas-cooled reactors and nuclear fusion were promoted as the important subjects. The related research, basic research, the research on radiation utilization, and the research and development of nuclear-powered ships were also made more substantial. JAERI conducted its business by taking up the contribution to the research and development of atomic energy and the promotion of its utilization as the institute's fundamental policy. The details of these research and development activities are reported. As for the research reactors and test reactors, the operation of utilizing JRR-2, JRR-4, and JMTR was carried out. As to the reconstruction of JRR-3, the project of removing the reactor was completed, and the construction of the building for experimental utilization was advanced. As for JPDR, the facility management for the long-term shutdown was carried out, and the test on the soundness of the pressure boundary was advanced. Techniques for dismantling reactors were developed, and the dismantling and removal of equipment were begun. As to the safety and security management, the regulation was improved, and various measures were taken.

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Jastrzebski, R.

Present State-of-the-Art of Underwater Metal Cutting

Przegląd Spawalnictwa 8711(2):15-20 (1987)

Evidence is presented that confirms that the employment of arc cutting under water is possible and that plasma cutting is not the only method which enables steel to be cut at great depths. An analysis is given of methods such as arc cutting with a water jet, gas cutting with a water curtain and plasma cutting. A comparison of advantages and shortcomings of the different methods is presented.

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Jennings, M.

Decommissioning with Diamond

Industrial Diamond Review 48(525):47-48 (1988, February)

As the first generation of nuclear reactors come to the end of their useful lives, it is estimated that around 200 reactors will be taken out of service worldwide over the next 20 years. Most nuclear reactors are designed with thick reinforced concrete bioshields as protection against radiation leaks. The controlled demolition of these structures will present unique problems, many of which can be solved by diamond tooled cutting. The article discusses test work in connection with the proposed demolition of the Windscale Advanced Gas-cooled Reactor at Sellafield, England.

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Decommissioning of Nuclear Facilities

Demolition of Special Structures, Proceedings of a One-Day Symposium, London, United Kingdom, September 20, 1984. Concrete Society, London, United Kingdom, 97 pp.; (pp. 71-82) (1985)

There are a number of options which may be considered by the operator of a nuclear facility when it reaches the end of its service life. These are protective storage, encasement, or any or all of decontamination, dismantling, and removal. If complete removal is required, then ways of disposing of the large amounts of radioactive wastes generated have to be available. Some techniques for decommissioning and dismantling are listed. The planning and documentation of decommissioning and dismantling is important; this is discussed in some detail. A two stage approach is suggested. The scheduling and resourcing of a project are discussed.

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Decommissioning of the Windscale Advanced Gas-Cooled Reactor

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5; (pp. 135-150) (1988)

The Windscale Advanced Gas-Cooled Reactor (WAGR), built as a prototype for the commercial AGRs, was commissioned in the early 1960s and ran very successfully until 1981 when on completion of the experimental program it was shut down. Prior to this final shutdown, the United Kingdom Atomic Energy Authority (UKAEA), increasingly aware of the need of the nuclear industry to demonstrate that a reactor could be decommissioned both safely and economically, decided to authorize the decommissioning of WAGR to Stage 3 (that is to a green field site). The reactor rated at 33 MW(e) comprises a graphite core within a steel pressure vessel housed within a reinforced concrete bioshield which is all housed within the spherical reinforced concrete containment buildings. The similarities of this reactor to the much larger Magnox reactors are sufficient to be able to provide valuable data and experience for the eventual decommissioning of these reactors. An account of the progress to date in decommissioning WAGR together with information on the decommissioning development work that is being undertaken is presented. It is possible that the estimates produced for the overall project cost of dismantling WAGR from Stage 1 to Stage 3 can establish indicative decommissioning costs for the other reactors in use in the United Kingdom.

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Jones, J.M., United Kingdom Atomic Energy Authority, Northern Research Laboratories, Windscale, Seascale, United Kingdom

Windscale Piles

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988.

Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 247-252) (1988)

This paper describes the Windscale Piles and the work being undertaken by the UKAEA to ensure the continuing safety of the Piles together with an investigation of the long-term options including possible eventual decommissioning. Included in this program is the intent to recover undamaged fuel from Pile 1, together with the very small quantity present in Pile 2, and from the inlet and outlet air ducts. As a first step both Piles are being isolated from their chimneys and provided with a ventilation and filtration system to maintain the existing cooling air flow conditions. The program of work on the two piles is being undertaken by the Engineering Division of the UKAEA, Northern Research Laboratories, Windscale which is already engaged in the decommissioning of the nearby Advanced Gas-Cooled Reactor.

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Jones, J.M., and A.L. Adams, United Kingdom Atomic Energy Authority, Windscale Nuclear Laboratories, Sellafield, Seascale, Cumbria, United Kingdom

Windscale Piles - Past, Present and Future

Atom. 374:14-17 (1987, December)

The article documents the Windscale reactor piles where a fire occurred in the core of pile 1 thirty years ago. A description is given of the two Windscale piles, the events leading up to the accident, and the state of the piles following shutdown. The surveillance and maintenance involved in ensuring that the pile and associated buildings were in a safe condition is discussed. The present state of the core, water ducts and pile chimneys is described. The present and future schedule of work to ensure long-term safety is discussed. This includes the initial steps in decommissioning of the piles.

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Kalczynski, W.

Methods of Underwater Metal Cutting

Przegląd Spawalnictwa 8701(2):16-18 (1986)

Constant need for raw materials from ocean beds, undersea oil drilling and ship salvage operations all create a need for cutting metals under water. Investigations are directed at raising the cutting speed which is an important factor, considering the limited time the cutter/welder can remain under water. Three types of underwater cutting can be distinguished, i.e. mechanical, explosive and thermal, the last of these accomplished either by gas torch or by electrical means (arc, arc-oxygen, and plasma). One of the most effective modern means is underwater cutting by plasma holders, first developed in the U.S. and used to pull down a reactor at the Elk River nuclear power station. Plasma holders enable easy underwater cutting without the need for substantial physical strength, and yield good results.

226

Katsumura, M., S. Nagata, H. Yoshida, and M. Noumi, Government Industrial Research Institute, Shikoku, Takamatsu, Japan

**Study on Cutting of Concrete by Use of Laser:
(1) - Selection of Proper Cutting Condition of Mortar**

PB85-170523/XAB; Reports of the Government Industrial Research Institute, Shikoku 16(1):38-43 (1984)

The study aims to obtain fundamental data for dismantling the concrete wall which has served as a biological shield of a nuclear reactor by use of 5 kW CO₂ laser. As the first step of this study, the effect of output power, cutting speed, focal length, and other factors on the cutting results of mortar is discussed. The main results obtained are as follows: cut thickness is increased with the increase of focal length in the range of plate thickness when used at the same output power, cutting speed and focal position; and the focal position is insensible to its cut thickness. A 50 mm thick mortar plate can be cut at the speed of 10 cm/min, regardless of the mixing ratio and the degree of humidity of the mortar. Judging from the results obtained in this study, the use of lasers in dismantling of biological shield concrete walls will be put into practice in near future.

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Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Reuse of Decontaminated Materials from Repair and Decommissioning of Nuclear Facilities

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988; (pp. 865-873) (1988)

A conference concerning reuse of materials from repair and decommissioning of nuclear facilities was organized and held at KFA-Juelich (Kernforschungsanlage Juelich) in West Germany on November 10 and 11, 1987. The authors report the licensing practice concerning boundary radiation limits for various reuse categories based upon the ALARA principle of the atomic law. Resulting difficulties in monitoring are outlined and the effects on waste management and economy are mentioned.

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Kernforschungszentrum Karlsruhe GmbH, Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen, Karlsruhe, Federal Republic of Germany

Standardization of Containers for Radwaste from Operating and Decommissioned Nuclear Facilities for Final Storage in Konrad Mine - Revised Version, As of November 1984

INIS-mf-11801; 45 pp. (1984)

The compilation gives a survey on the present state of the investigations and discusses harmonization in the field of standardization of radioactive waste containers for final storage in the pit, "Konrad". The results presented are contained in the final report of the GNS research project, issued by the Federal Government: "Preparation of an acceptable technical concept for the packaging, conditioning, transportation, and final storage of

Radioactive Waste from Closed-Down Nuclear Installations." The project was concluded on June 30, 1984.

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

Lingen Nuclear Power Plant Technical Report: January - June, 1987

INIS-mf-11737; 14 pp. (1987)

The technical report gives an account of the decommissioning and dismantling work in the period of January to June, 1987. Particular attention is given to the following items: primary loop, wastes, decommissioning of waste water treatment plant, *personnel* monitoring, radioactive wastes, chemical aspects, conventional plant equipment, nuclear components, waste water treatment, and radiochemical aspects.

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Klimov, Y.I.

NPP Decommissioning Is a Solvable Problem

Atomnaya Tekhnika za Rubezhom 4:16-21 (1988, April)

Information on foreign power reactor shutdown and planned for shutting-down through the year 2000 is presented. Consideration is also given to current and scheduled work in the United States, Federal Republic of Germany, Japan, United Kingdom, and France. Organizational measures for conducting the NPP decommissioning and remediation to one of three states (up to bringing the reactor site to the state of green lawn) are also discussed.

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Klimov, Y.I.

Evaluation of NPP Dismantling Cost

Atomnaya Tekhnika za Rubezhom 9:15-16 (1987, September)

The results of a decommissioning cost estimation

made by experts from Canada, Federal Republic of Germany, Finland, Sweden, and the United States for nuclear power plants (NPPs) with PWRs, BWRs, and HWLWRs (Canada) are given. Studies were made based on figures obtained from: (1) small nuclear plant decommissioning, and (2) from replacement and repair of the equipment at large nuclear power plants and conventional power plants with the same power. NPP decommissioning cost is estimated from 97 to 186 million dollars according to the prices of 1984. A conclusion is made regarding costs discounting; it is more favorable, from an economical point of view, to conduct equipment dismantling within the period of 30 to 100 years, when the induced radioactivity reduces up to the established level.

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Klopfer, H., R. Engelfried, D. Ricken, and R. Schmidt, Dortmund University, Dortmund, Federal Republic of Germany; Geholit Lack-und Kunststoffchemie GmbH, Graben-Neudorf, Federal Republic of Germany; Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany

Development of a Process for the Removal of Radioactively Contaminated Coatings from Concrete and Steel Structures, when Shutting Down Nuclear Plant

INIS-mf-11834 (1986, February)

Considerable cooling (removal of heat) of materials leads to contractions and embrittlement. This permits a commutation of substances to be achieved. Through the application of very cold media on coated surfaces of concrete, screed, plaster and steel, such a considerable amount of heat is to be removed that the arising inherent stresses lead to a separation of substrate in the coating. A carryout of radioactively contaminated components through arising primary and secondary waste must not occur here. Test specimens were produced with practical system structures from substrate and coating. Using a specially constructed experimental plant, liquid nitrogen was applied to the coating surfaces. Under certain circumstances, it is possible to separate clods of coating from the substrate. Fine dusts or thawed water, which could

cause a carryout of the radioactivity, were not observed. Application on an item must be preceded by clarification of various influences, e.g. diffusion of stress in the compound system during nitrogen application, and coating structure optimization.

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Kobayashi, T., T. Arai, and H. Yamada, Tohoku University, Tohoku, Japan; Nippon Petrochemical Corporation, Tokyo, Japan

Structure of a High-Speed Water Jet and the Damage Process of Metals in Jet Cutting Technology

JSME International Journal II(1):53-57 (1988, February)

The dynamic structure of high-speed water jets, the damage process of metallic materials and a microscopic comparison of cavitation damage are presented. The experimental conditions were an injection pressure of 30 to 90 MPa and a nozzle inner diameter of about 1 mm. Materials tested included Al, mild steel and stainless steel. The instantaneous behavior of the impact pressure was measured using a pressure transducer. Comparisons of stroboscopic observations for the structure of water jet, axial variation of the impact pressure and mass loss of the material caused by the jet impact showed that an axial location where the water jet begins to break up is close to the location of the maximum mass loss of the material. A detailed comparative observation of the damage process for a water jet and for the cavitation (magnetostrictive vibratory method) used a scanning electron microscope and found some distinct differences in the damage process.

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Konczek, G.J., and R.I. Smith, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station: Technical Support for Decommissioning Matters Related to Preparation of the Final Decommissioning Rule

NUREG/CR-0130 (Addendum 4); 98 pp. (1988)

The Pacific Northwest Laboratory (PNL) staff who are familiar with decommissioning matters have assisted the Nuclear Regulatory Commission (NRC) in preparing the final Decommissioning Rule. These efforts have included: (1) updating previous cost estimates (developed during the series of studies on conceptually decommissioning reference licensed nuclear facilities for inclusion in the Final Generic Environmental Impact Statement (FGEIS) on Decommissioning); (2) documenting the cost updates; (3) evaluating the cost and dose impacts of post-TMI-2 backfits on decommissioning; (4) performing revised scaling factor analyses concerning reactor plants different in size from the reference PWR described in the earlier studies; (5) determining the formula for adjusting current cost estimates to reflect escalation in labor, materials, and waste disposal costs; and (6) completing a study of recent PWR steam generator replacements to determine realistic estimates for time, cost, and radiation doses associated with steam generator removal during decommissioning. This report presents supporting information in four of the aforementioned areas concerning decommissioning the reference PWR: (1) updating the previous cost estimates to January 1986 dollars, (2) assessing the cost and dose impacts of post-TMI-2 backfits, (3) developing scaling and escalation formulae, and (4) assessing the impact of recent steam generator replacements.

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Konczek, G.J., and R.I. Smith, Pacific Northwest Laboratory, Richland, WA

Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station: Technical Support for Decommissioning Matters Related to Preparation of the Final Decommissioning Rule

NUREG/CR-0672 (Addendum 3); 64 pp. (1988, July)

Preparation of the final Decommissioning Rule by the U.S. Nuclear Regulatory Commission (NRC) staff has been assisted by Pacific Northwest Laboratory (PNL) staff familiar with decommissioning matters. These efforts have

included: updating previous cost estimates developed during the series of studies of conceptually decommissioning reference licensed nuclear facilities for inclusion in the Final Generic Environmental Impact Statement (FGEIS) on Decommissioning; documenting the cost updates; evaluating the cost and dose impacts of post-TMI-2 backfits on decommissioning; performing revised scaling factor analyses concerning reactor plants different in size from the reference BWR described in the earlier studies; and determining the formula for adjusting current cost estimates to reflect escalation in labor, materials, and waste disposal costs. This report presents supporting information in three of the aforementioned areas concerning decommissioning the reference BWR: (1) updating the previous cost estimates to January 1986 dollars, (2) assessing the cost and dose impacts of post-TMI-2 backfits, and (3) developing scaling and escalation formulae.

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Kopetschek, K., D. Schiefelbein, and B. Heinze

Use of Fusion-Drilling with the Oxygen-Core Lance for Creating Wall Openings in Very Dense Concrete

ZIS Mitteilungen 22(3):273-282

The example of an actual wall-cutting operation discussed is that of opening the 1 m thick reinforced walls of a research reactor for the purpose of building extensions. The density of concrete was 3.2 with heavy steel reinforcement. The technique developed for cutting is described with details of the equipment, personnel and safety precautions used.

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Krakowski, A., H. Kratz, T. Moser, and A. Steringer, Kraftanlagen AG, Heidelberg, Federal Republic of Germany; Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany

Tests and Investigations Concerning the Development of a Jet Action Process for the Decontamination of Metal Components During

Decommissioning of Nuclear Facilities, Producing No or Only Little Secondary Waste, Final Report

INIS-mf-11859; 88 pp. (1987, December)

Jet action tests with substances of various material categories were undertaken on varnished surfaces and/or on surfaces covered with an oxide film (rust). The obtained surface cleanup efficiency was evaluated according to DIN 55 928. The tests demonstrated that the below substances are suitable: (1) Dry ice (CO₂ in solid state) is suitable for adhesive contamination; (2) Ammonium tartrate is suitable for varnish removal; (3) Coke is suitable for varnish and rust removal; and (4) Polyamide, duroplastic is suitable for varnish removal. When using dry ice and plastics, the jetting agent was supercooled with liquid nitrogen in order to increase the hardness and to embrittle the varnish film. In the course of decontamination tests on varnished samples, decontamination factors (DF) of 100 were obtained with coke and duroplastic, whereas with ammonium tartrate the DV was 20. In case of oxide films, DF 15 was obtained with coke, and DF 8 with duroplastic.

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Kukkola, T., Imatran Voima Oy, Helsinki, Finland

New Decommissioning Principles for Loviisa NPP

Nuclear Europe 8(10):37-38 (1988, October)

Loviisa nuclear power plant's decommissioning target is equivalent to the IAEA Stage 3, namely complete decontamination of the plant and disposal of the resultant waste in a repository. All of the plant's radioactive parts will be removed to the final repository, which is a rock cavern at a depth of 100 m below the plant site. The site will be reused for power production. The primary circuit components will be transported to the final repository without further demolition, via a rock tunnel. The pressure vessel is intended to be used as a waste package for the reactor internal parts and the dummy fuel elements. A shielding cylinder from the plant will be used as a radiation shield during transport of these parts. The estimated time for the decommissioning process is 12 years and 4

months, requiring 2920 man-years. Radiation doses for the total work amounted to 23 manSv. The costs amount to about FIM 800 million. The packed waste volume for all decommissioning waste is 12400 cu m. The cavern volume for all decommissioning waste is 43500 cu m.

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Kukkola, T., and L. Lamberg, Imatran Voima Oy, Helsinki, Finland; Valtion Teknillinen Tutkimuskeskus, Espoo, Finland

Present Status of Decommissioning in Finland

VTT-SYMP-87; CONF-8709383; Nuclear Waste Management, Proceedings of the Third Finnish-German Seminar, Espoo, Finland, September 23, 1987; (pp. 264-266) (1988)

In Finland no practical experience is available on the decommissioning of nuclear power plants. All the four nuclear power plants are in operation. The first unit, Loviisa 1, will be decommissioned around the year 2010. The decommissioning will be financed by the assets collected yearly during power operation of the plants. Decommissioning waste is included in the nuclear waste management policy and it will be treated as the other radioactive plant wastes in Finland.

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Kurnosov, V.A., V.M. Bagryanskij, and I.K. Moiseev

Entombment of Chernobyl Unit 4

Atomnaya Energiya 64(4):248-54; Soviet Atomic Energy (Translation) 64(4):299-306 (1988, April)

The authors discuss: (a) data required to build the shelter structure around Chernobyl Unit 4, (b) design problems, (c) construction decisions, and (d) organizational and technical measures taken.

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Kyrs, M., and A. Moravec, Ustav Jaderneho Vyzkumu CSAE, Rez, Czechoslovakia

Selected Problems of the Minimization and Processing of Radioactive Wastes Arising from Nuclear Power Plants Decommissioning

UJV-8410-CH; 12 pp. (1988, May)

Literature data is presented covering the following: (1) strategy of nuclear power plants decommissioning, (2) the amount of produced wastes and their radioactivity, (3) the problems of the relative amount of different types of wastes, (4) the classification of wastes of various origins, and (5) the specific characteristics of decontamination related to nuclear power plants decommissioning. Experience and problems presented in recent publications dealing with wastes from nuclear power plant decommissioning are summed up.

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

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

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5 (1988)

The plans and estimated costs for the first generation of utility nuclear power plants in the United States are discussed in the 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 the 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.A. are presented.

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Large, J.H., Large and Associates, London, United Kingdom

Decommissioning of Major Radioactive Installations

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 268-273) (1988)

The complex factors involved in decommissioning large scale nuclear plants are briefly reviewed adopting the now ageing Magnox nuclear power stations as examples. The UK nuclear industry has adopted a policy of deferred decommissioning, which is delaying the process of complete dismantling of radioactive components and assemblies until one hundred years, or more, following close-down of the plant. This entails considerable confidence that (1) the technology required will become available with passing time, (2) that acceptable radioactive waste disposal methods will be available, (3) that the eventual costs of decommissioning will not escalate without restraint, and (4) that future governments will be able to cope with decommissioning in a way that the public then will regard as acceptable. Perhaps it is sufficient to summarise that as far as decommissioning is concerned, the nuclear industry does not quite know how to do it, when it will be attempted and when it will be completed, and they do not know how much it will eventually cost.

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Large, J.H., Large and Associates, London, United Kingdom

Decommissioning of Major Radioactive Facilities

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited,

Bury St. Edmunds, United Kingdom; (pp. 241-245) (1988)

The decision making process involving the decommissioning of the UK graphite moderated, gas-cooled nuclear power stations is complex. There are timing, engineering, waste disposal, cost and lost generation capacity factors to consider and the overall decision of when and how to proceed with decommissioning may include political and public tolerance dimensions. These factors and dimensions are briefly reviewed with reference to the aging Magnox power stations. It is concluded that the UK nuclear industry has adopted a policy of deferred decommissioning that is delaying the process of complete dismantlement of radioactive components and assemblies for at least one hundred years following close down of the plant. In following this option, the nuclear industry has expressed considerable confidence that the technology required will become available with passing time, that acceptable radioactive waste disposal methods and facilities will be available and that the eventual costs of decommissioning will not escalate without restraint. If the UK nuclear industry is to move forward with a new generation of high temperature, gas-cooled reactors then features facilitating decommissioning need to be incorporated at the design concept and detailing stages, although such decommissioning prerequisites may not be compatible with the total containment and integrated reactor pressure vessel aspects that feature so strongly in the UK reactor design philosophy.

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Laser, M., and S. Halaszovich, Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp. (1988, July)

A major concern in the reuse of decontaminated materials is the Materials from Repair and Dismantling of Nuclear Facilities, Juelich, federal radiation levels permitted for various types of reuse, e.g. in the nuclear industry, in other types of restricted reuse, and in possible general public contact with the materials. This was discussed at length including the resulting worst case scenarios for calculation of the public maximum individual dose resulting from this reuse. Reuse programs as well as the major conclusions reached during this meeting concerning boundary radiation limits for various reuse techniques and the influence of these limits on radiation measuring techniques have been discussed in the papers. The different contributions have been prepared separately for input into the databases INIS and ENERGY.

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Laser, M., H. Mallek, W. Jablonski, F. Rosenbaum, and E. Zange, Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Incineration of Low-Level Radioactive Waste - Experience with Installation, Operation and Decommissioning of an Incineration Plant

Proceedings of the 1987 International Waste Management Conference, L.C. Oyen, A.M. Platt, R.J. Tosetti, and F. Feizollahi (eds.), Kowloon, China, November 29, 1987. American Society of Mechanical Engineers, New York, NY; (pp. 215-220) (1987)

The Juelich Incineration Plant for the combustion of low-level radioactive waste was in action operation from 1976 to 1986. During this time many changes have been made to optimize the incineration and the off-gas cleaning system. The throughput of the plant was about 80 to 100 kg/hr. The reaction was easy to control, the burn-out of ash and off-gas were very good. The very stringent requirements of the German Radiation Safety Ordinance and the Clean Air Act could be fulfilled. In 1986 the plant was decommissioned. It was possible to complete this work without incorporation of radioactivity and without spreading of contamination. A new plant is under construction.

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Late News in Brief

Nuclear News 31(13):17-18, 1078 (1988, October)

The Strontium Semi Works at the Hanford site near Richland, Washington, is being decommissioned, and recently the exhaust stack of the old demonstration facility for radionuclide separation was brought down with explosives. The works had been built in 1949 as a pilot for the Redox process, then converted in 1954 to be the pilot for the Purex process used widely thereafter in spent fuel reprocessing. In the demolition, the tree-felling technique dropped the stack into a bermed pit that had been prepared specifically for the falling structure. Purex work ended in 1956, but the Works was employed again, from 1961 to 1967, for removal of strontium from liquid waste produced by various Hanford activities. Decommissioning began in 1983 by Westinghouse Hanford Company.

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Lewis, R.E., Ontario Hydro, Rolphton, Ontario, Canada

Decommissioning of NPD Generating Station

Proceedings of the Ninth Annual Canadian Nuclear Society Conference, Winnipeg, Manitoba, Canada, June 13-15, 1988. Canadian Nuclear Society, Toronto, Ontario, Canada, 487 pp.; (pp. 194-196) (1988)

The Nuclear Power Demonstration (NPD) generating station at Rolphton, Ontario was committed in 1955 and began operating in 1962. It is owned by Atomic Energy of Canada Limited and Ontario Hydro, and operated by Ontario Hydro. It was intended to demonstrate the practicability of producing electric power with the CANDU reactor design, and to provide information for use in the design, construction, and operation of larger stations. Over its twenty-five years of operation NPD has produced a great deal of information that has contributed to the success of later CANDU stations; it is continuing to produce useful information in its decommissioning.

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Liederman, J., Atomic Energy of Canada Limited, Montreal, Quebec, Canada

Decommissioning Cost Estimates a Rational Approach, Employing a Validated Computer Code

Proceedings of the Ninth Annual Canadian Nuclear Society Conference, Winnipeg, Manitoba, Canada, June 13-15, 1988. Canadian Nuclear Society, Toronto, Ontario, Canada, 487 pp.; (pp. 202-209) (1988)

Decommissioning cost estimating is receiving an increasing amount of attention. Estimates prepared to date, as drawn from the published literature, have displayed a rather wide variability, due, in great part, to the absence of a logical rational approach to cost estimation. The author puts forward a suggested approach based on the Unit Cost Factor (UCF) method. It further suggests that computerization of the estimation process provides significant benefits and flexibility. The AECL-DECOM computer code for decommissioning cost estimation is described in the context of the recommended approach. Two case studies, the Gentilly-1 and the Nuclear Power Demonstrator Reactor decommissioning projects, are described, as are the efforts made to date to validate the code on these projects. A reasonably good correlation has been achieved and improvements have been made, based on the experience gained.

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Lingscheidt, G., and H. Bahmann

Investigation on Thermal Cutting of Concrete and Steel With Oxygen Core Lances Under Water

Schweissen Schneiden 53(12):527-530 (1979, December)

After a description of the process principle, the types of operational difficulties are depicted, which have to be solved with a view to efficient and reliable cutting of steel-reinforced concrete with the oxygen core lance under water. The method has fundamentally proved suitable. In addition, necessary developments are pointed out.

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Loeschhorn, U., Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany

Total Dismantlement of the Niederaichbach Nuclear Power Plant

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 21-24) (1988)

The Niederaichbach Nuclear Power Plant was shut down for good in 1974 and brought into the state of safe enclosure. The follow 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 concrete of the 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 building or disposed of on conventional storage areas.

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Loeschhorn, U., U. Birkhold, and W. Stasch, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany; Noell GmbH, Wuerzburg, Federal Republic of Germany; NIS Nuklear-Ingenieur Service GmbH, Hanau, Federal Republic of Germany

Decommissioning of Germany's Niederaichbach NPP

Nuclear Europe 8(10):32-33 (1988, October)

The Niederaichbach nuclear power station is ideally suited for a study of decommissioning, because it has been shut down for some time. It has also been converted into the safe enclosure condition and contains a relatively low radioactivity inventory. Disposal work begins with the "safe enclosure"

plant condition. The aim is to restore the site to original "green field" condition so as to permit use for other purposes. Thus, the decommissioning of the plant will include: dismantling and external disposal of nonradioactive (800 tons), contaminated (1700 tons) and activated (steel 500 tons, concrete 500 tons) components; demolition of all buildings; removal of roads, canals and fences; removal and dumping of refuse (approximately 130,000 tons); levelling and grassing of the area.

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Loeschhorn, U., W. Zimmermann, M. Laser, and S. Halaszovich, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Waste Management Concept for the Niederaichbach Reactor Station

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 66-91) (1988, July)

The KKN reactor station was decommissioned in 1974, and after dismantling of the contaminated components and subsequent disposal in the reactor containment, the power station was safely enclosed. The licenses required for total dismantling of the reactor were issued in 1987. The paper explains the preparatory work for dismantling, which covers categorization of the various waste materials and components (into almost nonradioactive material, reusable material, radioactive material). Other tasks explained include the extensive sampling and analyzing program, the measuring program and the relevant documentation of data. Information is given on the radiation exposure of the personnel, and on the maximum permissible radiation doses determined by the dismantling licenses, including the limits set for general, almost nonradioactive waste.

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Lough, W.T., University of Virginia, Charlottesville, VA

A Technology Assessment Methodology for Electric Utility Planning with Application to Nuclear Power Plant Decommissioning

Dissertation Abstracts International 49(11-B):5007-5372 (1987)

Electric utilities and public service commissions have not taken full advantage of the many proven methodologies and techniques available for evaluation complex technological issues. In addition, evaluations which have been performed are deficient in their use of (1) methods for evaluating public attitudes and (2) formal methods of analysis for decision making. These oversights are substantiated through an examination of the literature relevant to electric utility planning, in general, and nuclear power plant decommissioning planning, in particular. The assessment process known as "technology assessment" or "TA" is proposed and a TA model is developed for routine use in utility planning by electric utilities and state regulatory commissions. Techniques to facilitate public participation and techniques to aid decision making are integral to the proposed model and are described in detail. Criteria are provided for selecting an appropriate technique on a case-by-case basis. The TA model is applied to the problem of selecting a method for decommissioning nuclear power plants. The application includes, among others, the following activities: defining the problem and the technology, identifying impacts including public attitude impacts, and evaluating the decommissioning methods based on the impacts and public input. The TA model proved to be an effective methodology for evaluating technological issues associated with electric utility planning such as decommissioning nuclear power plants. Through the use of the nominal group technique, the attitudes of a group of residential ratepayers were successfully identified and included in the decision making process. A formal technique known as decision analysis was used to evaluate the candidate decommissioning methods. The illustration demonstrated that decision analysis could be useful to electric utilities for documenting and justifying a particular technological option to regulatory agencies and the public.

255

Lowrey, J

Cutting Torch Increases Oxy-Fuel Cutting Speeds

Fabricator 1:26-28 (1986, January-February)

A new curtain nozzle for high speed cutting with oxy-fuel torches is described. Cutting speed is a function of oxygen purity and velocity at the tip. Velocity is maximized with a convergent/divergent expansion concept. Oxygen purity is maintained by surrounding the cutting O with an O curtain. Nozzle burn-up is prevented by flowing 1 cu ft/hr O through the curtain whenever the flame is lit.

256

Luck, W., and W. Knichelmann, Transnuklear GmbH, Hanau, Federal Republic of Germany

Underwater Cutting Device

German Patent DE 3,416,620/C/; 9 pp. (1986, May 7)

An underwater cutting device for demolishing activated and contaminated components of nuclear reactor cores is described, by means of which components of different geometries and with different properties can be cut up in order to reduce their volume. It consists of a fixed and movable part, each equipped with a compression jaw and a cutting knife. Each part can be controlled via a hydraulic cylinder. In each part, the transport of the components into the cutting unit is done via rollers which are connected by a chain.

257

Lukacs, G., and J. Essmann, Deutsches Atomforum eV, Bonn, Federal Republic of Germany; NIS Nuklear-Ingenieur Service GmbH, Frankfurt am Main, Federal Republic of Germany; Preussische Elektrizitaets Aktiengesellschaft, Hannover, Federal Republic of Germany

Strategy and Experience in Shutting Down Nuclear Power Stations

Nuclear Technology '86: Technical Session on Aspects of Nuclear Power Plant Operation -

Reactor Commissioning, Operational Enhancements, Decommissioning, (Jahrestagung Kerntechnik '86), Proceedings of an German Nuclear Society Annual Meeting, Aachen, Denmark, April 8, 1986. Deutsches Atomforum e.V., Bonn, Federal Republic of Germany, 187 pp.; (pp. 164-187) (1986)

The German EVU have created a picture of the course of shutting down nuclear power plants from extensive theoretical considerations together with experience in detailed areas, and have estimated the costs involved. It is therefore possible to develop a strategy in which concrete shutting down and dismantling measures can be carried out from the present-day point of view. The state of knowledge available today is shown and the procedure planned by the EVU is explained. Finally, the costs are given on the present price base.

258

Lukacs, G., P. Petrasch, M. Laser, and S. Halaszovich, NIS Nuklear-Ingenieur Service GmbH, Hanau, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Amount of Solid Waste Emanating from Nuclear Power Plant Decommissioning as a Function of Maximum Permissible Contamination

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 51-65) (1988, July)

The paper first explains the calculation of the materials and radioactivity inventory of a nuclear power plant at the end of serviceable life; and then the effects of a change of maximum permissible activity levels. The authors use results of investigations made for the purpose of proving the feasibility of decommissioning a nuclear power plant, and for assessing the waste management requirements. The computer code STILLKO 2 has been developed within the framework of said investigations.

259

Luo, S., X. Li, and Z. Pan, Academia Sinica, Beijing, China; Institute of Atomic Energy, Ministry of Nuclear Industry, Beijing, China

Decommissioning of Nuclear Facilities - Health

CONF-8609422; Radioactive Waste Management, Proceedings of a Conference, Hunan, China, September 21, 1986. China Atomic Energy Press, Beijing, China; (pp. 106-110) (1987)

A series of problems concerning the decommissioning of nuclear facilities, such as classification, procedure, planning, technology, decommissioning wastes, radiation protection, cost and dose estimation are discussed. Some suggestions are proposed.

260

Luxmoore, R.J., Remote Marine Systems Limited, United Kingdom

Aspects of the Design of Remote Handling Equipment for Use in Decommissioning Nuclear Fuel Reprocessing Facilities

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 299-303) (1988)

Unique aspects of the design of remote handling equipment for use in nuclear fuel reprocessing facilities, including that for use during decommissioning, are discussed. Of these, those involving manipulation and sensing can have fundamental influences on the design of remote equipment and therefore, occupy the bulk of this paper. In particular, the paper examines how the manipulator design is influenced by the way in which the plant was originally configured. Also considered are the types of sensors currently used to provide the operator with information, both about the environment in which the manipulator is operating and the state of the manipulator itself, and how the use of other sensors could increase the

flow of information. The paper concludes with a short description of a particular design philosophy used during remote handling projects.

261

Machida, N., Y. Katano, and Y. Kamiya, Kumagai Gumi Corporation, Tokyo, Japan

Experimental Study for Development of Thermic Lance Cutting Method

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 193-199) (1988)

A series of experiments on thermic lance cutting methods was carried out to obtain useful data for the purpose of making practical applications of this method to the dismantling of reinforced concrete. As a first step, a performance experiment was executed to study basic cutting performance relating to oxygen consumption, extent of bar loss and cutting speed, as well as by-products generated during cutting work such as powdered dust, gas, fumes and slag. An automated and remote-controlled cutting machine was then developed utilizing an automated bar supply and ignition. The authors describe the results of these experiments.

262

MacKerron, G., Sussex University, Science Policy Research Unit, Brighton, United Kingdom

The Decommissioning of Nuclear Plant: Timing, Cost and Regulation

Energy Policy 17(2):103-8 (1989, April)

The feasibility, costs and timing of decommissioning full-scale nuclear reactors is examined in the context of the tighter environmental regulation that will inevitably grow up in this area. It is concluded that delayed decommissioning may result from waste disposal site constraints rather than conscious

intention, that taking account of the interests of future generations is unlikely to place very heavy burdens on the present generation, and that a balance of environmental considerations, mediated through regulatory and political processes, is likely to predominate in determining the future course of decommissioning decisions.

263

Malko, J.R., Utah State University, Logan, UT

Financing Nuclear Power Plant Decommissioning

Forum for Applied Research and Public Policy
2(4):5-13 (1987, Winter)

This article discusses the fact that future decommissioning of nuclear power plants will cost the nation's electric utilities billions of dollars. Most electric utilities are not likely to incur plant decommissioning costs for 15 to 20 years. Yet, due to regulatory and accounting procedures now in place, these future expenditures can pose real financial problems today. Typically, a electric utility construction project, such as building a new generating plant or stringing new transmission lines, requires available funds. Customers pay for the construction project during its useful life. Decommissioning, however, is financed in reverse. Electric utilities collect revenues now for decommissioning projects that will take place in the future. This procedure compels ratepayers who currently benefit from nuclear power to pay for the plant's future disposal. Utilities in effect become "custodians" of ratepayer-contributed decommissioning funds collected during a plant's life. Some experts believe that current plans for financing plant decommissioning fall short on two counts: (1) the money being collected will likely be insufficient and (2) because the money (as collected) can be used for other corporate purposes, it may be unavailable when needed.

264

Martyr, D.R.

Cutting and Welding Stainless Steel Using High Power CO₂ Lasers

Stainless Steel Industry 76:8 (1985, November)

The carbon dioxide laser, assisted by coaxial gas provides an efficient method for cutting stainless steel and results in low heat input, high speed and narrow kerf. Using only 400 watts of power, stainless steel 1 mm thick can be cut at speeds in excess of 4 m/min. The 1 kW power laser can cut stainless steel up to 10 mm thick. The use of lasers facilitates automation and offers speed and accuracy. A 10 kW CO₂ laser can weld stainless steel plates up to 20 mm thick in a single pass by "Keyhole" Welding. The 5KW CO₂ lasers can handle welds in plates and tubes up to 10 mm thick. Laser welding offers low heat input, minimum distortion, speed and ease of automation.

265

Masubuchi, A., and S. Hayashi, Nippon Kokan K.K., Tokyo, Japan

Decontamination Method for Contaminated Surface Capable of Utilizing Decontaminating Agents Again

Japanese Patent Application 61-294673; 3 pp.
(1988, June 22)

Purpose: To efficiently eliminate contaminants and reuse decontaminating agents used in a facility for handling radioactive materials, poisons, etc. **Method:** The surfaces contaminated are heated by IR heaters. Then, easily-melting molten material (for example, paraffins) are coated onto the surfaces by being blown from a nozzle, and the contaminated surfaces are rubbed with a brush to separate the contaminants from the contaminated surface and incorporate them into the paraffins. After cooling and solidification of the paraffins, they are stripped off by a scraper, the contaminant-containing paraffins are recovered efficiently, and decontamination of the contaminated surfaces is completed. The solidification products can be heated and melted again to separate the contaminants contained therein by filtration and paraffins, after separation of the contaminants, can be utilized again.

266

Matsui, H., Y. Ikezawa, C. Nakamura, Y. Ashikagaya, M. Oshino, and T. Numakunai, Japan Atomic Energy Research Institute, Tokai

Research Establishment, Tokai, Ibaraki, Japan;

Radiation Control Program and Exposure to Workers and the Public in the Decommissioning of the JPD/R

CONF-890401; Radiation Protection Principles in Nuclear Energy, Proceedings of an International Conference, Sydney, Australia, April 18-22, 1988. International Atomic Energy Agency, Vienna, Austria, Vol. 2; (pp. 494-522) (1988)

The decommissioning of the Japan Power Demonstration Reactor is intended for complete removal of all the installations and buildings, using various newly developed dismantling techniques. The dose rates are high: at the reactor internals and at the connection of the primary coolant pipes and the upper part of the reactor vessel - 900 R/hr and 1000 mR/hr, respectively. Remote high dose rate measuring instruments in air and under water, a respirable dust monitor, an ingress and egress control system, a contamination inspection monitor and a waste package contamination and dose rate monitor have been developed and prepared for radiation surveillance. The collective doses to workers over the whole period of decommissioning are estimated to be 1020 mancenter dotmSv of external dose and 1.5 mancenter dotmSv of internal dose. The dose to the public is estimated to be $2.3 \times 10(E-10)$ mSv by inhalation, $7.1 \times 10(E-11)$ mSv by radioactive cloud, $7.4 \times 10(E-5)$ mSv by ingestion, and $2.8 \times 10(E-5)$ mSv by skyshine and direct gamma radiation.

267

McGough, M.S., W.E. Austin, and G. Knetl, Power Cutting, Inc., Lake Bluff, IL

Performance of the Automated Cutting Equipment System During the Plasma Cutting of the TMI-2 Lower Core Support Assembly

Transactions of the American Nuclear Society 57:504-505; CONF-881024; Nuclear Fission: Fifty Years of Progress in Energy Security and TMI-2 Accident: Materials Behavior, Plant Technology and Recovery, Proceedings of the American Nuclear Society 1988 International Conference, Washington, DC, October

30-November 4, 1988; (pp. 504-505) (1988)

The lower core support assembly (LCSA) of the Three Mile Island Unit 2 (TMI-2) reactor was not structurally damaged during the accident. To permit defueling of that region of the core, the LCSA was cut to permit access. A five-axis teleoperator was developed to deliver plasma cutting, rotary grinding, and abrasive water jetting end effectors to the LCSA. Complex geometry sectioning was completed in a mockup facility at chemistry and pressure conditions simulating those of the vessel, prior to actual-in-vessel operations. In-vessel activities began in early May of 1988. The authors present the details of the in-vessel cutting efforts.

268

McIsaac, C.V., C.M. Davis, J.T. Horan, and D.G. Keefer, EG&G Idaho, Inc., Idaho Falls, ID

Results of Analyses Performed on Concrete Cores Removed from Floors and D-Ring Walls of the TMI-2 Reactor Building

GEND-INF-054; 44 pp. (1984, June)

The March 28, 1979 loss-of-coolant accident at Three Mile Island Unit 2 (TMI-2) exposed about 7200 square meters of concrete surfaces within the reactor building to liquid and vapor-phase contaminants. The majority of those surfaces are protected by coatings of epoxy-based, nuclear grade paints. During September 1983, seventeen high quality cores were extracted from the concrete floors and D-ring walls at the 305- and 347-ft elevations of the Reactor Building. The samples were subjected to a series of analyses to determine the surface concentrations of radionuclides present and to characterize their distribution in the coatings layer and sub-surface concrete. The analysis results indicate the protective coatings provided significant protection against radionuclide penetration. Radiocesium, in most cases, was found to be confined within a few millimeters of the top surface of the coatings layer. However, at floor locations having coatings that were damaged prior to the accident, radiocesium penetrated into the sub-surface concrete to a depth of several centimeters. Parametric calculations performed using the ISOSHLD-2 computer code indicate that

the decontamination of the 347-ft elevation floor will reduce the general area gamma exposure rates at this elevation by as much as 40%. The data indicate that scabbling would be an effective decontamination technique.

269

Menon, S., J. Bjerler, and R. Soderman, Studsvik Energiteknik AB, Varberg, Sweden; Swedish State Power Board, Ringhals Nuclear Power Plant, Varberg, Sweden; ASEA-ATOM, Varberg, Sweden

Ringhals 2 - Pilot Decontamination of Heat Exchanger CSAHRG-01 - Summary Report

Report: 1986-10-17; 23 pp. (1986, October 17)

A study was carried out during 1984-85 concerning the feasibility of using a chemical decontamination method developed by Studsvik Energiteknik AB for the decontamination of steam generators in pressurized water reactors. The process is based on the use of ozone (O₃) in nitric acid solution in one step followed by rinsing with weak ascorbic acid solution, all carried out at room temperature. The work was done by AB ASEA-ATOM, the Swedish State Power Board, and Studsvik Energiteknik AB under a five-party agreement between AB ASEA-ATOM, the Swedish Nuclear Power Inspectorate, the Swedish National Institute of Radiation Protection, the Swedish State Power Board, and Studsvik Energiteknik AB. The investigation concluded that the process could be used to reduce the radiation dose in connection with the replacement of the steam generators in Ringhals 2.

270

Milloy, C.J., J.C. Miles, and M.S.T. Price, Ove Arup and Partners, London, United Kingdom; United Kingdom Atomic Energy Authority, Atomic Energy Establishment, Winfrith, Dorchester, Dorset, United Kingdom

Packaging and Transport of Decommissioning Waste

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the

Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 185-191) (1988)

The paper discusses an investigation of large packages to receive, store, transport and dispose of radioactive material arising during the decommissioning of European civil nuclear reactors. The study will produce outline designs for a disposable package and a package with returnable shielding.

271

Ministry of International Trade and Industry, Agency of Industrial Science and Technology, Tokyo, Japan

Method and Apparatus for Underwater Cutting of Stainless Clad Steel

United Kingdom Patent Application 2 092 049 A (1982, August)

A method is claimed for the underwater cutting of stainless steel clad mild steel of 150-350 mm thickness, e.g. the dismantling of a nuclear pressure vessel at the end of its service life, where there is a need to contain the radioactive contamination. The stainless steel layer is gouged by an arc cutting torch at an angle of 25-70 deg and a jet of water emerges through a nozzle behind the torch to blow away the molten stainless steel. The exposed mild steel is cut by an underwater oxy-gas cutting torch. The arc torch, gas torch, and water jet nozzle are fastened together. The gouge in the stainless layer must be at least 8 mm wide for gas cutting to be effective, and this is achieved by weaving the electrode wire.

272

Molin, C., and E. Lauritzen, Statens Provvningsanstalt, Boras, Sweden

Blasting of Concrete: Localized Cutting In and Partial Demolition of Concrete Structures

SP-RAPP-1988:09; 65 pp. (1988)

The purpose of the report is to highlight the

present state of knowledge in the area of concrete blasting. Experimental and practical experience indicates that blasting with drilled-in charges is an interesting method for achieving localized cutting and partial demolition of concrete structures. For now, however, lay-on charges can be used only in special circumstances, and these lay-on charges should preferably be shaped charges. It might also be possible to use explosives for fragmentation when concrete is to be reused. Special emphasis is laid on research and development results during the last decade.

273

Montjoie, M., J.R. Costes, and F. Josso, Commissariat à l'Energie Atomique, Centre de Marcoule, Bagnols-sur-Cèze, France

Example of Power Reactor Cooling Circuit Decontamination

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp.127-130) (1988)

This paper describes the process developed to decontaminate the CO₂ cooling system of the G2 gas-cooled reactor with the objective of recycling the majority of the scrap material as conventional waste. The process is first implemented before dismantling to facilitate pipe cutup operations. If necessary, a second application is performed in a sealed cell to meet the specified objective.

274

Moore, P.E., Arcair Company, London, United Kingdom

Exothermic Cutting Electrode

United Kingdom Patent GB-2101510-A

An exothermic cutting electrode or thermic lance has an oxidizable metal tube surrounded by a mass of metal similar to that of the tube, which is retained on the tube by means such as an outer

oxidizable metallic tube and/or an electrically insulating water impervious cover. At least one end of the electrode is adapted for connection to a source of oxidizing fluid, to be supplied to the inner tube, and electric current, so that an arc can be struck between a workpiece and the free end of the electrode to initiate and maintain combustion of the free end of the electrode, producing a cutting flame. By proper selection of the type and mass of the materials of construction the electrode will burn even if the electric current is turned off. The electrode is suitable for cutting in air or water, structural materials e.g. cast iron, steel, concrete and rock.

275

Morency, K., Power Cutting, Inc., Lake Bluff, IL

Advances in Thermal-Mechanical Cutting in Support of Steam Generator Replacement

Transactions of the American Nuclear Society 46(1):92-93; Design, Construction and Operation of Nuclear Power Plants, Proceedings of a Joint ANS/ASME Conference, Portland, OR, August 5-8, 1984; (pp. 92-93) (1984)

To date, five domestic Westinghouse pressurized water reactors (Surry 1 and 2, Turkey Point 3 and 4, and Point Beach 1) have performed steam generator replacements, replacing a total of 14 steam generators. Another U.S. project is in the process. This paper discusses one of the key technological developments associated with that project, namely the destructive cutting, precision cutting, and precision heavy wall vessel and large bore pipe weld preparation necessary to accomplish field changeout of the generators.

276

Mori, M., K. Sugita, and T. Fujioka, Taisei Corporation, Technical Research Institute, Tokyo, Japan

Concrete Cutting by CO₂ Laser

PB86 221009/XAB; Taisei Technical Research Report 18:1-10 (1986)

A 5 kW CO₂ laser continuously operating at 10.6 μ m has been successfully used to cut various kinds of concrete. The output power of the laser, the position of the focal spot, the speed of the laser spot on the material, the species and the pressure of the gases used to assist the cutting were changed as parameters in the experiments.

277

Mosavi, R.K.

Comparing Laser and Waterjet Cutting

Lasers Optronics 7:65-68 (1987, July)

The general attributes of laser and waterjet cutting that promote their use on the manufacturing floor are described. The market for such nonconventional cutting is discussed. The principles of laser cutting are described. CO₂, Nd:YAG systems and their applications are compared. The basic elements of the waterjet system are diagramed and discussed. Capital and operational costs, cutting speeds and qualitative operational factors are compared.

278

Nakamura, H., T. Kanao, M. Ichikawa, S. Suzuki, T. Hasegawa, and F.H. Wittmann, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan; Shimizu Construction Company Limited, Tokyo, Japan

Cutting Robot for Activated Concrete Wall

CONF-870812; Structural Mechanics in Reactor Technology, Proceedings of an International Conference, Lausanne, Switzerland, August 17, 1987; (pp. 609-614) (1987)

The robot-based demolition system, used in the JPDR's activated biological shield concrete, is presented.

279

Nakamura, H., T. Narazaki, H. Yasoshima, and T. Konno, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai,

Ibaraki, Japan

Remote Cutting Systems for Dismantlement of the Japan Power Demonstration Reactor Concrete Biological Shield

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 223-228) (1988)

The decommissioning program of the Japan Power Demonstration Reactor (JPDR) is under way. For the purpose of dismantling the biological shield of JPDR safely without increasing the radiation exposures to workers, two remote cutting systems, namely, a diamond sawing and coring and an abrasive-waterjet, have been developed. These systems are to be applied to the highly-activated region of the biological shield. The features of these systems and the dismantling procedures by these systems are described in this paper including the fundamental test results used for the system design.

280

Napier, B.A., G.F. Piepel, W.E. Kennedy, and R.G. Schreckhise, Pacific Northwest Laboratory, Richland, WA

A Manual for Applying the Allowable Residual Contamination Level Method for Decommissioning Facilities on the Hanford Site

PNL-6348; 161 pp. (1988, August)

This report describes the modifications that have been made to enhance the original Allowable Residual Contamination Level (ARCL) method to make it more applicable to site-specific analyses. This version considers the mixture of radionuclides present at the time of site characterization, the elapsed time after decommissioning when exposure to people could occur, and includes a calculation of the upper confidence limit of the potential dose based on sampling statistics that are developed during the site characterization efforts. The upper confidence limit of potential exposure can now be used for comparison against applicable radiation

dose limits (i.e. 25 mrem/yr at Hanford). The level of confidence can be selected by the user. A wide range of exposure scenarios were evaluated; the rationale used to select the most limiting scenarios is explained. The radiation dose factors used for the inhalation and ingestion pathways were also updated to correspond with the radiation dosimetry methods utilized in the International Commission of Radiological Protection Publications 26 and 30. This simplifies the calculations, since "effective whole body" doses are now calculated, and also brings the dosimetry methods used in the ARCL method in conformance with the rationale used by DOE in developing the 25 mrem/yr limit at Hanford.

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National Institute for Occupational Safety and Health, Cincinnati, OH

National Institute for Occupational Safety and Health - Criteria for a Recommended Standard: Welding, Brazing, and Thermal Cutting

DHHS/PUB/NIOSH-88-110; 248 pp. (1988, April)

The document examines occupational health risks associated with welding, brazing, and thermal cutting, and provides criteria for eliminating or minimizing risks encountered by workers in these occupations. The main health concerns are increased risks of lung cancer and acute or chronic respiratory disease. Data in the document indicate that welders have a 40 percent increase in risk of developing lung cancer as a result of their work experience. The basis for the excess risk is difficult to determine because of uncertainties about smoking habits, possible interactions among the various components of welding emissions, and possible exposures to other occupational carcinogens. Excesses in morbidity and mortality among welders exist even when reported exposures are below current OSHA permissible exposures limits for the many individual components of welding emissions. An exposure limit for total welding emissions cannot be established because the composition of welding fumes and gases vary. NIOSH recommends that exposures to all welding emissions be reduced to the lowest feasible concentration using state-of-the-art engineering controls and work practices. Exposure limits for

individual chemical or physical agents are to be considered upper boundaries of exposure.

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National Institute for Occupational Safety and Health, Cincinnati, OH

NIOSH (National Institute for Occupational Safety and Health) Criteria for a Recommended Standard: Welding, Brazing, and Thermal Cutting - Abridged Edition

DHHS/PUB/NIOSH-88-110A; 68 pp. (1988, August)

This document examines the occupational health risks associated with welding, brazing, and thermal cutting, and it provides criteria for eliminating or minimizing the risks encountered by workers in these occupations. The main health concerns are increased risks of lung cancer and acute or chronic respiratory disease. An exposure limit for total welding emissions cannot be established because the composition of welding fumes and gases varies for different welding processes and because the various components of a welding emission may interact to produce adverse health effects. NIOSH therefore recommends that exposures to all welding emissions be reduced to the lowest feasible concentrations using state-of-the-art engineering controls and work practices. Exposure limits for individual chemical or physical agents are to be considered upper boundaries of exposure.

283

Neider, R., R. Goertz, M.K. Mueller, D. Kuchida, and E. Wirth, Bundesanstalt fuer Materialforschung und -pruefung, Berlin, Federal Republic of Germany; Brenk Systemplanung Ingenieurbuero fuer Wissenschaftlich-Technischen Umweltschutz, Aachen, Federal Republic of Germany; Bundesgesundheitsamt, Institut fuer Strahlenhygiene, Neuherberg, Federal Republic of Germany

Criteria and Conditions for the Unrestricted Release of Materials from Decommissioned Nuclear Facilities

CONF-880401; Radiation Protection Principles in Nuclear Energy, Proceedings of an International Conference, Sydney, Australia, April 18-22, 1988. International Atomic Energy Agency, Vienna, Austria, Vol. 2; (pp. 285-294) (1988)

In the course of the maintenance, refurbishment, and decommissioning of nuclear facilities such as nuclear power plants and nuclear fuel processing and reprocessing installations, large amounts of material with very low-level specific or surface activities arise. These may be handled either as conventional wastes, reused and recycled conventionally, or treated as radioactive wastes. In any case, it is necessary to define criteria which make it possible to discriminate between the two options. One main objective of the policy followed in the Federal Republic of Germany is the recycling of these materials within the nuclear field. The advantage of this alternative is the limitation of distribution of radioactive materials in the general environment. However, even for this strategy it is necessary to establish limits for the specific and surface activities below which materials can be reused, recycled, and disposed of without further regulatory control. Two studies were performed on the derivation of release limits for the activity of materials to be recycled or to be disposed of as conventional waste in a municipal landfill or an incineration plant. For the recycle option a new method of calculating these limits is described that permits the assessment of the radiological consequences of recycling low-level radioactive material by means of a statistical model that takes into account the wide variety of possible recycling pathways. On this basis the distribution of individual doses to members of the general public is calculated. The second study investigated the conditions under which municipal waste is disposed of in the Federal Republic of Germany and which exposure pathways have to be taken into consideration when calculating potential doses to members of the general public due to the disposal of very low-level radioactive wastes. An exposure limit of 10 m Sv/a was chosen.

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Neider, R., M. Laser, and S. Halaszovich, Bundesanstalt fuer Materialpruefung, Berlin, Federal Republic of Germany;

Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Radiological Principles To Be Applied for Harmless Recycling and Reuse of Low-Level Radioactive Steel and Iron Scrap from Nuclear Power Plant: A Recommendation of the SSK

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp.33-50) (1988, July)

The recommendation presented here has been worked out over several years by the SSK (Strahlenschutzkommission) and an SSK sub-committee on 'Radiological protection with regard to radioactive scrap and other residual materials'. The recommendation is concerned with: (a) Unconditional release for reuse; (b) radiation limits for scrap accepted for unrestricted reuse; (c) radiation limits for restricted reuse of scrap. The recommendation explains the criteria and limits defined.

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Neupert, D., M. Kaemmerling, W. Luck, M. Laser, and S. Halaszovich, Transnuklear GmbH, Hanau, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Dismantling of Large-Size Components and Preparation for Harmless Recycling

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 161-167) (1988, July)

The tasks are illustrated by the example of a steam dryer unit from the Wuergrass reactor. The paper explains the required disassembly work for this large component prior to decontamination (thermal cutting by oxygen core tools) in a specific room.

286

Neusen, K.F., P.K. Rohatgi, C. Vaidyanathan, and D. Alberts, University of Wisconsin, Madison, WI

Abrasive Waterjet Cutting of Metal Matrix Composites

Proceedings of the Fourth U.S. Water Jet Conference, Berkeley, CA, August 26-28, 1987. American Society of Mechanical Engineers, New York, NY (1987)

An experimental investigation was conducted to determine the abrasive waterjet cutting characteristics of metal matrix composites. A variety of composites including solidification processed Al-SiC and magnesium-based composites were studied. The cut surfaces were examined under an optical and scanning electron microscope to illustrate the nature of the surfaces generated and to understand the mechanism of waterjet cutting of metal matrix composites. The effects of volume percentage of hard phase and its distribution on cutting performance were also determined. To assess the effects of abrasive waterjet cutting parameters on cutting performance, a range of conditions was used to cut each material. Water pressure at the nozzle was varied from 172-310 MPa (25 000-45 000 psi). The jet traverse speed, which was controlled by a robotic positioner, was varied from approx 12.7-254 mm/min (0.5-10.0 in./min) so as to produce acceptable surface quality. Abrasive feed rates varied from 0.23-1.1 kg/min (0.5-2.5 lb/min).

287

NRC Calls for Assurance of Decommissioning Funds

Nuclear News 31(14):33 (1988, November)

The Nuclear Regulatory Commission (NRC) has told the owners of the Seabrook Nuclear Plant that they must provide a financial plan demonstrating how they would pay for decommissioning. The provision of such a plan is a prerequisite for the issuance of a low-power operating license for this plant. The NRC decision, which came on September 22 by a 4 to 0 vote, calls on Seabrook owners to provide, before low-power operations, the reasonable assurance that they can pay the

decommissioning costs. The implication of the order is that the plant ultimately may never be licensed for full-power operation.

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Nuclear Power Demonstration (NPD) Nuclear Generating Station Decommissioning

Licensing Overview Document; NEA Cooperative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects, Proceedings of the Fifth Meeting, Paris, France, February 23-24, 1988; (5 pp.) (1988)

This document gives an overview of the decommissioning plan for the Nuclear Power Demonstration (NPD) Station at Rolphton, Ontario, Canada. Decommissioning of NPD will follow the general concepts and principles established for the Gentilly-1 station, and followed for the Douglas Point station. Briefly, this entails putting the station into a "static state", followed by a dormancy period of 30 years or more before ultimate disposal.

289

Robotic Demolition Worker

OEM Design 8810:13

The World's first nuclear reactor decommissioning robot, developed by Taylor Hitec, UK, is described. Working under remote control, with 7 degrees of freedom, it operates an oxypropane cutting tool with metal powder injection.

290

Polowski, S., and J.M. Gandolfo, Commission of the European Communities, Directorate-General for Science, Research, and Development, Brussels, Belgium

The Community's Research and Development Program on Radioactive Waste Management and Storage - Shared Cost Action Annual Progress Report 1986

EUR-11089; 389 pp. (1988)

This is the first Annual Progress Report of the European Community's 1985-1989 program of research on radioactive waste management and disposal, carried out by public organizations and private firms in the community under cost-sharing contracts with the Commission of the European Communities. The program is aiming at perfecting and demonstrating a system for managing the radioactive waste produced by the nuclear industry, insuring, at the various stages, the best possible protection of man and the environment.

291

Parent, M.

Robotics and Nuclear Dismantlement

Revue de l' Energie 38(395):439-440 (1987, September)

The dismantling of nuclear power plants which are not in use will develop in the coming years and will have to use the latest technologies in robotics. In particular, TAO technologies (tele-separation assisted by computers) will be indispensable to solve the safety and productivity problems which will arise.

292

Park, H.H., W.Z. Oh, H.J. Won, H.P. Kim, C.H. Jung, S.Y. Park, J.B. Shin, C.H. Cho, and W.K. Choi, Korea Advanced Energy Research Institute, Daeduk, Republic of Korea

Decontamination and Decommissioning Technology Development of Nuclear Facilities

KAERI/RR-705/87; 510 pp. (1988, April)

The present project consists of three parts. In part I, dilute chemical decontamination processes developed up to date in foreign countries were reviewed and a recent trend was analysed. Decontamination for an entire primary coolant system of PHWR is in the stage of commercialization and that of BWR is expected to be commercialized within the next 2 years. On the other hand, recent applications of decontamination technology to PWR have been limited to the steam generator channel

head. But considering vital R&D activities, it is expected that decontamination for an entire primary coolant system of PWR will be commercialized in the near future. In part II, the effects of the application sequence of the KAERI decontamination process on oxide dissolution and on material integrity were examined on a laboratory scale. A procedure for the demonstration of the KAERI decontamination process in a steam generator channel head on a pilot scale was documented. The KAERI decontamination process was effective in dissolving oxide and assured material integrity, and a performance of KAERI decontamination equipments was qualified. In 1988, it is scheduled to complete the demonstration of a complete KAERI decontamination process with both simulated and in situ hot specimens. In part III, the status of decommissioning technology of nuclear facilities developed in foreign countries was reviewed. Although decommissioning projects are usually under the control of government, decommissioning technology is in a beginning state of commercial application. To decommission a domestic nuclear facility with effectiveness, the following are necessary: (1) establishment of decommissioning regulation and technical criteria, (2) development of decommissioning computer codes, (3) early introduction of decommissioning concepts to the stage of design and construction, and (4) development of remote handling technology.

293

Parrish, A.L.

Replacing the Steam Generators at Surrey Unit 2

Nuclear Engineering International 25(299):21-28

Details are given of the work involved in replacement of troublesome steam generators in a U.S. nuclear power plant. Topics covered include: reasons for replacing rather than retubing the steam generators; planning the operation; reactor shutdown; decontamination of work areas; removal of the old steam generators, including use of plasma and flame cutting; installation of the new steam generators, including MMA (SMA) welding; TIG and submerged arc welding of coolant pipes; problems experienced; and post-installation work.

294

Pasqualetti, M..

Decommissioning as a Neglected Element in Nuclear Power Plant Siting Policy in the US and UK

Nuclear Power in Crisis: Politics and Planning for the Nuclear State, Nichols Publishing Co., NY and Croom Helm, London & Sydney, 1987, Chapter 9; (pp. 196-216) (1987)

Attention given to nuclear power by environmentalists has for years focused on the hazards and other impacts of the middle, or operational, phase of the nuclear fuel cycle. The neglect of back-end considerations began to appear when waste disposal needs grew more pressing. Now that first-generation nuclear power stations are nearing the end of their operational lives, decommissioning is emerging as another back-end issue not fully anticipated or assessed. The matter of decommissioning is beginning to pose difficulties largely because the full life cycle of power plants was not considered when initial nuclear planning was taking place; it was simply accepted on faith that any future problems could be solved. This approach has failed because it is essentially asocial. As we have seen in the opposition to waste disposal schemes, the public is not willing simply to accept the analysis, conclusions or decisions of the nuclear industry. Decommissioning planning is now taking shape in a similar fashion. This chapter has shown that siting, decommissioning, and land use are related issues. It has also demonstrated that none of the relationships between these issues contributed substantively to siting decisions, although their influence could be significant. Indeed, it would be sensible to make decommissioning a mandatory siting consideration, statutorily enforced as an element in choosing future nuclear sites. It should also be a factor in any normal environmental impact evaluation.

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Pattantyus, P., Ontario Hydro, Rolphton, Ontario, Canada

Decommissioning of NPD from an AECL Perspective

Proceedings of the Ninth Annual Canadian

Nuclear Society Conference, Winnipeg, Manitoba, Canada, June 13-15, 1988. Canadian Nuclear Society, Toronto, Ontario, Canada, 487 pp.; (pp. 196-201) (1988)

Following shutdown of NPD, AECL assumed its obligations to decommission the nuclear portion of the NPD facility. The present NPD decommissioning program calls for preparing the site for an interim storage period. The intention is to place the plant into a hazard-free state so that it can be monitored remotely from CRNL located 40 km east of NPD, with only occasional on-site inspection by CRNL staff. To this effect all irradiated reactor fuel and heavy water will be transported to CRNL. The author highlights the history of NPD and describes in detail the planning and implementation of the ongoing decommissioning activities at the NPD site with particular emphasis on the nuclear portion of the facility.

296

Peach, M.J., and R.L. Skelton, Davy McKee Nuclear Limited, Stockton-on-Tees, United Kingdom

Chemical Decontamination for Decommissioning

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 151-157) (1988)

The use of chemical decontamination techniques in nuclear plant decommissioning is discussed with a view to finding the best processes for the purpose. Most early attempts at chemical decontamination for decommissioning paid little regard to the problems of waste disposal. This paper reviews the available processes from the point of view of minimizing total detriment. By the use of a very simple form of attribute analysis it is shown that some of the more sophisticated decontamination processes originally developed for in-service decontamination could well also be the best for decommissioning decontamination.

297

Pengelly, M.G.A., and R.C. Burnett, United Kingdom Atomic Energy Authority, Atomic Energy Establishment, Materials Technology Division, Winfrith, Dorchester, Dorset, United Kingdom

Proposed Development Program for a Temporary Containment System for Alpha Active Decommissioning

AAEW-M-2239; PCMRP-83-14; 14 pp. (1983, June)

This report makes a proposal to design, develop and test a containment of modular construction under plutonium active conditions. While this proposal contemplates work with plutonium, the system, when fully developed, has obvious applications wherever a temporary containment of radioactive or toxic materials is required. The fundamental feature of the proposal is that strippable coatings are used to prevent the inner surfaces of the working area from becoming contaminated. It is envisaged that this method of protecting the surfaces will enable the modular containment structure to be disassembled and re-used.

298

Perrott, E.H., and J.R. Wakefield, United Kingdom Atomic Energy Authority, Northern Research Laboratories, Windscale, Seascale, United Kingdom

Development Program for the Decommissioning of the Windscale Advanced Gas-Cooled Reactor

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 201-207) (1988)

The Major Items in the UKAEA Windscale Advanced Gas-Cooled Reactor (WAGR) Decommissioning Development Program are discussed. The Areas covered include plant

radioactivity assessment (both for operator safety and waste management), dismantling techniques, remote manipulation and viewing requirements, and filtration and decontamination techniques.

299

Pettersson, S., O. Johansson, I. Persson, and L. Gustavsson, Swedish State Power Board, Ringhals Nuclear Power Plant, Varberg, Sweden; Swedish State Power Board, Maintenance Department, Ringhals Nuclear Power Plant, Vargerg, Sweden

Decontamination Facilities at Ringhals Nuclear Power 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, 2193 pp.; (pp. 1523-1530) (1987, July)

With four nuclear units on one site, Vattenfall (Swedish State Power Board) considered it very important to have an effective workshop and decontamination facility at Ringhals Nuclear Power Plant. The decontamination facility is installed in the central active workshop, which was completed and put into use in mid-1983. This document describes the decontamination plant in the active workshop. It also describes design and operating experiences of installed decontamination equipment and systems.

300

Pickering, C.A., H. Der Hagopian, and V.N. Evdokimoff, Boston University Medical Center, Radiation Protection Office, Boston, MA

Health Physics Activities in the Dismantling of a Radioactive Incinerator

Health Physics 56(3):373-375 (1989, March)

Protection was provided to incinerator workers during dismantling of an incinerator used for the disposal of radioactive animal carcasses. The incinerator workers received no external exposure or I-125 in their thyroids. The incinerator was

found to be only mildly contaminated despite continuous use over 25 years. The time required by radiation safety was five full days plus considerable time planning this event. A member of the radiation safety staff was present when the incinerator was being dismantled to maintain control for incinerator workers, equipment and refractory as they crossed between restricted and unrestricted zones. Significant time was spent surveying the incinerator refractory piece by piece for exposure/contamination potential as it was removed from the incinerator. After 5 days, the incinerator was sufficiently dismantled to the foundation to be rebuilt. The remaining structure was determined, by direct reading with survey instruments and wipe testing, to be free of contamination.

301

Pollock, C., Worldwatch Institute, Washington, DC

Decommissioning: An Unresolved Problem

Forum for Applied Research and Public Policy 2(4):23-30 (1987, Winter)

This article discusses how to safely and economically decommission nuclear reactors. Engineers are attempting to lengthen the life expectancy of reactors, but economical operation may not be feasible for longer than 30 years. It is thought that by the turn of the century, nuclear decommissioning may be the largest expense facing the utility industry, a task that the 26 countries relying on nuclear power are not prepared to undertake. The oldest commercial reactors are nearing the end of their useful lives, and some plants have closed prematurely because of accidents or faulty designs. Decommissioning reactors is a subject that is receiving much less attention than it deserves. It is a fact that public health and safety and utility financial solvency demand accelerated research on and financial planning for decommissioning.

302

Price, M.S.T., United Kingdom Atomic Energy Authority, Atomic Energy Establishment, Materials Technology Division, Winfrith,

Dorchester, Dorset, United Kingdom

Large Transport Packages for Decommissioning Waste: Semi-Annual Report for Period January 1 through June 30, 1988

AAEW-M-2527; 47 pp. (1988, August)

This document reports progress on a study of large transport packages for decommissioning waste and is the semiannual report for the period January 1-June 30, 1988. The main tasks performed during the period related to the assembly of package design criteria ie those aspects of manufacture, handling, storage, transport and disposal which impose constraints on design. This work was synthesized into a design specification for packages which formed the conclusion of that task and was the entry into the final task - the development of package design concepts. The design specifications, which concentrated on the Industrial Package category of the IAEA Transport Regulations, has been interpreted for the two main concepts (a) a self-shielded package disposed of in its entirety and (b) a package with returnable shielding. Preliminary information has been prepared on the cost of providing the package as well as transport to a repository and disposal. There is considerable uncertainty about the cost of disposal and variations of over a factor of 10 are possible. Under these circumstances there is merit in choosing a design concept which is relatively insensitive to disposal cost variations. The initial results indicate that on these grounds the package with returnable shielding is preferred.

303

Prolonged Obsequies of Nuclear Power

Modern Power Systems 8(11):49-53 (1988, November)

The nuclear industry is having to decide what to do with reactors which have reached the end of their service life. The initial decommissioning, removal of fuel and coolant after final shutdown, can then be followed by stage 2 where buildings outside the biological shield are demolished. The current debate is whether or not to follow this with stage 3 decommissioning, the complete removal of the radioactive core and containment to leave a greenfield site. Present consensus is in favor of

postponement for a century or so of this phase, leaving the radioactivity to decay to levels where removal will be less costly. Removal only transfers the radioactivity to high-level waste repository. The experience in various countries in Europe is described and the need to cooperate was stressed. In Europe the robots, remote tools etc necessary for core dismantling are being developed. In France experience of dismantling a plutonium metal facility and a slag processing plant is mentioned. In the UK work to decommission the Windscale Advanced Gas-Cooled Reactor is reported. In West Germany seven reactors are being decommissioned, or there are plans to do so, and the experiences are described. The progress in the U.S. of the decommissioning of the Shippingport pressurized water reactor is described.

304

Rankin, W.N., Savannah River Plant, Aiken, SC

Decontamination and Coating of Lead

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 5, 324 pp.; (pp. 1529-1540) (1988, October 3)

Technology is being developed to decontaminate lead used in shielding applications in contaminated environments for recycle as shielding. Technology is also being developed to coat either decontaminated lead or new lead before it is used in contaminated environments. The surface of the coating is expected to be much more easier to decontaminate than the original lead surface. If contamination becomes severely embedded in the coating and cannot be removed, it can be easily cut with a knife and removed from the lead. The used coating can be disposed of as radioactive (not hazardous) waste. The lead can then be recoated for further use as a shielding material.

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Rankin, W.N., S.P. Bush, C.E. Lyon, and V. Walker, Savannah River Laboratory, Aiken, SC; University of Tennessee, Knoxville, TN; North Carolina Agricultural and Technical State University, Greensboro, NC

Decontamination and Coating of Lead

CONF-8808396; DOE Low-Level Waste Management, Session IV: Waste Treatment and Minimization, Proceedings of the Tenth Annual Conference, Denver, CO, August 30-September 1, 1988, 119 pp.; (pp. 71-84) (1988, December)

Technology is being developed to decontaminate and recycle lead used in shielding applications and to coat either decontaminated lead or new lead before it is used in contaminated environments. The surface of the coating is expected to be much easier to decontaminate than the original lead surface. If contamination becomes severely embedded in the coating and cannot be removed, it can be easily cut with a knife and removed from the lead. The used coating can be disposed of as radioactive waste. The lead can then be recoated for further use as a shielding material. Conclusions from lab-scale tests pointed to polyurethane rubber as a good coating because it has sufficient resistance to irradiation and enough strength to withstand normal handling of the pieces of lead.

306

Rantanen, J., and L. Lamberg, Valtion Teknillinen Tutkimuskeskus, Otaniemi, Finland; Reaktorilaboratorio Valtion Teknillinen Tutkimuskeskus, Espoo, Finland

Decommissioning of Nuclear Facilities - R and D Activities in Finland: A Computer Code for Modelling Transport of Radionuclides in the Primary System of a PWR Nuclear Power Plant

VTT-SYMP-87; CONF-8709383; Nuclear Waste Management, Proceedings of the Third Finnish-German Seminar, Espoo, Finland, September 23, 1987; (pp. 267-278) (1988)

A computer model simulating transport and accumulation of activated corrosion products in the primary system of a pressurized water reactor is described. Some test results are presented and proposed future use of the code is reviewed shortly.

307

Regan, J.D., National Nuclear Corporation

Limited, Knutsford, United Kingdom

Decommissioning of Nuclear Stations

Nuclear Europe 8(10):39 (1988, October)

At the design stage of the nuclear power station it has become necessary, in many countries, to submit a decommissioning proposal. This provides the designer with the opportunity to examine the design approach, and influence the project in a manner which will ease the task of decommissioning the station after 50 to 100 years. Rapid advance of technology over the past 50 years has led to the development of nuclear power stations. It is not unreasonable to expect that, in the next 50 years, remote handling techniques will be developed to the extent that dismantling of the same stations will not be hazardous to the demolition team or the general public. It is clear that decommissioning of nuclear facilities will provide the nuclear demolition industry with an opportunity to develop profitable enterprises in the not too distant future.

308

Remote Plasma Cutting Used on TMI Core

Modern Power Systems 8(11):31-33 (1988, November)

To accomplish a major part of the final phase of defueling the damaged Three Mile Island Unit 2 reactor, GPU Nuclear have developed a computerized, remotely operated plasma arc system. The lower core support assembly consists of five structural plates. The top plate is the lower grid top rib assembly and the bottom plate is the elliptical flow distributor head. Plasma arc is the only technique considered to be capable of cutting the LCSA in a reasonable time. The oxidation resistance of stainless steel precludes the use of the alternative oxyfuel gas cutter.

309

Rittscher, D., H. Geiser, and F. Klockner, Gesellschaft fuer Nuklearservice, Essen, Federal Republic of Germany; Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany

Investigation and Determination of Safety and

Health Physics Specifications for Packaging and Conditioning of Decommissioning Wastes

INIS-mf-11753; 157 pp. (1987, September)

This report analyzes the impact of the new International Atomic Energy Agency recommendations on future transports of radioactive materials in waste containers intended for final storage in the Konrad facility. Through the application of the new transport regulations to the Konrad containers, the major portion of the transports can be made in standardized industrial packaging. The transition area for the use of Type B casks is described. Also, safety and health physics aspects were examined by computer and/or by experiment. For this, loading and conditioning experiments were performed with full-scale standardized Type V containers. The loading of containers was tested with steel scrap, rubble, and bulky materials in drums. The feasibility of filling in the hollow spaces in containers, even with loose rubble, was demonstrated. For this purpose, filler material with special flow characteristics was selected and tested. Post-test examinations of the containers showed that the hollow spaces had been practically completely filled in the tests. The health physics aspects of the large-scale packaging of radioactive waste from decommissioning are considered, and tips for the future application of this technique are given.

310

Robertson, D.E., and C.W. Thomas, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC; Pacific Northwest Laboratory, Richland, WA

Radionuclide Source Term Measurements for Power Reactor Decommissioning Assessment

NUREG/CP-0091 (Vol. 6); Water Reactor Safety, Volume 6 - Decontamination and Decommissioning, Accident Management, TMI-2, Weiss, A.J. (comp.), Proceedings of the U.S. Nuclear Regulatory Commission 15th Information Meeting, Gaithersburg, MD, October 26, 1987; (pp. 67-88) (1988, February)

Studies are in progress to characterize the residual radionuclide concentrations, distribution, and

inventories in materials and components from nuclear power reactors at the time of decommissioning. These studies are providing essential information for assessing the radiological safety, technology, waste disposal, and environmental assurance associated with commercial reactor decommissioning. The decommissioning of Shippingport Station provides the first opportunity, following the establishment of NRC rules on commercial decommissioning and waste disposal, to characterize and assess the residual radiological conditions during the actual decommissioning of a nuclear power station. Preliminary measurements have indicated that the residual activation product concentrations in primary loop systems at Shippingport Station are, on the average, 5 to 50 times lower than observed at commercial stations. In addition, no significant concentrations of fission products and transuranic radionuclides are present in the residual radioactive materials. Studies are also in progress to assess the problem associated with decommissioning and disposal of highly neutron activated components from within commercial reactor pressure vessels and spent fuel assembly hardware. This assessment is being accomplished through a sampling and analysis program which examines neutron activation of pressure vessel steel, stainless steel, Inconel and Zircaloy components of fuel assembly hardware. This assessment will include a comparison of empirical activation product measurements with predicted levels using established codes to evaluate the accuracy and identify any shortcoming in the predictive calculation methodology.

311

Roze, B., J.C. Costa, and H. Chevillard, Compagnie Generale des Matieres Nucleaires (COGEMA), Centre de Marcoule, Bagnols-sur-Ceze, France

Dismantling the Traveling Crane of the Vitrification Plant of Marcoule

RECOD '87; Nuclear Fuel Reprocessing and Waste Management, Proceedings of an International Conference, Paris, France, August 24, 1987. Societe Francaise d'Energie Nucleaire (SFEN), Paris, France, Vol. 1; (pp. 231-244) (1987)

The operation for the replacement of contaminated handling material in a plant for vitrification of fission products from a reprocessing plant is described.

312

Sanderford, P.R., Tennessee Valley Authority, Knoxville, TN

A Case In Point: TVA

Forum for Applied Research and Public Policy 2(4):20-22 (1987, Winter)

The Tennessee Valley Authority's (TVA) approach to decommissioning nuclear power plants has evolved from nonsegregated internal funding to segregated internal funding. The evolution occurred as TVA became more financially conservative in its desire to ensure that adequate long-term funding is available to cover the costs of decommissioning. Brown's Ferry, TVA's first nuclear power plant, began commercial operations in the mid-1970s. By the end of 1984, TVA had cancelled construction of eight nuclear units, representing an investment of \$4.6 billion. The financial stress resulting from construction cancellations and heightened concern for the future financial viability of the power system led TVA financial planners to refocus their efforts on lowering the risks of future financial shocks (such as might occur if the agency faced the prospects of borrowing large amounts of capital for expensive decommissioning projects). In this new financial environment, TVA concluded that it should not rely on the issuance of revenue bonds to finance decommissioning. The agency decided that a funded reserve would allow it to maintain interest coverage at a lower level than would otherwise be necessary.

313

Sappok, M., M. Laser, and S. Halaszovich, Siempelkamp Giesserei GmbH und Company, Krefeld, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Experience So Far in the Melting of Large Amounts of Radioactive Scrap

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 207-245) (1988, July)

The author describes the development and application of a method for the melting of scrap consisting of removed components from decommissioned nuclear facilities. The melting process under partial vacuum and the three-stage filtering system are explained, together with the regulatory aspects such as licensing procedure, radiological protection, and documentation of radiological measurements. With the melting method and equipment, more than 1,000 tonnes of material have been recovered so far, which were used to produce shielding slabs or doors and containers for nuclear use. Examples of practical efficiency are presented.

314

Sasamoto, N., T. Sukegawa, H. Kotegawa, M. Shibamoto, and H. Ezure, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Radioactive Inventory Calculation for JPDR To Be Dismantled

CONF-870405; Theory and Practice in Radiation Protection and Shielding, Proceedings of a Topical Conference, Knoxville, TN, April 21-22, 1987. American Nuclear Society, La Grange Park, IL (1987)

The Japan Atomic Energy Research Institute has been conducting the decommissioning program of the Japan Power Demonstration Reactor (JPDR) since 1981. It is essential for planning the dismantlement of JPDR to estimate the radioactive inventory involved in the reactor accurately. For this purpose, a code system DOIC (Discrete Ordinates Inventory Calculation Code) has been developed and its validity is verified by analyzing measured radioactivities in the reactor pressure vessel, its internals and biological shield of JPDR. The calculation with DOIC is found to predict radioactivity fairly well in the reactor internals and pressure vessel. The calculated value in the

biological shield, however, is overestimated as compared with the measured one by a factor of 2 to 3 at the core midplane. The radioactive inventory of JPDR due to neutron activation is estimated to be 1.7×10^{14} Bq (4600 Ci) as of March 1986 based on the calculations and measurements.

315

Saunders, D.H., and R.E.P. Barton

The Use of Fan-Shaped Water Jets in Preference to Straight Jets to Remove a Paint Coating

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

Traditionally, straight water jets have been used for cutting operations, and fan-shaped jets to clean large surface areas. A major reason for this is the difficulty of obtaining consistent surface coverage when using straight jets in hand-held equipment. Recent advances in manipulating systems, including rotating nozzle carriers, have enabled wide band coverage to be reliably obtained with straight water jets. These systems are now being used for cleaning and surface preparation. Although it may be a general rule that straight jets manipulated in this way are more effective cleaning tools than fan-shaped jets, this paper presents situations where fan-shaped jets definitely provide a faster removal rate for a surface coating. The relationships are explored between paint removal performance and operating parameters such as pressure, nozzle size, fan angle, standoff distance and traverse speed, and it is illustrated how these parameters can be combined to predict the cleaning performance in complex nozzle manifold systems.

316

Savannah River Laboratory, Aiken, SC

Cutting Machine and Examination Facility - Cells 9

CAPE-1165

A remotely operated machine was designed for use in Cell 9 of the Metallography Facility for cutting

specimens of radioactive materials for metallographic examinations and chemical studies. Either an abrasive or diamond wheel may be used for cutting specimens of various sizes and shapes ranging from a 0.5-in. cube to a 3.5 X 3.5 X 35 in. bar. The materials are cut underwater in a box to contain the radioactive waste. The cell also contains an ultrasonic cleaner, centrifuge, and scrubber.

317

Scholz, L., Ifo-Institut fuer Wirtschaftsforschung eV, Projektgruppe Energie, Rohstoffe, Technologie, Muenchen, Federal Republic of Germany

Is It Economically Justifiable to Decide on Nuclear Power Phaseout?

VIK Mitteilungen 5:105-111 (1988, October 26)

The author critically comments on the various expert opinions describing and assessing the economic and other impacts of a nuclear power phaseout. One of his conclusions is that the complexity of the problems involved may lead astray in the public controversy about the nuclear issue, inducing irrational speculations on the one hand, and blue-eyed hopes on the other. This may lead to the dangerous situation that speculations or arbitrary information may be clad with the cloak of (unjustified) assumptions made to look like scientific information.

318

Schulz, W., M. Laser, and S. Halaszovich, Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

**Decontamination of Components of Parts Removed from Nuclear Installations
Dekontamination**

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 199-206) (1988, July)

The paper summarizes the methods applied in the Juelich Nuclear Research Center for decontamination of metallic components removed from nuclear facilities, and discusses the problems encountered by means of selected practical examples also referring to the radiological measuring methods.

319

Schumann, S., H.U. Freund, K. Hollenberg, W. Horning, and H.J. Esser, Battelle-Institut eV, Frankfurt am Main, Federal Republic of Germany

Investigation of the Development and Optimization of Cutting Loads for the Cutting of Steel Pipes with Typical Properties and Material Properties for Nuclear Power Stations

INIS-mf-11649; 48 pp. (1987, April)

The aim of the project was to develop a type of cutter loading for the cutting of thick walled steel pipes by an explosive technique which, due to its construction and cutting performance, 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 (e.g. octagon) around pipes of different diameters. A steel pipe with dimensions 610 mm diameter X 36 mm wall thickness (live steam pipe in a German BWR of a new type) was completely and accurately cut using a cutting load sleeve with 1.84 kg of explosive. The great tamping of the cutting loader type developed, minimizes the quantity of explosive required and reduces the air shock or blast wave peak pressure to 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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Sepold, G., and R. Rothe

Laser Beam Cutting of Thick Steel

ICALEO '83, Materials Processing, Proceedings

of a Conference, Los Angeles, CA, November 14-17, 1983. Laser Institute of America, Toledo, OH, Vol. 38 (1984)

Since commercial lasers of up to 10 kW have been available it is possible to cut thicker plates by the following three techniques: oxy-laser cutting, laser-sublimation cutting and laser-melt-cutting. The commonly used one is the oxy-laser cutting-technique. Here the kerf mainly results from burning the kerf material. The laser beam essentially serves the purpose of heating the kerf zone up to ignition temperature whereas the oxygen jet burns the material and blows off the slag. The exothermic reaction heat provides a high fraction of the total process power. Therefore it is possible to cut steel plates greater than 30 mm thick with a 5 kW laser. Experiments had been carried out cutting mild steel and austenitic Cr-Ni steel. The cutting set-up and some results are shown. The results are discussed and compared with the results of conventional oxy-flame cutting.

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Severa, J., and J. Knajfl, Vojenska Lekarska Akademie J.E. Purkyne, Hradec Kralove, Czechoslovakia

Use of Foams for Decontamination of Building Parts of a Nuclear Power Plant

Jaderna Energie 34(10):380-382 (1988, October)

Seven types of foam used for surface decontamination were tested on some buildings of the A-1 nuclear power plant in Jaslovske Bohunice. The compositions are listed of the agents and the procedures of their preparation and application are described. Briefly discussed are some results of the experiments. The experiments were found to show the suitability of the foams in decontamination of building parts of the decommissioned plant. The efficacy of decontamination depended on the composition of foaming agents, the time of action and the method of final treatment of the decontaminated surface. It also significantly depended on the character of the contaminant-surface binding. Surfaces contaminated with radionuclide aerosols could completely be cleaned.

322

Shimizu, Y., Kyoto University, Research Reactor Institute, Osaka, Japan

Flexible Solution of Linear Program with an Application to Decommissioning Planning of Nuclear Reactor

Annual Report of the Research Reactor Institute, Kyoto University, Japan 21:170-175 (1988)

The author shows how to apply a methodology development in order to obtain the flexible solution of a linear program. He provides a simple example associated with nuclear reactor decommissioning.

323

Short, S.M., Pacific Northwest Laboratory, Richland, WA

Procedure for Estimating Facility Decommissioning Costs for Non-Fuel-Cycle Nuclear Facilities

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 2, 329 pp.; (pp. 539-550) (1988, October 3)

This paper reports on a procedure to estimate the costs of decontaminating and/or decommissioning laboratory-type facilities. The Nuclear Regulatory Commission (NRC) staff has been reappraising its regulatory position relative to the decommissioning of nuclear facilities over the last several years. Approximately 30 reports covering the technology, safety, and costs of decommissioning reference nuclear facilities have been published during this period in support of this effort. One of these reports, "Technology, Safety, and Costs of Decommissioning Reference Non-Fuel-Cycle Nuclear Facilities" (NUREG/CR-1754), was published in 1981 and was felt by the NRC staff to be outdated. The Pacific Northwest Laboratory (PNL) was asked by the NRC staff to revise the information provided in this report to reflect the latest information on decommissioning technology and costs and publish the results as an addendum to the previous report. During the course of this

study, the NRC staff also asked that PNL provide a simplified procedure for estimating decommissioning costs of non-fuel-cycle nuclear facilities. The purpose being to provide NRC staff with the means to easily generate their own estimate of decommissioning costs for a given facility for comparison against a licensee's submittal. This report presents the procedure developed for use by NRC staff.

324

Siegel, J.J., Engineering and Economics Research, Inc., Reston, VA.

Utility Financial Stability and the Availability of Funds for Decommissioning: An Analysis of Internal and External Funding

NUREG/CR-3899; 41 pp. (1988, June)

The NRC is currently developing final rules in the area of decommissioning nuclear facilities. A part of that rulemaking effort is assuring that funds will be available at the time of decommissioning of power reactors. Previous NRC reports, including NUREG/CR-3899, published September, 1984, have examined the issue by studying various funding methods. The report provides an update by considering public comments received on the NRC's proposed rule on decommissioning (published February, 1985) and by analyzing the relative level of assurance of internal and external reserves. In its analysis, the report makes use of specific case utility financial situations. The report concludes that from a financial standpoint, with the exception of PSNH, internal reserves currently provide sufficient assurance of funds for decommissioning. The report also concludes that the NRC should recommend changes in bankruptcy laws, including decommissioning obligations in utility prospectuses, and conduct periodic financial reviews of nuclear utilities due to changing economic conditions.

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Siemens AG, Unternehmensbereich KWU, Erlangen, Federal Republic of Germany

Laboratory Scale Melt Experiments with Am-241, Fe-55 and Co-60 Traced Austenitic

Steel Scrap

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988; (pp. 859-864) (1988)

During the lifetime of nuclear facilities such as NPPs, fuel enrichment plants, fuel fabrication plants, and reprocessing plants, some components are decommissioned. The scrap from NPPs is contaminated by beta- and gamma-emitters, mainly with corrosion product radionuclides. The large-scale meltdown of these components for re-use in nuclear facilities is studied. The authors present results of studies of radionuclides in the melt and slag.

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Skupinski, E., and B. Huber, Commission of the European Communities, Brussels, Belgium

The European Community's Research Program on the Decommissioning of Nuclear Installations

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5 (1988)

The Commission of the European Communities (CEC) continues implementing a second research program on the decommissioning of nuclear installations (1984-1988), after having completed a first program on the decommissioning of nuclear power plants (1979-1983). The program includes the development and testing of advanced techniques for decommissioning activities such as decontamination and dismantling of redundant installations and the consideration of the radioactive waste arising from them. An important part of the available funding is devoted to industrial scale applications of new technologies and procedures. An overview is given on the motivations of the CEC for such programs and on the technical content of the second program.

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Smith, M.D., Bechtel Eastern Power Corporation, Three Mile Island Nuclear Station, Middletown, PA

Use of Deep-Bed Filtration Technology in the Cleanup of Three Mile Island Unit 2

Transactions of the American Nuclear Society 57:528; CONF-881024; Nuclear Fission: Fifty Years of Progress in Energy Security and TMI-2 Accident: Materials Behavior, Plant Technology and Recovery, Proceedings of the American Nuclear Society 1988 International Conference, Washington, DC, October 30-November 4, 1988; (p. 528) (1988)

The deep-bed testing program at TMI was designed to determine the merits of deep-bed filtration technology as it applies to the TMI water clarity problems. This testing program had three distinct phases. The first phase consisted of small-scale filtration tests using demineralized water to establish a benchmark for throughput versus pressure values, which were necessary for subsequent testing in phase 2. Phase 2 consisted of small-scale testing using actual reactor coolant system (RCS) water. These tests determined the ability of deep-bed technology to remove RCS impurities and improve visibility. Phase 3 consisted of full-scale testing using demineralized water on a defueling water cleanup system (DWCS) filter mockup to provide a scaleup factor for use in determining expected throughput for a full-sized DWCS deep-bed filter canister based on phase-2 testing results.

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Smith, P.K.J., and M.J. Eccleston, Taylor Hitec Limited, Chorley, United Kingdom

WAGR Decommissioning Manipulator

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London,

United Kingdom, 342 pp.; (pp. 320-326) (1988)

This paper summarises the design of a manipulator which is to be used to remotely decommission Windscale's Advanced Gas-Cooled Reactor. Its design follows principles established in previous manipulators produced for the CEBG. The manipulator carried various cutting tools and their design and development are also described.

329

Stang, W., Valtion Teknillinen Tutkimuskeskus, Espoo, Finland

German Experiences on Decommissioning Illustrated By the Activities at KRB A Nuclear Power Plant

VTT-SYMP-87; Nuclear Waste Management, Lamberg, L. (ed.), Proceedings of the Third Finnish-German Seminar, Espoo, Finland, September 23, 1987; (pp. 262-263) (1988)

The German electricity supply companies have investigated the most expedient way of decommissioning nuclear power plants at the end of the period of use. Two alternative scenes were proposed: (1) safe enclosure of the plant and (2) immediate total removal without safe enclosure. The study confirmed that both alternatives are technically feasible at present, but the latter case is impractical due to the absence of enclosure as required by IAEA standards. Decommissioning work is at present going on for 5 German nuclear power stations. For KRB-A decommissioning planning was initiated in 1980 and the plan was issued in 1982. Actual decommissioning work began in 1982 and has continued to the present time. Through 1985, approximately 1500 tons of contaminated materials have been removed from the turbine building. About two thirds of this mass consists of steel and other metals, and one third of concrete and other nonreusable materials. The steel has been decontaminated to release levels and sold on the scrap market. About 400 tons of concrete turbine shielding were removed, decontaminated and released for unrestricted normal disposal. The amount of radioactive waste produced by decommissioning activities in the turbine house remains below 5% of dismantled material.

330

Stang, W., M. Lasch, M. Laser, and S. Halaszovich, Kernkraftwerke Gundremmingen Betriebsgesellschaft GmbH, Gundremmingen, Federal Republic of Germany; Kernforschungsanlage Juelich GmbH, Juelich, Federal Republic of Germany

Decontamination and Other Waste Minimization Methods Applied in the Gundremmingen Reactor Station, Unit A

Juel-Conf-62; CONF-8711296; Reuse of Residual Materials from Repair and Dismantling of Nuclear Facilities, Proceedings of a Seminar, Juelich, Federal Republic of Germany, November 10, 1987, 307 pp.; (pp. 168-184) (1988, July)

Unit A of the Gundremmingen nuclear power station was shut down in 1977 after an operational incident, and after receipt of the license for decommissioning and limited dismantling, work started in 1983 with the clearing of the turbine building. A major task was management, disposal and recycling of the solid material and components removed from the controlled area. According to the atomic energy law, recycling of these materials has priority over disposal.

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Stang, W., and G.V.P. Watzel, Kernkraftwerk R W E - B a y e r n w e r k G m b H , Gundremmingen/Guenzburg, Federal Republic of Germany; Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen, Federal Republic of Germany

Recycling the Turbine Hall at Gundremmingen, Federal Republic of Germany

Nuclear Engineering International 33:408-429 (1988, July)

The demonstration BWR at Gundremmingen in the Federal Republic of Germany was shut-down in 1977, and the first stage of the decommissioning was the dismantling of the turbine house. Decontamination of the turbine building has allowed much of the material to be recycled.

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State of Dismantling of Reactor Facilities (JPDR) in Tokai Research Establishment, Japan Atomic Energy Research Institute (Fiscal Year 1986)

Genshiryoku Anzen Linkai Geppo 15:6 (1987, November)

The contents of the notice on the Japan Power Demonstration Reactor (JPDR) dismantling and the administration dismantling policy were reported to the Nuclear Safety Commission beforehand, and after approval was obtained, the work has been performed. As per the directions of the chairman of Nuclear Safety Commission on January 6, 1983, the state of dismantling is reported. In fiscal year 1986, the second stage dismantling was begun in December, and it was confirmed that the activities were being carried out safely. In order to provide the required space for dismantling and removing in-core structures and the pressure vessel, the pressure vessel upper cover and its heat insulator were removed from the third story of the containment vessel. Part of the facilities installed on the second and third stories of the containment vessel were also dismantled and removed. In order to utilize the area for the temporary preservation and decontamination of dismantled items, a part of the facilities installed in the dump condenser building was dismantled and removed. The control building was reconstructed to facilitate the entrance of workers. Thirty-six spent fuel assemblies were removed for reprocessing. The exposure dose of workers was below the detectable limit of film badges. The dismantled wastes consisted of about 171 tons of metals and 34 tons of concrete.

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Struss, R.G., Iowa State University, Ames Laboratory, Ames, IA

Decommissioning of a 5 MW Research Reactor

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 51-53) (1988)

The complete decommissioning of a research reactor is described. Planning and execution of all activities, including schedules, budgets, waste management, health physics and subcontracted operations are presented. Flexibility in operations was obtained by using the operating staff as the decommissioning progressed. Totals for waste shipments and costs are given. Final site conditions are presented along with a description of the subsequent use of the facility.

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Sugita, K., M. Mori, and T. Fujioka, Taisei Corporation, Technical Research Institute, Tokyo, Japan

Cutting Reinforced Concrete by High Power CO₂ Laser

PB88-193388/XAB; Taisei Technical Research Report 20:87-103 (1987)

A 15 kW CO₂ laser continuously operating at 10.6 micrometers was successfully used to cut various kinds of concrete. The output power of the laser, the point of focus, focal length, the speed of the laser beam on the specimen, the kind of gas, and the pressure used to assist the cutting were changed as parameters in the experiments. From the results, the authors concluded that the laser beam will be used to cut various types of concretes in the near future, though some difficulties must be overcome for the actual application.

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Suh, I.S., W.Z. Oh, D.H. Suh, B.Z. Jun, and C.H. Cho, Korea Advanced Energy Research Institute, Daeduk, Republic of Korea

Technology Development of Decontamination and Decommissioning of Nuclear Reactors

KAERI/RR-575/86; 150 pp. (1987, April)

Decontamination and decommissioning technology of nuclear reactors is in the stage of technical demonstration even in advanced countries in the nuclear field. The retired TRIGA MARK II research reactor at KAERI was selected to demonstrate the relevant technologies. The results of the study carried out this year can be

summarized with the following three parts. First, state of the art decontamination and dismantling technology, which includes: (1) Examining the methods for radionuclide inventory estimation, (2) Comparing and analyzing the methods and application: for decontamination and dismantling technologies, and (3) Examining the present status of decommissioning activities for commercial and research reactor in the world. Secondly, the study of the TRIGA reactor decommissioning plan. The decommissioning study for the retired TRIGA MARK II research reactor at KAERI has been carried out and two decommissioning plans were prepared: one is for complete dismantling and the other for conversion to museum. The radionuclide inventory and the man-rem exposures for workers were also estimated in the study by using ANISN computer code. The Korea regulations concerning decommissioning has been analyzed compared with the U.S. regulations, 10 CFR and Regulation Guide. The decommissioning cost, schedule and manpower development including organization for two alternatives were also prepared. Third, the study of decontamination for radioactively contaminated metals. Experimental works for the decontamination of the contaminated stainless steel metal were carried out. The experimental results shows that the chemical ultrasonic method gives acceptable decontamination factor of around 20 for metals.

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Suwa, T., S. Goto, T. Gorai, N. Kuribayashi, Y. Nemoto, M. Hoshi, C. Sagawa, C. Yonezawa, I. Nakahara, I. Miyazaki, H. Yasunaka, and E. Tachikawa

Development of Chemical Decontamination Process with Sulfuric Acid-Cerium (IV) for Decommissioning: Demonstration Test at JPDR Recirculation System

Journal of Atomic Energy Society 30(11):1020-1029 (1988, November)

The new decontamination process using sulfuric acid-cerium (N) solution (SC process) for reactor dismantling has been developed and demonstrated to evaluate its applicability at the recirculation system of the JPDR (A-loop). The decontamination test loop with the surface area of 42.7 sq m (contaminated area of 9.2 sq m) and

solution volume of ca. 2.3 cu m consisted of the main circulation. Ce-4+/- regeneration and waste solution treatment lines. The decontamination-step was operated with continuous electrolytic regeneration of Ce-4+ and Ce-3+ to maintain the Ce-4+ concentration in the range of 1 approximately 210(E-3) M at Ce-4+/Ce-3+ less than or equal to 0.1. The test results are summarized as followed: (1) the decontamination factors (DF) for sampling specimens after the decontamination ranged 360 approximately 1800; (2) the corrosion rate of the test loop increased linearly with a flow rate (0.55 approximately 2.6 m/s) in the presence of Ce 4+; (3) burst of scale (similar to cruds) in the early stage of the decontamination led to the decrease of Ce-4+ concentration; and (4) the desired values for a current efficiency $\eta_{\text{sub e}}$ greater than or equal to 80% at 50 A/sq m was obtained in the electrolytic regenerating cell. The results of demonstration test on the SC process indicate that a high decontamination factor can be obtained in a low Ce-4+ concentration by means of its electrolytic regeneration.

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

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

Journal of Nuclear Science and Technology 25(7):574-585 (1988)

The electrolytic regeneration of Ce-4 plus from Ce-3 plus, which is required to achieve a high decontamination factor (DF) in this process, has been investigated. A calculation model was derived for the regenerating current required during the decontamination as a function of dissolution rate of crud, corrosion rate (R/c), current efficiency (η_{e}) and characteristics of decontamination loop. From the above calculation, it was found that the current was mainly governed by R/c and η_{e} .

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Suzuki, S., Shimizu Construction Company

Limited, Tokyo, Japan

Removal of JRR-3 Biological Shield Concrete and Mock-Up Tests of Diamond Sawing and Coring Technique of JPDR Biological Shield Concrete

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 4-73 - 4-96) (1988, October)

The Japan Research Reactor No. 3 (JRR-3) of the Japan Atomic Energy Research Institute (JAERI), was removed to a storage facility between October 14 and November 7, 1986. The 2250 ton reactor block (10 m X 10 m X 10 m) removal was performed as a part of the program to replace the JRR-3's core (10-MW thermal) with an upgraded research reactor core. The heavy water and fuel elements were taken out from the JRR-3 prior to the removal work. The reactor block was separated from the main structure (reinforced concrete) of the reactor building, using the core boring method. The separation was carried out both horizontally and vertically. Horizontal core boring of approximately 210 m long was completed in 11 days. Vertical cutting by continuous core boring was approximately 820 m long. It took nearly a month to complete 259 m of core boring.

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Suzuki, S., Y. Ichihashi, C. Nakazaki, T. Nagamatsuya, H. Nakata, and H. Itami, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Underwater Plasma Arc Cutting of In-Reactor Tube of In-Pile Creep Test Facility

JAERI-M-88-199; 44 pp. (1988, October)

The in-reactor tube of the In-Pile Creep Facility had been irradiated periodically for over 6 years in the Japan Materials Testing Reactor (JMTR) up to the end of 1978 under an operating condition of high temperature and high pressure identical to that of the Prototype Advanced Thermal Reactor, FUGEN, to gain the basic data for estimating the amount of creep which would occur in the pressure tubes of FUGEN. Following the removal of the

in-reactor tube out of the JMTR, the test sections in the tube which were to be subjected to post irradiated examination were cut out. Underwater plasma arc cutting was employed to prevent the spread of contamination to the work area, to confine the heat affected zone in the test pieces to a minimum and to simplify disposal of the unneeded portions of the pressure tube.

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Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden

Costs of Nuclear Power Radioactive Waste Products

SKB-PLAN-87; 29 pp. (1987, June)

The utilities are responsible for necessary measures of safety handling and final disposal of spent nuclear fuel and radioactive waste products from Swedish nuclear reactors. The main steps are planning, construction, and running of the vital plant systems. The utilities have commissioned the Swedish Fuel and Waste Management Company (SKB) for this task. Cost estimates of all these measures are presented in this report. They are based upon a plan for handling and final disposal of the radioactive waste products, prepared by SKB and described in the report. The final disposal of the highly-active, long-lived waste products will not be started until some years after 2000, so the continued research and development might indicate new processes, influencing system formulation as well as costs. This fact is considered and leads to simplified solutions. The plants and systems in operation or in construction are: (1) transportation systems for radioactive waste products, (2) central intermediate storage of spent fuel (CLAB), and (3) final storage of reactor waste products, SFR 1. In a later step there are plans for: (1) a processing plant for spent nuclear fuel, (2) final storage of long life waste products, and (3) final storage of demolition waste products. The cost estimations include costs for research and development and for liquidation and demolition of the plants. The total future costs for the Swedish waste system from 1988 and on are estimated to SEK 39.5 X 10(E+9) in price level January 1987. The costs will fall due for 60 years. Per December 1987, SEK 6.1 X 10(E+9) in current price level were spent.

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Tachikawa, E., H. Yasunaka, T. Suwa, T. Gorai, and M. Kawasaki, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Research and Development on LWR System Decontamination: Mechanochemical and Redox-Decontamination Methods

CONF-8804174; Water Chemistry in Nuclear Power Plants - Operational Experience and New Technologies for Management, Proceedings of the 1988 JAIF International Conference, Ibaraki, Japan, April 19-22, 1988. Japan Atomic Industrial Forum, Tokyo, Japan, Vol. 2, 819 pp.; (pp. 443-448) (1988)

Decontamination prior to reactor dismantling must satisfy several requirements, which differ somewhat from those for decontamination of nuclear facilities under operation. At JAERI efforts have been paid to develop decontamination for dismantling, as part of the JPDR-decommissioning project activity, with emphasis on that the method provides a high DF for any kind of crud, and that the waste solution resulting from decontamination can easily be treated. Two decontamination methods have been developed, a mechanochemical method and a redox method, and successfully applied for the part of the primary system of JPDR. The former is based on the synergistic effect of mechanical and chemical cleanings, while the latter on the strong oxidizing power of Ce(IV) and its regeneration.

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Takimoto, Y., K. Sakota, N. Hamamoto, K. Harada, and K.M. Edwards, Babcock Hitachi K.K., Tokyo, Japan

Method of Cutting Radioactivated Metal Structures

Japanese Patent 60-39,597/A; 4 pp. (1985, March 1)

A device is described which will improve metal cutting performance to a level that is comparable to cutting in air, as well as reducing the scattering of the radioactive materials when cutting to that level

in water-cutting. After igniting a gas-cutting torch automatically, water spray by the local water sprayer is started by the actuation of a submerged pump, while a gas-cutting manipulator is operated to cut the nuclear reactor pressure vessel. In this way, cutting exhaust gases resulting from the gas-cutting torch are water-washed by the spray from the local water sprayer and fall within the nuclear reactor pressure vessel in the form of water streams or droplets along the inner wall surface. Water is then fed again to the local water sprayer by the submerged pump.

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Tanaka, M., S. Yanagihara, M. Ishikawa, and M. Kawasaki, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Japan Power Demonstration Reactor Decommissioning Program

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 25-31) (1988)

In consideration of future decommissioning of commercial power reactors, the Japan Power Demonstration Reactor (JPDR) Decommissioning Program has been conducted since 1981 by the Japan Atomic Energy Research Institute (JAERI). Technologies necessary for the reactor dismantling were developed in the first stage of the program. These were remote control cutting techniques to dismantle activated and/or contaminated components. These techniques will be applied to the physical dismantlement of JPDR in the second stage of the program. A wide variety of data will be collected through the JPDR decommissioning program for future commercial power reactor dismantlement.

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Tanguy, Pierre, Electricite de France, Paris,

France

Dismantling of Nuclear Power Plants Which Are Not in Use

Revue de l' Energie 38(395):429-438 (1987, September)

At the end of its life span, a nuclear power plant contains big quantities of radioactive products. The corresponding risks must be controlled and over the long range, all radioactivity must be definitively removed. The latter operation is called dismantling. In France, at the beginning of 1987, five nuclear units which were permanently put out of use have to be dismantled. These units are presented in this article. From this presentation, it can be seen that there are now techniques which provide for complete control of the risks corresponding to radioactivity. However, in France, as in the rest of the world, the dismantling of nuclear plants will not attain its full industrial level until the 21st Century. The problems which have to be solved are known, but better performing technologies have to be developed in order to obtain a superior protection of dismantling work crews and a reduction of costs. This article concludes with an appeal for high French interest in international activities in this field.

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Tarasov, V.M.

Nuclear Facility Decommissioning in the USA

Energeticheskoe Stroitel'stvoza Rubezhom 2:21-24 (1988, April)

The main problems of nuclear facility decommissioning are analyzed based on experience accumulated in the U.S. during recent 30 years. By 1980 111 reactors have been decommissioned, among them 69 facilities (52 research and 17 power reactors) were in the U.S. The American Elk-River reactor was the only in the world completely demounted power reactor (besides the Otto Hahn reactor). The conclusion is made on the absence of rather precise assessments of expenditures for reactor decommissioning and of existence of different view points and approaches to fund formation for implementation of such works.

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Tarasov, V.M.

Nuclear Facility Decommissioning in France

Energeticheskoe Stroitel'stvoza Rubezhom 4(3):4-6 (1988, June)

This report considers the approaches to solving the problem of decommissioning various types of nuclear power objects in France. The main efforts are directed to the development of the general rules (recommendations) for work organization. Also developed are criteria for evaluating both quality of means and instrumentation for dismantling equipment and structures and efficiency of their application. Great attention is paid to the problem of aging units which are used as protection barriers. There is interest as well in determining how long a reactor will hold up before its final dismantling.

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Tarasov, V.M.

Solving the Problem of NPP Decommissioning in the Great Britain

Energokhoziaistvo za Rubezhom 6:5-8 (1987, November-December)

The main stages of activities on decommissioning and dismantling of the WAGR reactor are considered. The WAGR plant with advanced gas-cooled and graphite moderated reactor was constructed in 1957-61 as a prototype for the Magnox-type reactors. The plant operated during 1963-61, and then the first stage of the WAGR decommissioning began. The key point of the reactor decommissioning plan is radioactive waste removal. The conclusion is that the achieved progress in technology has brought about safe and highly-effective decommissioning of reactor plants within the full dismantling scenario. All doubts concerning solvability of the dismantling problem will be removed when the WAGR reactor decommissioning plan is realized.

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The Cutting of Corrosion Resisting and Stainless Steels

Southern Africa Stainless Steel Development Association Industry Compendium, 1986/1987 (1987)

Recommended procedures are given for the cutting of corrosion resisting and stainless steels. In the area of mechanical cutting, consideration is given to sawing, shearing, blanking, perforating, piercing, nibbling, friction cutting, and abrasive cutting. Powder cutting, arc cutting, and plasma cutting are the three thermal cutting techniques discussed. A brief outline is also given of two new technology methods, laser cutting and water-jet cutting.

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The Water Jet Makes Strides - Cutting by Water: A Technology for the Future

Dyna JA 63(1):12-14 (1988, March)

The simple water jet cutting technique based on a water pressure up to 4500 kg/sq cm and up to three times the speed of sound also eliminates tool resharpener and reduces dust, noise, heating, and deformation of the work. Plastics, graphite, epoxy resin, glass fiber, Ti, steel, Al, etc. and also composites, can be cut cleanly with robot and data processing based control. LTV Aircraft Products Group employs a 3.8 l/min, greater than 4000 atmospheres pump controlled by a microcomputer, for cutting of Ti and steel, with better results than when using traditional cutters.

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Thomas, P.J., T. Boorman, and A.R. Gregory, United Kingdom Atomic Energy Authority, Northern Research Laboratories, Windscale, Seascale, United Kingdom; Central Electricity Generating Board, Barnwood, United Kingdom

Decommissioning the Windscale Advanced Gas-Cooled Reactor: A Demonstration Project for UK Reactors Construction Division

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 1-10)

(1988)

A description is given of the project to decommission to Stage 3 the Windscale Advanced Gas-Cooled Reactor, which is being carried out by the UKAEA with the support and participation of the UK Generating Boards. The engineering program and progress to date are detailed.

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Thomas, S., Sussex University, Science Policy Research Unit, Brighton, United Kingdom

Nuclear Operating Costs Are Rising Exponentially

OPEC Bulletin 19(6):49-51 (1988, August)

This paper, published fully in Financial Times Energy Economist of May 1988 and presented here in a summary, is based on: the decisions of EDF in France and CEBG in Great Britain to retire their older gas-cooled and Magnox reactors; and the DOE/EIA-0511 document "An Analysis of Nuclear Power Plant Operating Costs" by J. Hewlett. The argument is that due to the fast technical progress in nuclear reactor design and growing regulatory requirements (e.g. those resulting from the TMI accident) it is more economical to dismantle the older power reactors before the end of their design life.

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Thompson, G., K. Lee, and H. Crossley, University of Manchester, Department of Mechanical Engineering, Manchester, United Kingdom

Windscale Advanced Gas-Cooled Reactor Core Restraint Band Removal

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 55-62) (1988)

Examines the problem of removing the Windscale

Advanced Gas-Cooled Reactor core restraint bands during decommissioning. A brief description of a restraint band and the basis of its design is given followed by an analysis of the dimensional changes in the graphite core since the restraint bands were first installed. An estimate is made of the present condition of the structure. Methods of disassembly are reviewed, including flame cutting and mechanical techniques. The hazards and operational difficulties of each method, and the behavior of the restraint band when dismantled, are considered. The recommended method is discussed in some detail.

353

Thompson, G., K. Lee, and J.R. Wakefield

Design Problems in Reactor Decommissioning

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 292-298) (1988)

Two examples are used from the decommissioning program of the Windscale Advanced Gas-Cooled Reactor to illustrate the kinds of design problems encountered and the approaches to their solution. The examples are: removal of the core restraint bands and removal of insulation from the exterior of the pressure vessel. The first case consists of careful investigation and analysis to predict the present state of the core and restraint bands before removal methods can be considered. There is much uncertainty involved in the design process to find the best method. In contrast, the condition of the vessel insulation is known to a high degree of certainty, as are most of the design constraints to this problem. The paper will discuss the work so far undertaken on the restraint band problem and the design methods to be employed to determine a suitable technique for removing the insulation.

354

Till, J.E., and R.E. Moore, Savannah River Plant, Aiken, SC

DECOM: A Pathway Analysis Approach for Determining Acceptable Levels of Contamination of Radionuclides in Soil

CORR-86-0403; 22 pp. (1986, February 28)

The purpose of this report is to describe a method for determining acceptable levels for decontamination of soil containing radionuclides at waste sites located on the Savannah River Plant. This task was achieved through development of a computer program called "DECOM". The DECOM code is written in BASIC, runs on an IBM microcomputer (AT, XT, or compatible), is interactive, and calculates the annual radiation dose that an individual receives while living on property that has been decommissioned and decontaminated. User selected pathways of exposure include direct radiation from ground surface, ingestion of contaminated food, inhalation of resuspended radionuclides, and drinking contaminated water. The program requires a minimum of knowledge in radiological assessment. Although default values have been provided for most parameters, the methodology requires the user to define an acceptable effective dose equivalent that the resident can receive. Other input data required to run the code include the concentration of radionuclides in soil and some site specific parameters relating to the characteristics of the area.

355

Till, J.E., and R.E. Moore, Radiological Assessments Corporation, Neeces, SC

A Pathway Analysis Approach for Determining Acceptable Levels of Contamination of Radionuclides in Soil

Health Physics 55(3):541-548 (1988, September)

A methodology for determining acceptable levels for decontamination of soil containing radionuclides at waste sites is described. This methodology calculates the annual radiation dose that an individual receives while living on property that has been decommissioned and decontaminated. Pathways of exposure include direct radiation from ground surfaces, ingestion of contaminated food, inhalation of resuspended radionuclides and drinking contaminated water. Results calculated

using this methodology were compared with U.S. Department of Energy (DOE) guidelines for a southeastern U.S. site. There is good agreement between the two methods provided similar assumptions are used.

356

Titzler, P.A., and C.R. Allen, Hanford Engineering Development Laboratory, Richland, WA

Evaluation of Glovebox Sectioning Using Weld Splitting Techniques

HEDL-SA-3547-FP; 14 pp. (1986, November 16)

A weld splitting method is being evaluated for sectioning austenitic stainless steel components. Testing consists of sectioning simulated stainless steel gloveboxes into disposable pieces to determine the acceptability of using dissimilar metal weld splitting methods. The activities are being performed for the Savannah River Laboratory by Westinghouse Hanford Company (WHC) in Richland, Washington.

357

Toda, M., T. Kinoshita, N. Funakawa, and H. Idemura, Sato Kogyo Company, Limited, Tokyo, Japan

Research and Development of Removal Technique for Contaminated Concrete Surface in Nuclear Power Plant: 3 - Development and Demonstration of Clean Cut Removal System

Gijutsu Kenkyusho-ho 14:55-64 (1987)

The authors selected an original milling cutter system to remove contaminated concrete surfaces and acquired fundamental data by experimentally cutting concrete and collecting debris. The cutting device and collection device had been designed and fabricated using this data. Its safety and capability were confirmed by efficiency test (cold test) of each device in a full-size facility. The hot test was carried out in a contaminated facility. The result of these tests demonstrated that this method could remove contamination accurately and collect radioactive debris efficiently. Therefore, the

prevention of internal exposure and recontamination, the reduction of external exposure, and the minimization of waste are achieved by this method. The new method of concrete decontamination by the original milling cutter is called the "Clean Cut Removal System".

358

Turna, M., and D. Ryban, Facility of Engineering Technology, SVST TVST Trnava, Czechoslovakia

Thermal Cutting of Austenitic CrNi Steel with a CO₂ Laser

Welding International 2(7):658-663 (1988)

An experimental procedure is described and results are presented showing the effects of nozzle shape, focus position, and type of auxiliary gas (air, Ar or O₂). Maximum and optimum rates of thermal cutting at various laser beam powers and material thicknesses are plotted and compared.

359

Tutte, W.F.

The Application of Laser Cutting to Stainless Steel

Stainless Steel Industry 86:9-11 (1987, July)

Carbon dioxide gas lasers dominate the industrial material processing market. One of the main advantages of laser processing to the stainless steel processor concerns the avoidance of wear or tool maintenance costs. Short run jobs can be turned around quickly, low distortion levels and a narrow heat-affected zone can be achieved, as can cutting without scratching, while scrap can be reduced to a minimum. These and many other advantages have enhanced the popularity of the technique for metal cutting and welding systems. Laser systems offer a combination of cost saving, quality improvement and productivity increases compared with conventional methods.

360

Tymons, B.J., and A.P. Colquhoun, Atkins (W.S.) Engineering Sciences, Warrington,

United Kingdom

Health Physics Problems Associated with the Decommissioning of Unconventional Nuclear Structures

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 264-267) (1988)

In the decommissioning of unusual nuclear structures the health physics safety requirements have often been underestimated. In some cases, the structure may have ceased operation many years ago and been left alone, allowing radioactive decay. This can create problems with structural deterioration of components which are contaminated with radioactive material. The particular problems associated with the planned initial decommissioning of the Windscale Pile Chimneys are used as an example.

361

U.S. Council for Energy Awareness, Washington, DC

Completing the Task: Decommissioning Nuclear Power Plants

USCEA Brochure; 24 pp. (1988, October)

Like other electric power plants, nuclear plants must be decommissioned at the end of their economic life. This means retiring them from service while protecting the public and the environment. Over the next 20 years or so, some 35 large nuclear power plants will reach the end of their current license terms and face decommissioning. Electric utilities may recondition these plants to operate for another decade or more. Even so, eventually the plants will be decommissioned. Thanks to 25 years of experience, the technologies and procedures to decommission nuclear plants are ready now. This practical knowledge developed from retiring about 15 nuclear reactors in the U.S. that supplied electricity to consumers. Good estimates of decommissioning costs, too, are being produced by detailed

engineering studies of particular units at specific sites; funds for decommissioning are now being collected in monthly bills for electric service. Utilities and public utility commissions make sure these expenses fall fairly among customers who benefit from electricity generated by these plants.

362

U.S. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, TN

Nuclear Reactors Built, Being Built, or Planned: 1987

DOE/OSTI-8200-R51; 55 pp. (1988, June)

This document contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of December 31, 1987. The Office of Scientific and Technical Information (OSTI), U.S. Department of Energy (DOE), gathers this information annually from Washington headquarters and field offices of DOE; from the U.S. Nuclear Regulatory Commission; from the U.S. reactor manufacturers who are the principle nuclear contractors for foreign reactor locations; from U.S. and foreign embassies; and from foreign governmental nuclear departments. The major change in this revision involves the data related to shutdown and dismantled facilities. Because this information serves substantially different purposes, it has been accumulated in a separate section, "Reactors and Facilities Shutdown or Dismantled." Cancelled reactors or reactors whose progress has been terminated at some stage before operation are included in this section. Other changes involve different formatting.

363

U.S. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, TN

Nuclear Reactors Built, Being Built, or Planned: 1988

DOE/OSTI-8200-R52; 80 pp. (1988, August)

This document contains unclassified information

about facilities built, being built, or planned in the United States for domestic use or export as of December 31, 1988. The Office of Scientific and Technical Information (OSTI), U.S. Department of Energy (DOE), gathers this information annually from Washington headquarters and field offices of DOE; from the U.S. Nuclear Regulatory Commission; from the U.S. reactor manufacturers who are the principle nuclear contractors for foreign reactor locations; from U.S. and foreign embassies; and from foreign governmental nuclear departments. The major change in this revision involves the data related to shutdown and dismantled facilities. Because this information serves substantially different purposes, it has been accumulated in a separate section, "Reactors and Facilities Shutdown or Dismantled." Cancelled reactors or reactors whose progress has been terminated at some stage before operation are included in this section. Other changes involve different formatting.

364

U.S. Nuclear Regulatory Commission, Division of Engineering, Washington, DC

Report on Waste Burial Charges: Escalation of Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities

NUREG-1307; 33 pp. (1988, July)

One of the requirements placed upon nuclear power reactor licensees by the U.S. Nuclear Regulatory Commission (NRC) is for the licensees to periodically adjust the estimate of the cost of decommissioning their plant, in dollars of the current year, as part of the process to provide reasonable assurance that adequate funds for decommissioning will be available when needed. This report, which is scheduled to be revised annually, contains the development of a formula for escalating decommissioning cost estimates that is acceptable to NRC, and contains values for the escalation of radioactive waste burial costs, by site and by year. The licensees may use the formula, the coefficients, and the burial escalation factors from this report in their escalation analysis, or may use an escalation rate at least equal to the escalation approach presented herein.

365

U.S. Nuclear Regulatory Commission, Division of Low-Level Waste Management and Decommissioning, Washington, DC

Interim Guidance on the Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, and 70

NUREG-1336; 124 pp. (1988, December)

Interim Guidance on the Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning under 10 CFR Parts 30, 40, and 70, NUREG-1336, discusses the information to be provided in a license application and established a uniform format for presenting the information required to meet the decommissioning licensing requirements. The use of the Standard Format will (1) help ensure that the license application contains the information required by the regulations, (2) aid the applicant in ensuring that the information is complete, (3) help persons reading the Standard Format to locate information, and (4) contribute to shortening the time required for the review process. The Standard Format and Content (NUREG-1336) ensures that the information required to perform the review is provided, and in a useable format.

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U.S. Nuclear Regulatory Commission, Division of Low-Level Waste Management and Decommissioning, Washington, DC

Interim Guidance on the Standard Review Plan for the Review of Financial Assurance Mechanisms for Decommissioning Under 10 CFR Parts 30, 40, and 70

NUREG-1337; 34 pp. (1988, December)

Interim Guidance on the Standard Review Plan (SRP) for the Review of Financial Assurance Mechanisms for Decommissioning under 10 CFR Parts 30, 40, and 70 is prepared for the guidance of Nuclear Regulatory Commission staff reviewers in performing reviews of applications from material licensees affected by the decommissioning regulations established June 27, 1988 (53FR24018).

The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a base from which to evaluate the financial assurance aspects of the applications. NUREG-1337, identifies who performs the review, the matters that are reviewed, the basis of the review, how the review is performed, and the conclusions that are sought.

367

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

Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident, Three-Mile Island Nuclear Station, Unit 2, Pennsylvania

EIS-86-0535; 132 pp. (1986, December)

A draft of the environmental impact statement (EPA No. 860537DS-2) describes a proposal for decontaminating and disposing of radioactive wastes resulting from the Three Mile Island-2 reactor accident. The new draft reevaluates the impacts of water disposal alternatives on the basis of new and more complete information. It describes plans for disposal of large quantities of radioactive water by forced evaporation followed by on-site solidification of remaining solids and disposal in a low-level waste burial ground. The project would reduce the radiological hazard for the neighborhood and downstream communities with little risk to the public. The most significant potential impact would come from the risk of transportation accidents. There would be some economic and psychological impacts, particularly for local residents.

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

Decontamination and Disposal of Radioactive Wastes Resulting from the March 28, 1979 Accident, Three-Mile Island Nuclear Station, Unit 2, Pennsylvania

EIS-87-0242; 356 pp. (1987, June)

This report documents the implementation of

actions necessary for decontamination of the facility, defueling of the reactor, and disposition of the radioactive wastes that resulted from the accident on March 28, 1979 at Unit 2 of the Three-Mile Island Nuclear Station in Dauphin County, Pennsylvania. This second final supplement to the final environmental impact statement, filed in March 1981 on facility decontamination, reevaluates the environmental impacts of accident-generated water disposal alternatives, using more complete and current information. This supplement also includes a specific evaluation of the recently submitted proposal for water disposition. The project would alleviate a radiological hazard that threatens the well-being of the surrounding population and downstream communities. Risks to the general public have been estimated to be very small fractions of the estimated normal incidence of cancer fatalities and genetic disorders. The most significant potential impact is the risk of physical injury associated with transportation accidents. Social impacts during the operation could result in reduced property values, competition between the work force and tourists for temporary housing, and congestion of local traffic arteries. Some psychological stress would be experienced by area residents. Economic effects could include increased electricity rates, reduced tourism, and possible resistance to consumption of area goods that consumers might mistakenly think are contaminated.

369

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

Summary, Analysis, and Response to Public Comments on Proposed Amendments to 10 CFR Parts 30, 40, 50, 51, 70, and 72: Decommissioning Criteria for Nuclear Facilities

NUREG-1221; 713 pp. (1988, June)

In February, 1985, the NRC issued for public comment proposed rules on decommissioning of nuclear facilities. Comment letters were received from 143 organizations and individuals. The report provides a summary and analysis and response to the public comments received.

370

U.S. Nuclear Regulatory Commission, Washington, DC

Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities

NUREG-0586; 497 pp. (1988, August)

This final generic environmental impact statement was prepared as part of the requirement for considering changes in regulations on decommissioning of commercial nuclear facilities. Consideration is given to the decommissioning of pressurized water reactors, boiling water reactors, research and test reactors, fuel reprocessing plants (FRPs) (currently, use of FRPs in the commercial sector is not being considered), small mixed oxide fuel fabrication plants, uranium hexafluoride conversion plants, uranium fuel fabrication plants, independent spent fuel storage installations, and non-fuel-cycle facilities for handling byproduct, source and special nuclear materials. Excluded here from consideration for regulatory change, are decommissioning of low-level waste burial facilities, high-level waste repositories, and uranium mill and mill tailings piles, which are covered in separate rulemaking activities, and decommissioning of uranium mines which are not under NRC jurisdiction. Decommissioning has many positive environmental impacts such as the return of possibly valuable land to the public domain and the elimination of potential problems associated with increased numbers of radioactively contaminated facilities with a minimal use of resources. Major adverse impacts are shown to be routine occupational radiation doses and the commitment of nominally small amounts of land to radioactive waste disposal. Other impacts, including public radiation doses, are minor.

371

Valpayce, S., University of Southern Mississippi, Hattiesburg, MI

Understanding the Mechanics of Waterjet Cutting

Manufacturing Engineering 2:92-93 (1988, August)

The variables of the waterjet cutting process can be grouped on the basis of efficiency, velocity ratio, and mass ratio. The analysis presented shows the interaction among these variables as applied to the cutting of Al and steel. For a given input energy, softer materials can be cut more efficiently than harder materials, if their thicknesses are the same. Also, thicker workpieces of a given material will be more efficient than thinner ones for a given input energy.

372

Vattenfall, Ringhals Nuclear Power Plant, Varberg, Sweden

Decontamination Procedures at Ringhals Nuclear Power Plant

Progressive Marketing/Tre Punkter Gbg 1986 (Pamphlet); 18 pp. (1986)

In Sweden, when Vattenfall's central department for nuclear waste began making plans for a complete decontamination facility under one roof, the idea was entirely new. As a result of this endeavor, many new methods of decontamination using varying types of new equipment were developed in association with appropriate suppliers. New approaches have been incorporated and integrated under a one roof operation. Such decontamination equipment as the chemical decontamination unit, the washing cabin, the washing and blasting box, and freon cleaning equipment now work together in conjunction. The goal was to achieve as high a decontamination factor ($Df = \text{Radioactivity measured before decontamination} / \text{Radioactivity measured after decontamination}$) as possible.

373

Veenhuizen, S., and G.G. Yie, Joint Engineering Technology, Inc., Kent, WA

Concrete Removal with Abrasion Jet

FHWA/IS-85/221; 50 pp. (1985, February)

An abrasive waterjet system was designed and built to demonstrate the ability of this method to remove bridge deck concrete. The removal system consisted of two rotating abrasive nozzles mounted on the front of a garden tractor. A hydraulic

system was used to traverse the nozzles across the front of the tractor.

374

Vervae, D., L.H. Porter, and R.J. Dzikowski, Ocean Systems Engineering, Houston, TX

Development of an Underwater Remote Manipulator System for Use in TMI-2 Reactor Defueling

Transactions of the American Nuclear Society 57:504; CONF-881024; Nuclear Fission: Fifty Years of Progress in Energy Security and TMI-2 Accident: Materials Behavior, Plant Technology and Recovery, Proceedings of the American Nuclear Society 1988 International Conference, Washington, DC, October 30-November 4, 1988; (p. 504) (1988)

Defueling operations in the original core region of the Three Mile Island Unit 2 (TMI-2) reactor vessel were conducted with long-handled tools that were manually positioned by operators on a rotating work platform over the reactor vessel. The difficulties encountered with these operations led GPU Nuclear Corporation (GPU) to consider other means of operation when defueling the core support assembly and reactor vessel lower head, which is approximately 12 m (40 ft) below the work platform. GPU determined a 12 m (40 ft) below the work platform. GPU determined a heavy-duty remote manipulator system could be an effective alternative. The MANFRED (MANipulators For Reactor Defueling) system was thus developed for this purpose by Ocean Systems Engineering and International Submarine Engineering under contract to GPU.

375

Vieno, T., H. Nordman, K. Rasilainen, and V. Suolonen, Voimayhtiöiden Ydinjätetoimikunta, Helsinki, Finland; Valtion Teknillinen Tutkimuskeskus, Ydinvoimatekniikan Laboratory, Otaniemi, Finland

Safety Analysis of Disposal of Decommissioning Wastes from Olkiluoto

YJT-87-16; 120 pp. (1987, December)

The disposal plans for decommissioning wastes from the Olkiluoto nuclear power plant are based on co-location of the necessary repository caverns with the repository to be constructed for low- and medium-level operational reactor waste. The repository will be excavated at a depth of about 50-90 meters in the bedrock at the power plant site. The planned cavern for activated metal waste consists of a pile of concrete waste containers surrounded by thick concrete walls and a layer of low permeable buffer material. The analysis also includes safety evaluation of an alternative disposal concept for activated metal waste: a deep bedrock repository assumed to be co-located with a planned repository for spent nuclear fuel. The obtained results of the analysis show clear safety margins. In the realistic scenario for intermediate depth (75 m) disposal the maximum annual dose rate is $3 \times 10(E-12)$ Sv/a via the local sea pathways, $8 \times 10(E-9)$ Sv/a via the lake pathways and $2 \times 10(E-5)$ Sv/a via a well bored in the vicinity of the repository. In the basic scenario the corresponding dose rates are $4 \times 10(E-10)$ Sv/a (sea), $5 \times 10(E-7)$ Sv/a (lake) and $4 \times 10(E-5)$ Sv/a (well). For disposal of low-level decommissioning wastes two alternatives have been compared: concrete silos and rock silos, both at a depth of about 60-90 meters in the bedrock at the power plant site. The consequent doses are rather low in both cases. Final optimization of the engineered barriers necessitates more precise data about the activity contents of the wastes to be disposed of at these silos.

376

Vitiello, T., Ente Nazionale per l'Energia Elettrica, Latina, Italy

Garigliano BWR Decontamination

NEA Cooperative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects, Proceedings of the Fifth Meeting, Paris, France, February 23-24, 1988; (9 pp.) (1988)

Several decontamination and shielding operations are described that were used for the secondary steam generators bypass decontamination during the

Garigliano BWR decommissioning. Specifically, the reduction obtained at a distance of about 1 ft in front of the 24 in. outlet pipe of the recirculation pump cutting section was from 5000 mR/hr to 100 mR/hr (reduction factor equal to 50). The techniques included using a pressurized water system, lead shots for shielding, and mechanical abrasion by means of steel brushes.

377

Waite, T.H.

Cutting Irradiated and Radioactive Materials

Remote Systems Technology, Proceedings of the 29th American Nuclear Society Winter Meeting, San Francisco, CA, November 30-December 2, 1981. American Nuclear Society, La Grange Park, IL, Vol. 2.; (pp. 81-84)

A high voltage high current arc saw is described for cutting metals underwater. The arc is maintained between the rotating circular saw blade and the material being cut which is clamped to a table under 4.5 m of water. The saw gives a smooth clean kerf, and can remotely cut radioactive materials regardless of hardness. Saw wear is minimized as the blade only contacts the substrate at arc initiation.

378

Watzel, G.V.P., J. Vollradt, J. Essmann, M. Mittler, G. Lukacs, and P. Petrasch

Technology and Costs of the Decommissioning of Nuclear Power Plant at the End of Service Life

Fortschritt-Berichte der Verein Deutscher Ingenieure Zeitschriften, Reihe 15(52):96 (1987)

The report explains in detail the STILIKO model concept for the decommissioning of nuclear power plants equipped with LWR-type reactor, discussing two variants fully covered by the model. The decommissioning procedure is characterized by means of selected work schedules of interest from the technical perspective. Dismantling, treatment,

and storage or processing of the reactor components are described from the perspective of either radioactive waste treatment or materials recycling. The report shows how the various steps of decommissioning are to be weighted and classified, and how they are assessed in terms of cost. A survey is given of both general and novel technological means of decommissioning, and also of the licensing practices in West Germany.

379

Weichselgartner, H., Max-Planck-Gesellschaft zur Foerderung der Wissenschaften eV, Goettingen, Federal Republic of Germany

Process for Decontaminating the Surface of an Object

German Patent DE 3,446,931/C2/; 4 pp. (1987, January)

The process provides for the manufacture of a corrosive foil which can be pulled off. A paste or gel layer with tensides or weak organic corrosive material, a layer with an aggressive inorganic corrosive material and a third layer are applied to the surface to be decontaminated, where the third layer forms the coherent elastic foil for pulling off. The effective means of decontamination depend on the type of contamination (radioactive, chemical, or toxic).

380

Weinblatt, M.D., S. D'Elia, and T.A. Havell

Choosing Investment Strategy for Qualified Nuclear Plant Decommissioning Trusts

Public Utility Fortnightly 122(10):33-6 (1988, November 10)

The authors describe the challenge to nuclear utilities to determine the most effective investment strategies for the accumulating funds which they are now required to segregate to meet future costs of retiring, dismantling, and decontaminating existing nuclear facilities. They consider the relative benefits of specific financial instruments differing in kind and in length to maturity in the light of realistic inflation expectations to arrive at a strategy recommendation for a maximum real return on

investment.

381

West Valley Nuclear Services Company, Inc., West Valley, NY

West Valley Demonstration Project, West Valley, New York: Annual Report

WVDP-89AR; 46 pp. (1989, January)

Under the West Valley Demonstration Project Act, Public Law 96-368, liquid high-level radioactive waste stored at the Western New York Nuclear Services Center, West Valley, New York, that resulted from spent nuclear fuel reprocessing operations conducted between 1966 and 1972, is to be solidified in borosilicate glass and transported to a federal repository for geologic disposal. A major milestone was reached in May 1988 when the Project began reducing the volume of the liquid high-level waste. By the end of 1988, approximately 15 percent of the initial inventory had been processed into two waste streams. The decontaminated low-level liquid waste is being solidified in cement. The high-level waste stream is being stored in an underground tank pending its incorporation into borosilicate glass. Four tests of the waste glass melter system were completed. These tests confirmed equipment operability, control system reliability, and provided samples of waste glass for durability testing. In mid-1988, the Department validated an integrated cost and schedule plan for activities required to complete the production of the waste borosilicate glass. Design of the radioactive Vitrification Facility continued.

382

White, D.A., Imperial College of Science and Technology, Department of Chemical Engineering and Chemical Technology, London, United Kingdom

Development of Reagents for the Decontamination of Stainless Steel Plant Scrap by Bulk Dissolution

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference,

London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 111-116) (1988)

In this paper the development of chemical reagents which are capable of leaching 316 stainless steel components is discussed. Tests were carried out using small pellets of stainless steel that were dissolved in a variety of reagents. We have identified that mixtures of HCl and hydroxylammonium hydrochloride are very suitable for this application. The rates of corrosion with agitation and moderate (60 C) temperatures are very rapid. Surface erosion by dissolution of 0.5 cm in a day has been achieved. The corrosion process in NH₃-OHCl-HCl mixtures is smooth, pitting is reduced, and the corrosion products are soluble in HCl. One litre of leach solution can hold 38 gms of 316 stainless steel in solution and cathodic protection would allow the process plant to be made out of stainless steel. Applications of the method for the bulk decontamination of large radioactive pieces of scrap plant are discussed.

383

Whyte, I.L., Institution of Civil Engineers, London, United Kingdom; Manchester University, Institute of Science and Technology, Manchester, United Kingdom; National Economic Development Office, London, United Kingdom

Towards a More Professional Demolition and Dismantling Industry, London, United Kingdom

CONF-8803180; Decommissioning - 1988: Decommissioning Offshore, Onshore and Nuclear Works, Whyte, I.L. (ed.), Proceedings of the First International Conference, Manchester, United Kingdom, March 22-24, 1988. Thomas Telford Limited, London, United Kingdom, 342 pp.; (pp. 1-7) (1988)

The work of the National Economic Development Office Demolition and Dismantling Group in four areas which are crucial to the economic performance of the demolition and dismantling industry and its safety record is considered. The first concerns the availability and accessibility of information about unconventional structures and

details are given of the sort of information often kept for different types of structure. Secondly, the need is stressed for guidelines for the client, particularly on the risks involved and the choice of a competent contractor. Thirdly, basic credentials which it is important for contractors to set out in order to establish a good reputation for the industry are set out. Finally, the particular case of nuclear power station decommissioning is considered with reference to the size of the market, the pioneering knowledge to be gained from the decommissioning of the Windscale Advanced Gas-Cooled Reactor, private sector involvement and the special techniques required.

384

Wightman, D.F., Ingersoll-Rand Company, Phillipsburg, NJ

What Is New in Waterjet/Hydroabrasive Cutting?

Fabricator 5:18-19 (1988, July-August)

A brief history of the development of hydroabrasive/waterjet cutting is given, and the equipment is shown schematically. Hydroabrasive machining has three advantages: little or no secondary machining, little material waste, and the low pressure exerted reduces the need for heavy fixturing. Before investing in equipment, it is suggested that parts be cut at a job shop to prove the feasibility of the process for the equipment, and then check the costs, field support, and water quality which can be critical to the successful operation of the unit. The systems offer alternatives to gas or plasma cutting, laser cutting, or a punch press. The cutting of Ti airframe components is presented as an example.

385

Wille, H., and H.O. Bertholdt, Siemens AG, Erlangen, Federal Republic of Germany

Decontamination of Systems and Components for Decommissioning

CONF-881008; Decommissioning of Major Radioactive Facilities, Proceedings of the Eighth IMechE International Conference,

London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 145-149) (1988)

For the decontamination of complete systems the CORD process is applied. This process is a 'soft', low chemical concentration (similar to 2000 ppm/cycle), multicycle decontamination process. It can be performed with a mobile external system or, for complete primary loop decontamination, with the systems of the nuclear power plant itself. The amount of waste can be reduced considerably if the decontamination solution is evaporated. Actual decontamination tasks resulted in activity level reductions of 6 to 8 in the compartments of the systems, associated with local decontamination factors (DFs) of similar to 20 or more. A severe problem is the decontamination for unrestricted release of dismantled components and material. A demonstration in decontamination was carried out with recirculation piping sections, which were replaced in 1985 in a BWR. About 15 tons of piping and valves were decontaminated from an initial contact dose rate of similar to 30000 mu/Sv/hr to 1 to 2 mu/Sv/hr in a combined chemical and electrochemical treatment by CORD and ELPO decontamination processes. This enabled the requirements of ICRP for unrestricted release to be easily met.

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Wille, H., and H.O. Bertholdt, Siemens AG, Erlangen, Federal Republic of Germany

Chemical Decontamination of Components and Systems

Nuclear Europe 8(10):41-42 (1988, October)

Chemical decontamination is becoming more and more important within the framework of procedural development for inspection and repair of nuclear power plants. To meet ALARA requirements, increasing dose rates of older plants make decontamination to reduce occupational radiation exposure more essential. Steadily increasing attention is therefore being given to decontaminating plant components or, better still, entire systems and loops. Furthermore, decontamination of a whole system or of a complete primary loop is sometimes easier to

perform than cleaning of a single component. Since Siemens offers several decontamination processes, there is always a single process or a combination of processes available to meet the specific requirements of a decontamination task. For chemical decontamination of a complete system it is obvious that the process to be applied should be 'soft', i.e. low concentration. Use of a high chemical concentration 'hard' process would lead to too large amounts of waste. Due to problems and costs associated with waste handling for the decontamination of dismantled components, soft decontamination processes have now also been developed and applied.

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

Guidelines for Estimating Nuclear Power Plant Decommissioning Costs

Cost Engineering 31(4):20-7 (1989, April)

Recently proposed NRC rules amendments contain provisions that would require utilities to demonstrate that adequate funds are available to safely decommission their nuclear plants at the end of their useful life. The guidelines are intended to assist utilities in preparing cost estimates for a site-specific study to meet the intent of the proposed rules amendments. This article describes the guidelines by providing a logical sequence of steps that the estimator may follow to develop a site-specific decommissioning cost estimate using the developed guidance. The guidelines identify the work to be performed during each of the cost estimate development activities. They also provide a description of the required information to accomplish each activity and the decisions to be made that will affect the overall results of the estimate.

388

Willie, H., and H.O. Bertholdt, Kraftwerk Union AG, Erlangen, Federal Republic of Germany

System Decontamination With CORD and Decontamination for Unrestricted Release

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5 (1988)

The Kraftwerk Union AG (KWU) method, used in the Federal Republic of Germany (FRG), applies the chemical oxidation reduction decon (CORD) process for the decontamination of systems. This is a low (approximately 2000 ppm per cycle) concentration soft process. It is performed with only two essential chemicals and without the need for an intermediate purification step, or a change of the decontamination liquid. In a single operation, the CORD process was used in a boiling water reactor to decontaminate the sealing water supply system for the internal axial flow pumps. The automated mobile decontamination appliance was connected via special adapters which replaced the valve internals to the system. The volume including the decon equipment was similar to 12 cu m. The time requirement for the three CORD cycles including filling and heating was 48 hours, with an additional preparation time of 72 hours for system dewatering, mounting of adapters and etc. Because of the activity removal, the radiation level in the compartments of the system was reduced by a factor of 6-8. The decontamination factors (DFs) for the contact measurements on 20 predetermined components such as valves, filters, pumps, piping (up to DN 250) and a cyclone averaged 18. If some existing hot spots are disregarded, this DF would be nearly double. A serious problem in connection with NPPs is the decontamination from unrestricted release of dismantled components and material. A demonstration of the possibilities of chemical and electrochemical decontamination was done with the recirculation piping sections, which were replaced in 1985 in a BWR. About 15 tons of piping and valves were decontaminated from an initial contact dose rate of approximately 30,000 $\mu\text{Sv/hr}$ to 1-2 $\mu\text{Sv/hr}$ in a combined CORD and electrochemical decontamination process.

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Windelberg, D., F.W. Bach, B. Georgi, and H. Steiner

Quality of Plasma Arc Cutting and Aerosol Generation

Journal of Aerosol Science 18(6):919-922

Investigations are reported into the relationship between the quality of plasma arc cutting, the cutting parameters and the melted or evaporated particles released into the water or the atmosphere. Underwater plasma cutting tests were conducted on 1.4550 austenitic stainless steel and St 37 ferritic steels with various depths of water and various working parameters. The aerosol formed was measured and the water was collected for chemical analysis and measurement of suspended materials. Prediction of the amount of radioactive dust produced when dismantling nuclear power plant by plasma cutting is possible by this type of analysis.

390

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

Decommissioning Nuclear Power Stations

CEGB Research 22:32-41 (1988, September)

The main objective of research at Berkeley Nuclear Laboratories into the decommissioning of nuclear power stations is to assess the safety implications of the various strategies which are being considered worldwide for the eventual dismantling of these stations. Although the BNL studies have primarily addressed the oldest of the CEGB's plant, the steel pressure vessel Magnox reactors, assessments of PWR decommissioning have also been undertaken to allow design changes to be introduced which will reduce eventual dismantling problems and minimize the production of radioactive waste.

391

Woolman, R., Plasma Cutting Service

Plasma and Water Jet Cutting of Titanium

Light Metal Age 9-10:14-15, 22 (1987, October)

Plasma arc torches can easily slice through thick plates of stainless steels, heat-resistant Ti alloys and other materials (e.g. Al, composites, plastics). Recent innovations in plasma torch equipment and cutting techniques have helped reduce the size of the heat affected zone (HAZ), which was previously

considered a serious problem when cutting Ti. Water jets containing abrasive materials are also useful for cutting steels, Ti and certain aerospace composites. The abrasive material is commonly finely powdered garnet. In modern plasma and waterjet systems, the technique of cutting is combined with computer numerical control and interactive, computerized nesting.

392

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

Shielding Calculations at Dismantled Synrocyclotron

CONF-870405; Theory and Practice in Radiation Protection and Shielding, Proceedings of a Topical Conference, Knoxville, TN, April 21-22, 1987. American Nuclear Society, La Grange Park, IL (1987)

The Space Radiation Effects Laboratory located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration. A synrocyclotron was formerly in operation in this building was removed in 1980. At several locations, the scattered radiation caused an induced radioactivity within the walls of the cyclotron room. A radiological survey has been performed to determine the amount of residual radioactivity on the walls. Calculations were performed to determine the thickness of the concrete walls and floor for shielding the residual radiation in the cyclotron room. Recommendations are made to minimize exposures from the residual radioactivity on the walls and floor of the cyclotron room to potential occupants working in the building.

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

Results of a Radiological Survey at the Space Radiation Effects Laboratory, Newport News, Virginia

Health Physics 54(5):545-549 (1988, May)

After the decommissioning and removal of the synrocyclotron from the SREL a radiological survey was conducted to determine the level of residual radioactivity present in the building. The dose to potential occupants working in the building was calculated and recommendations are made for minimizing exposure to residual radioactivity.

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Yanagihara, S., S. Ashida, and H. Usui, Japan Atomic Energy Research Institute, Tokai Research Establishment, Tokai, Ibaraki, Japan

Dismantling of JPDR Internals Using Underwater Plasma Arc Cutting Technique Operated by Robotic Manipulator

Journal of Nuclear Science and Technology 25(11):891-894 (1988, November)

The Japan Power Demonstration Reactor (JPDR) Decommissioning Program, functioning since 1981, is making steady progress and has been producing useful data for future decommissioning of commercial power reactors. A superior cutting performance with remote control technology was required to minimize occupational radiation exposure on dismantling of highly activated and complex-shaped steel structures. For this purpose, an underwater plasma arc cutting technique and a robotic manipulator system have been developed then these were successfully used to dismantle some JPDR internals at the first step toward dismantling the JPDR components. Various useful data such as manpower and radiation exposure to workers have been collected through this dismantling activity. The authors briefly describe the results of the dismantling works for some JPDR internals.

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Yanagihara, S., H. Gohda, F. Hiraga, and M. Yokota

Remote Cutting Systems for Dismantlement of Steel Structures in the Japan Power Demonstration Reactor

CONF-881008; Decommissioning of Major

Radioactive Facilities, Proceedings of the Eighth IMechE International Conference, London, United Kingdom, October 11-12, 1988. Mechanical Engineering Publications Limited, Bury St. Edmunds, United Kingdom; (pp. 215-221) (1988)

The JPDR Decommissioning Program was started in 1981 at the Japan Atomic Energy Research Institute (JAERI) in order to develop applicable techniques for future commercial power reactor decommissioning. The decommissioning program consists of two major phases: (1) development of necessary techniques for reactor decommissioning; and (2) actual dismantlement of JPDR. In the first phase of the program, efforts were concentrated on development of remote control cutting techniques for dismantling steel and concrete structures. These techniques developed in this program are being applied to the actual dismantlement of JPDR. Data such as cutting performance and operability have been collected in mockup tests and in the actual dismantling activities.

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Development of Plasma Arc Cutting Technique for Dismantlement of Reactor Internals in JPDR Decommissioning Program

Journal of the Atomic Energy Society of Japan 30(3):235-246 (1988, March)

The decommissioning program for the Japan Power Demonstration Reactor (JPDR) has been conducted by the Japan Atomic Energy Research Institute since 1981 under contract with the Science and Technology Agency of Japan. The development of cutting tools for dismantling the JPDR is one of the important items in the program. An underwater plasma arc cutting technique was selected for dismantling the JPDR core internals. The study was concentrated on improving the cutting ability in water. Various cutting tests were conducted changing the parameters such as arc current, supply gas, and cutting speed to evaluate the most effective cutting condition. Through the study, the capacity to cut a 130 mm thick stainless steel plate in water has been demonstrated. In

addition, the amount and the characteristics of byproducts were measured during the cutting tests for the safety evaluation of the dismantling activities. Final cutting tests and checkout of the whole plasma arc cutting system were conducted using a mockup water pool and test pieces simulating the JPDR core internals. It was proved from the tests that the cutting system developed in the program will be applicable for the JPDR core internals dismantlement.

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Yie, G.G., Fluidyne Corporation, Auburn, WA

Cutting Concrete with Abrasive Waterjets - Phase 1: Evaluation of Relatively Low Pressure Water-Jet Performance

EPRI-EL-4409; 48 pp. (1986, January)

In laboratory testing, a prototype low-pressure abrasive water-jet system proved more effective in cutting concrete and asphalt than the high-pressure systems tested before. Projected operating costs for the hand-carried unit could mean savings between \$15,000 and \$20,000 per mile of cut.

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Yie, G.G., Fluidyne Corporation, Auburn, WA

Hard Rock Cutting with Abrasion Jet

NSF/CEE-83039; 28 pp. (1983, September)

The usefulness of high-pressure waterjets in cutting hard materials such as concrete, rock, and minerals was significantly improved by entraining selective abrasives into the waterjet. In fact, good entrainment of abrasives into the waterjet was found to be a prerequisite of generating high-capability abrasive waterjets. Experiments further revealed that Fluidyne's unique Abrasion-Jet nozzles can provide the desired entrainment of abrasives without severe wear problems. Thus, with the use of a suitable nozzle and hard/sharp abrasives, water pressure was determined to be of secondary importance in cutting hard rock.

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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 operation in Japan. At present, there are 33 commercial nuclear power plants in operation, supplying about 25 percent of the total electricity. Some of them will be

terminated in the near future and enter the decommissioning stage. Therefore, it is necessary to develop new decommissioning technologies, including dismantling techniques of these power plants. The development of the concrete cutting machine is one of the most important items applicable to dismantling biological shield walls of the plants. This document describes the outline of the cutting machine developed for the demolition of the biological shield wall of the Japan Power Demonstration Reactor (JPDR). It also includes some actual decommissioning works that were tested.

**FORMERLY UTILIZED SITES REMEDIAL
ACTION PROGRAM**

400

Adler, D., Bechtel National, Inc., Oak Ridge, TN

Presentation on the Role of Risk Assessment in FUSRAP Remedial Planning

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-59 - 5-74) (1988, October)

Although the primary emphasis of the FUSRAP program is to mitigate hazards by removing and disposing of contamination exceeding relevant generic guidelines, current FUSRAP protocol allows for application of supplemental risk-based standards in unique cases where generic standards are inappropriate. This presentation provides background information on the rationale supporting current generic cleanup standards, and how site-specific, risk-based standards can be applied to improve the cost effectiveness of overall remedial strategies.

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Bechtel National, Inc., Oak Ridge, TN

Dewatering Radioactive Pitchblende Residues at the Niagara Falls Storage Site

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 745-750) (1988)

The U.S. Department of Energy (DOE), with Bechtel National, Inc. (BNI), as the Project Management Contractor (PMC), is responsible for the Niagara Falls Storage Site (NFSS) Interim Waste Containment Facility in Lewiston, New York. The NFSS contains approximately 190,000 cubic meters (250,000 cubic yards) of low-level radioactive waste resulting from the remediation of approximately 600 hectares (1,500 acres) of the U.S. Army's former Lake Ontario ordnance works. The remedial action is being performed as part of

DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP) and Surplus Facilities Management Program (SFMP). Radioactive pitchblende residues stored on-site in a saturated condition required dewatering before final encapsulation within the containment facility. The successful dewatering operations, using both standard and innovative dewatering techniques, provide added confidence in the stability of the containment facility.

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Bechtel National, Inc., Oak Ridge, TN

FUSRAP the Past, the Present, and the Future

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 363-370) (1988)

The Formerly Utilized Sites Remedial Action Program (FUSRAP) is a U.S. Department of Energy (DOE) program to evaluate and remedy radiological and chemical contamination conditions at sites across the nation where contamination exceeding current guidelines remains from the early years of the nation's atomic energy program or from commercial operations that resulted in conditions Congress has mandated DOE to remedy. FUSRAP was initiated in 1974 and now includes 29 sites in 12 states. Since the start of field work in 1979, through the end of fiscal year 1987, 218,000 cubic meters of contaminated material have been removed during remedial action and one permanent disposal facility has been constructed. Current estimates are that the program will be completed in 2002 at a cost of approximately \$960 million. Significant issues in the immediate future are the development of permanent disposal sites to permit the program to be completed and the impact of the Superfund Amendments and Reauthorization Act (SARA) on the program. The program's origin, organization and responsibilities, and activities from 1981 to 1987 are described. The current status of FUSRAP is presented and the paper concludes with a discussion of the future of FUSRAP.

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Bechtel National, Inc., Oak Ridge, TN

Remedial Action at the National Guard Armory and the University of Chicago in Chicago, Illinois

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 387-391) (1988)

In 1987, the U.S. Department of Energy (DOE) conducted remedial action at the University of Chicago and the National Guard Armory (NGA) as part of its Formerly Utilized Sites Remedial Action Program (FUSRAP). In 1941, the National Defense Research Committee, and later the Manhattan Engineer District (MED), contracted the University of Chicago to conduct research related to the development and production of the first nuclear weapon. To alleviate space constraints at the University, the MED leased the Illinois NGA. This paper describes the nature of the radiological/chemical contamination at these sites as a consequence of the MED work, and the construction techniques used to perform the successful remediation.

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Bechtel National, Inc., Oak Ridge, TN

Remedial Action Progress by the U.S. Department of Energy in New Jersey

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 861-867) (1988)

The U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program is responsible for identifying, evaluating, and decontaminating sites used during the Manhattan Engineer District's project that has resulted in residual radioactive contamination at 29 sites in 12 states. New Jersey contains five (or 17 percent) of

these sites, all in differing stages of completing remedial action. Two of these sites have not been included in recent program activities. The authors focus on the three active sites and discuss the contrasts in the attitudes of the public and local governments, the quantities of contaminated materials, and the mechanisms by which the contaminants have migrated to vicinity properties. Additionally, several factors affecting the planning and completion of the program, that is, lack of a permanent disposal site and the Environmental Protection Agency's role, are presented.

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Bechtel National, Inc., Oak Ridge, TN

Remedial Actions for Mixed Chemical/Radioactive Wastes at the Colonic Interim Storage Site

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 975-978) (1988)

Bechtel National, Inc. (BNI) is the Project Management Contractor for DOE, and is responsible to DOE for conducting remedial action at CISS. The authors describe the selection of the technical approach and development of work plans in general, and give excerpts from a specific work plan developed by BNI to treat mixed chemical/radioactive wastes left at CISS. Although 10 work plans have been developed to date, the authors describe the destruction of sodium cyanide in electroplating baths used for plating uranium products with cadmium. A total of 4294 liters of electroplating solution averaging 1.0 molar cyanide and 90 nCi/liter uranium were treated. The treatment method was oxidation with calcium hypochlorite. As a result of this work, acutely hazardous mixed waste was converted to a uranium contaminated heavy metal sludge. The sludges were solidified with portland cement and sodium. A total of forty, 209-liter drums of solidified waste resulted from this work.

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Bechtel National, Inc., Oak Ridge, TN

Status of the Design and Construction of the Niagara Falls Storage Site

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 739-744) (1988)

The U.S. Department of Energy established the Niagara Falls Storage Site near Lewiston, New York for the short-term storage of low-level radioactive wastes and residues. The facility was constructed to provide interim storage for these waste materials for a period of 25 to 50 years, but can be upgraded to provide a service life of 200 to 1000 years. In this paper, the processes by which the facility was designed and constructed are described. In addition, the technical "lessons learned" in relation to each of these processes are summarized. Finally, the programs for maintenance and surveillance, environmental monitoring, and performance monitoring at the NFSS are described.

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Bechtel National, Inc., Oak Ridge, TN

Middlesex Sampling Plant Annual Site Environmental Report - Calendar Year 1988

DOE/OR/20722-214; 143 pp. (1989, April)

The monitoring program at the former Middlesex Sampling Plant (MSP) site measures radon concentrations in air; external gamma radiation levels; and uranium, and radium concentrations in surface water, groundwater, and sediment. To assess the potential effect of MSP on public health, the potential radiation dose was estimated for a hypothetical maximally exposed individual. Based on the scenario described in this report, this hypothetical individual would receive an external exposure approximately equivalent to 9 percent of the DOE radiation protection standard of 100 mrem/yr. The cumulative dose to the population within an 80-km (50-mi) radius of the site that results from radioactive materials present is

indistinguishable from the dose that the same population receives from naturally occurring radioactive sources. Results of the 1988 monitoring show that MSP is in compliance with applicable DOE radiation protection standards and with applicable requirements specified by the New Jersey Department of Environmental Protection groundwater permit No. NJ0054836.

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Bechtel National, Inc., Oak Ridge, TN

Wayne Interim Storage Site Annual Site Environmental Report - Calendar Year 1988

DOE/OR/20722-215; 93 pp. (1989, April)

The monitoring program at the Wayne Interim Storage Site (WISS) measures radon and thoron concentrations in air; external gamma radiation levels; and uranium, radium, and thorium concentrations in surface water, groundwater, and sediment. The radiation dose was calculated for a hypothetical maximally exposed individual to verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess its potential effects on public health. Based on the conservative scenario described in the report, this hypothetical individual receives an annual external exposure approximately equivalent to 2 percent of the DOE radiation protection standard. The cumulative dose to the population within an 80-km (50-mi) radius of the WISS that results from radioactive materials present at the site is indistinguishable from the dose that the same population receives from naturally occurring radioactive sources. Results of the 1988 monitoring show that the WISS is in compliance with the DOE radiation protection standard and with applicable requirements specified by New Jersey Department of Environmental Protection groundwater permit No., NJ0055051.

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Bechtel National, Inc., Oak Ridge, TN

Maywood Interim Storage Site Annual Site Environmental Report

DOE/OR/20722-216; 98 pp. (1989, April)

During 1988, the environmental monitoring program, begun in 1984, was continued at the Maywood Interim Storage Site (MISS), a U.S. Department of Energy (DOE) facility located in the Borough of Maywood and the Township of Rochelle Park, New Jersey. The MISS is currently used for storage of soils contaminated with low-level radioactivity. The monitoring program at the MISS measures thoron and radon concentrations in air; external gamma radiation levels; and thorium, uranium, and radium concentrations in surface water, groundwater, and sediment. Results of the 1988 monitoring show that the MISS is in compliance with the DOE radiation protection standard and with applicable permit requirements specified by the New Jersey Department of Environmental Protection Division groundwater permit No. NJ0054500.

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Bechtel National, Inc., Oak Ridge, TN

**Colonic Interim Storage Site Annual Site
Environmental Report - Calendar Year 1988**

DOE/OR/20722-217; 63 pp. (1989, April)

The monitoring program at the Colonic Interim Storage Site (CISS) measures external gamma radiation levels and uranium, radium-226 concentrations in surface water, groundwater, and sediment. The radiation dose was calculated for a hypothetical maximally exposed individual to verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess its potential effects on public health. Based on the conservative scenario described in the report, this hypothetical individual receives an annual external exposure approximately equivalent to 3 percent of the DOE radiation protection standard. The cumulative dose to the population within an 80-km (50-mi) radius of CISS that results from radioactive materials present at the site is indistinguishable from the dose that the same population receives from naturally occurring radioactive sources. Results of the 1988 monitoring show that CISS is in compliance with the DOE radiation protection standard.

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Bechtel National, Inc., Oak Ridge, TN

**Hazelwood Interim Storage Site Annual Site
Environmental Report - Calendar Year 1988**

DOE/OR/20722-218; 95 pp. (1989, April)

The monitoring program at the Hazelwood Interim Storage Site (HISS) measures radon and thoron concentrations in air; external gamma radiation levels; and uranium, radium, and thorium concentrations in surface water, groundwater, and sediment. The radiation dose was calculated for a hypothetical maximally exposed individual to verify that the site is in compliance with the DOE radiation protection standard (100 mrem/yr) and to assess its potential effects on public health. Based on the scenario described in the report, this hypothetical individual receives an annual external exposure approximately equivalent to 1 percent of the DOE radiation protection standard. The cumulative dose to the population within an 80-km (50-mi) radius of HISS that results from radioactive materials present at the site is indistinguishable from the dose that the same population receives from naturally occurring radioactive sources. Results of the 1988 monitoring show that HISS is in compliance with the DOE radiation protection standard.

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Bechtel National, Inc., Oak Ridge, TN

**St. Louis Airport Site Annual Site
Environmental Report - Calendar Year 1988**

DOE/OR/20722-220; 106 pp. (1989, April)

The monitoring program at the St. Louis Airport Site (SLAPS) measures radon 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 SLAPS on public health, the potential radiation dose was estimated for a hypothetical maximally exposed individual. Based on the scenario described in this report, this hypothetical individual would receive an external exposure approximately equivalent to 7.5 percent of the DOE radiation protection standard of 100 mrem/yr. Results of the 1988 monitoring show that SLAPS is in compliance with the DOE radiation protection standard.

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Golchert, N.W., Argonne National Laboratory, Environment, Safety, and Health Department, Argonne, IL

Site Surveillance and Maintenance Program for Palos Park Report for 1988

ANL-89/7; 43 pp. (1989, April)

The results of the environmental monitoring program conducted at Site A/Plot M in the Palos Park Forest Preserve area for CY 1988 are presented. The monitoring program is the ongoing remedial action that resulted from the original radiological characterization of the site. That 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 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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Havrdeys, W.E., R.R. Land, V.G. Spicer, and W.F. Stanley, Bechtel National, Inc., Oak Ridge, TN

Conceptual Design Report for a Permanent Disposal Site for FUSRAP Wastes

DOE/OR/20722-212; 45 pp. (1989, April)

The scope of this report encompasses the conceptual design of a 500,000 cu yd above-grade facility for the disposal of radioactive FUSRAP wastes in compliance with 40 CFR 192 (Ref. 1). The design is developed in sufficient detail to verify the acceptability of design concepts and to provide a basis for developing a cost estimate. The conceptual design includes features to ensure compliance with current federal orders, regulations, and standards. The final design will reflect additional or revised standards or refinements developed during the detailed design process.

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Howard, R.M., Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the Wayne Site - 1985 and 1987 Wayne, New Jersey

DOE/OR/20722-088; 37 pp. (1989, March)

As part of the work conducted during 1985 and 1987 under the Formerly Utilized Sites Remedial Action Program (FUSRAP), Bechtel National, Inc. (BNI) removed radioactive contamination from six areas in Wayne, New Jersey. These areas were: Wayne Township Park, backyard of 112 Deerfield Road, side and front yards of 34 Farmingdale Road, under Farmingdale Road, a portion of Sheffield Brook, and the mouth of Sheffield Brook. The purpose of this report is to document post-remedial action sampling performed by BNI on the properties remediated during 1985 and 1987. 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 areas and depths of excavation, and provides data on the current radiological status of each property.

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Kaye, M.E., and A.M. Feldman, Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the Niagara Falls Storage Site Vicinity Properties - 1985 and 1986

DOE/OR/20722-133; 108 pp. (1989, January)

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. The site is located approximately 10 mi north of the City of Niagara Falls and lies within the Town of Lewiston, New York. Some of the radioactive materials stored at the NFSS were subject to water and wind erosion over the years. As a result, radioactive materials migrated off-site, chiefly through on- and off-site drainage ditches.

These radioactively contaminated areas located adjacent to or near the NFSS are referred to as "vicinity properties." Bechtel National, Inc. (BNI), in its capacity as DOE's Project Management Contractor for the NFSS, removed radioactively contaminated soil from the vicinity properties. This report documents BNI's post-remedial action sampling of the properties cleaned up in 1985 and 1986 and briefly describes the origin of the radioactive contamination on the properties, the methods used to determine the extent of contamination, and the types of remedial action performed. This report also provides the guidelines used in performing the remedial action and provides data on the current radiological status of the properties.

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Kaye, M.E., and A.M. Feldman, Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the George Herbert Jones Chemical Laboratory at the University of Chicago Site Chicago, Illinois

DOE/OR/20722-205; 102 pp. (1989, January)

This report documents the radiological condition of the George Herbert Jones Chemical Laboratory at the University of Chicago in Chicago, Illinois following remedial action conducted by Bechtel National, Inc. (BNI) from July 1987 through October 1987. The work was performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a Department of Energy (DOE) project that was established to identify and decontaminate or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program. The remedial action described in this report was conducted in areas that were identified on the basis of pre-remedial action activities as being contaminated in excess of guidelines. Pre-remedial action activities are described in Subsection 3.1; the types of remedial action conducted are described in Subsection 3.2.

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Liedle, S.D., Bechtel National, Inc., Oak Ridge, TN

Conversion of Mixed Waste to Radioactive Waste: A Case Study

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-145 - 5-156) (1988, October)

As part of the U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), Bechtel National performed remedial actions at the National Guard Armory (NGA) in Chicago, Illinois. During remedial actions at the NGA, sixteen 55-gallon (208-liter) drums of sludge were removed from catch basins and drain lines in the garage area of the Armory. The sludge met the Resource Conservation and Recovery Act (RCRA) criterion for ignitability; therefore, the sludge was classified as a RCRA hazardous/radioactive mixed waste. Bench scale tests were conducted on samples of the sludge to identify techniques for separating the chemical and radiological hazards so the sludge could be disposed. Thermal treatment was selected for field implementation when bench scale thermal tests raised the flash point of a sample to above 800 deg F (426.7 deg C), well above the RCRA criterion. Post treatment analysis of the sludge confirmed that the waste no longer demonstrates the RCRA characteristic of ignitability, or any other RCRA characteristic.

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Liedle, S.D., Bechtel National, Inc., Oak Ridge, TN

Environmental Compliance at U.S. Department of Energy FUSRAP Sites

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 2, 329 pp.; (pp. 915-921) (1988, October 3)

With the promulgation of the Superfund Amendments and Reauthorization Act (SARA), federal facilities were required to comply with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) in the same manner as any nongovernment entity. This presented challenges for the Department of Energy

(DOE) and other federal agencies involved in remedial action work because there are many requirements under SARA that overlap other laws requiring (DOE) compliance, for example, the National Environmental Policy Act (NEPA). This paper outlines the options developed to comply with CERCLA and NEPA as part of active, multi-site remedial action program. The program, the Formerly Utilized Sites Remedial Action Program (FUSRAP), was developed to identify, cleanup, or control sites containing residual radioactive or chemical contamination as a result of the nation's early development of nuclear power. During the Manhattan Project, uranium was extracted from ores and resulted in mill concentrates, purified metals, and waste products that were transported for use or disposal at other locations. As a result of these activities materials, equipment, buildings, and land became contaminated, primarily with naturally occurring radionuclides.

420

McNamee, E.M., Bechtel National, Inc., Oak Ridge, TN

Optimizing the Efficiency of the Drilling Program at the Ashland 2 Site

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-1 - 5-12) (1988, October)

During the initial planning for characterization of the Ashland 2 site (located near Tonawanda, New York), a systematic sampling methodology was initially selected. If this method had been implemented, 108 sampling locations would have been established across the Ashland 2 site. However, as planning progressed, a new sampling methodology was developed and implemented. This methodology uses an iterative approach and consists of the placement of biased sampling locations to determine the horizontal boundaries of contamination. Implementation of the iterative approach at the Ashland 2 site reduced the number of planned sampling locations to 48, as opposed to the 108 that would have been required using the systematic methodology. This in turn results in

considerable savings in sampling and analysis cost. Preliminary estimates of the remedial investigation costs indicate that use of the iterative approach provided a 30 percent saving in the total cost as compared to cost that would result using the systematic approach.

421

McNamee, E.M., Bechtel National, Inc., Oak Ridge, TN

Post-Remedial Action Report for the National Guard Armory Site Chicago, Illinois

DOE/OR/20722-184 (Rev. 1); 60 pp. (1988, December)

This report documents the radiological condition of the National Guard Armory site in Chicago, Illinois, following remedial action. The remedial action was conducted by Bechtel National, Inc. (BNI) from April 1987 to July 1987. The work was performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S. Department of Energy (DOE) program to identify, decontaminate, or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program. All the measurements taken after the removal of radioactive materials indicate that no areas of radioactive contamination remain in which concentrations exceed DOE guidelines. An independent assessment of the remedial action conducted at the National Guard Armory, Chicago, Illinois, was performed by Oak Ridge Associated Universities (ORAU) under the Radiological Site Assessment Program. The assessment verified BNI data supporting the adequacy of remedial action and confirmed that radiological conditions at the armory are in compliance with DOE remedial action guidelines.

422

Ring, N.C., and S.K. Livesay, Bechtel National, Inc., Oak Ridge, TN

Radiological Characterization Report for the Lodi Municipal Park

DOE/OR/20722-175; 63 pp. (1988, November)

This report summarizes the procedures and results of the radiological characterization of the property at Lodi Municipal Park in Lodi, New Jersey, conducted from September through December 1986 and three additional boreholes drilled in December 1987. The data generated during the radiological characterization will be used to define the complete scope of remedial action necessary to release the site. On the basis of information gathered during the radiological characterizations of several residential properties near this property, thorium-232 is most likely the primary contaminant of the property. In addition, historical information concerning the route of the Lodi Brook, which is believed to be a primary source of transportation for contamination in this area, supports the information obtained during these characterizations. Because the major contaminants at the vicinity properties are thorium and radium, the decontamination guidelines provide the appropriate guidance for the cleanup activities. DOE believes that these guidelines are conservatively low for considering potential adverse health effects that might occur in the future from any residual contamination. The dose contributions from uranium and any other radionuclides not numerically specified in these guidelines are not expected to be significant following decontamination. In addition, because the vicinity properties will be decontaminated in a manner to reduce future doses to levels that are as low as reasonably achievable (ALARA), DOE will ensure that most of the radioactivity present at these vicinity properties will be removed during the cleanup.

423

U.S. Department of Energy, Division of Facility and Site Decommissioning Projects, Washington, DC

Progress and Problems in the Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a

Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 357-362) (1988)

The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established in 1974 to identify, evaluate, and as appropriate, conduct remedial actions at sites used in the early years of nuclear energy development by the Manhattan Engineer District and the Atomic Energy Commission (AEC). This program currently has 29 sites and is evaluating 350 other sites for possible inclusion in the program. Another remedial action program in the Department of Energy's (DOE) Division of Facility and Site Decommissioning Projects is the Surplus Facilities Management Program (SFMP). The SFMP involves the safe management, decontamination and disposal of surplus DOE contaminated facilities which were not related to defense activities. There are currently 33 projects at 15 different sites in the program. These two programs have made steady progress over the last 10 or so years in clearing up sites so that they can be reused or released for unrestricted use. Work has been completed at 8 of the FUSRAP sites and three of the SFMP sites. In addition, significant efforts continued at the Shippingport Station Decommissioning Project, which is scheduled to be completed by 1990. The Department has also initiated work on a major project at the Weldon Spring Site in Missouri, which was first used by the Army as an ordnance works and later by a DOE predecessor agency as a uranium feed material plant. However, these programs, like other remedial action programs, face many challenges and issues which could significantly delay their completion or increase their costs. Some of these issues include how to deal with mixed waste (waste which has both hazardous and radioactive components), how to integrate the National Environmental Policy Act (NEPA) requirements with those of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and how to best interact with the Environmental Protection Agency (EPA) and State agencies. The siting and development of permanent disposal facilities is a very difficult challenge which must be met successfully to complete these programs.

424

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

Washington, DC

**Radioactive Material in the West Lake Landfill
- Summary Report**

Report; 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 disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. The report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from the processing of uranium ores and the subsequent sale by the Atomic Energy Commission of the processing residues. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is called for.

425

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

Radioactive Material in the West Lake Landfill

Report; 23 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 disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. The 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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Wright, J.H., M.E. Kaye, and C.M. Sekula,
Bechtel National, Inc., Oak Ridge, TN

**Radiological Characterization Report for the
Albany Research Center, Albany, Oregon**

DOE/OR/20722-204; 117 pp. (1989, April)

This report describes the methods used for the most recent characterization of the Albany Research Center, which was performed subsequent to the 1987 remedial action at ARC, and presents characterization results. Characterization activities included review of historical data and radiological characterization of the following: interiors of 19 ARC buildings (walls, floors, structural and equipment surfaces, surfaces and residues in manholes, sumps, trenches, and miscellaneous storage containers); exterior surface and subsurface soil; building subfloor areas; buried and exposed piping; and the lime pit east of Building 31. Characterization data include isotopic analysis results, total and removable alpha and beta-gamma contamination levels, and gamma radiation exposure rates associated with ARC building surfaces. Results of this characterization show that the majority of surface measurements were at background levels and that most subsurface measurements fell within guidelines. Those measurements above guidelines for indoor/outdoor structure surface contamination were generally one to five times the applicable DOE guidelines and were usually of low-level, total beta-gamma radiation. Only seven items exhibited surface alpha measurements above applicable DOE guidelines. Contaminated items identified include floors, walls, trenches, ceiling/attic structures, windows, sumps, various pieces of equipment, and areas of residual contamination underneath asphalted areas.

**FACILITIES CONTAMINATED WITH
NATURAL RADIOACTIVITY**

427

Atomic Energy of Canada Limited, Pinawa, Manitoba, Canada

Workplace Decontamination and Temporary Storage of Radioactive Soils at a Small Industrial Site

BN 0-662-54631-8; Canadian Waste Management, Proceedings of the Eighth Annual Conference, Halifax, Nova Scotia, Canada, September, 3-5, 1986; (pp. 321-342) (1986)

The operation of a small niobium smelter during the early seventies resulted in the contamination of an industrial property in Surrey, British Columbia with low-level radioactive waste. In the summer of 1985, the Low-Level Radioactive Waste Management Office of Atomic Energy of Canada Limited decontaminated the work areas of the site by excavating contaminated soils from under and around buildings. Excavated soils were placed in temporary containment, on-site, to await final disposal. The project required considerable preplanning in the design stages to minimize the environmental impact of the work and to ensure the radiological safety of the public and workers. Monitoring during the project showed that no contamination was spread from the site during the operation, that workers on the project received no measurable internal dose, and that the maximum external dose to a worker, attributable to the project, was 0.1 mSv. Additional aspects of the subject are discussed.

428

Camp Dresser and McKee, Inc., Edison, NJ

Draft Final Feasibility Study for Montclair/West Orange and Glen Ridge, New Jersey Radium Sites

NP-8011453 (1985, September 13)

The Montclair/West Orange and Glen Ridge Radium Sites are three noncontiguous radium-contaminated sites consisting of 45 acres in Montclair, 9 acres in West orange and 50 acres in Glen Ridge. All three sites are located in densely residential areas of suburban Essex County in northeastern New Jersey. Radium-contaminated

soils have been deposited as fill material around and under homes in the three sites causing elevated radiation exposures that pose a danger to the health of the residents of these areas. The radiation exposures consist of elevated indoor concentrations of radon gas - a decay product of radium, and elevated outdoor and indoor gamma radiation levels that approach and sometimes exceed the radiological standards for the general public. The U.S. Environmental Protection Agency (EPA) contracted with Camp Dresser and McKee Inc. (CDM) to evaluate the feasibility of alternative plans to remediate the contamination at the three sites. Because several remediation alternatives will require disposal of large amounts of contaminated soil, a variety of different disposal alternatives also were evaluated. The overall objective of the remedial action at the Montclair/West Orange and Glen Ridge Radium Sites is to minimize or eliminate the potential health hazard produced by the radioactive contaminated soils present in the three communities. The purpose of this study is to provide the information necessary to select the most appropriate methods to remediate the contamination at the sites and to dispose of the contaminated material.

429

Camp Dresser and McKee, Inc., Edison, NJ

Remedial Investigation Study for the Montclair/West Orange and Glen Ridge, New Jersey Radium Sites: Volume 1

NP-8011467; 121 pp. (1985, September 13)

Elevated radiation exposures that approach and sometimes exceed the radiological standards for the general public have been identified in the Montclair/West Orange and Glen Ridge study areas. Elevated outdoor and indoor gamma radiation levels and indoor radon concentrations in excess of expected background ranges have been found. The source of the elevated radiation exposure is known to be radium-contaminated soil that has been deposited as fill material in several discrete pockets throughout the study areas.

430

Environment Canada, Canada Centre for Inland Waters, National Water Research

Institute, Burlington, Ontario, Canada

**Groundwater Transport of Radium-226 and
Uranium from Port Granby Waste Management
Site to Lake Ontario**

Nuclear and Chemical Waste Management
8(3):199-209 (1988)

A finite element model is developed for delineating radioactive contaminant plumes via groundwater, and used to predict the migration of Ra-226 and Uranium from the Port Granby waste management site to Lake Ontario. The model runs are made simulating either one or two stratigraphic layers and simulating varying degrees of anisotropy in each layer. The model-predicted Ra-226 and Uranium concentrations are found to be in good agreement with those actually observed. Recovery phase analysis predicts that the continuous migration of both contaminants is likely to persist even after the waste is removed from the site.

431

Steele, R., R.E.M. Lees, and J.H. Roberts,
Senes Consultants Limited, Willowdale,
Ontario, Canada

**Study of the Health Effects of Low-Level
Exposure to Environmental Radiation
Contamination in Port Hope, Ontario**

INIS-mf-11270; 162 pp. (1984, June)

From 1939 to 1948 residues from radium production at Eldorado Nuclear Limited's plant in Port Hope, Ontario were disposed of in and around the town of Port Hope. In 1980 a study was set up to determine the health effects of these residues. This report concerns Phase Two, a case-control study of lung cancer in the exposed population. Doses for the 118 cases and controls were

reconstructed to give the final year of exposure, the residences occupied during the period of exposure, and the total estimated exposure for various latency periods. Statistical analysis of the data gathered could not give coherent results or show an identifiable increased risk of lung cancer from elevated alpha-radiation levels due to the confounding effect of cigarette smoking. Ninety percent of the cases of lung cancer found were attributable to smoking.

432

Vandergaast, G., D. Moffett, and B.E.
Lawrence, Eldorado Resources Limited,
Ottawa, Ontario, Canada

**Cleanup Around an Old Waste Site - A
Success Story**

Proceedings of the Ninth Annual Canadian
Nuclear Society Conference, Winnipeg,
Manitoba, Canada, June 13-15, 1988. Canadian
Nuclear Society, Toronto, Ontario, Canada, 487
pp.; (pp. 151-156) (1988)

Approximately 42500 cu m of contaminated soil were removed from off-site areas around an old, low-level radioactive waste site near Port Hope, Ontario. The cleanup was done by means of conventional excavation equipment to criteria developed by Eldorado specific to the land use around the Company's waste management facility. These cleanup criteria were based on exposure analyses carried out for critical receptors in two different scenarios. The excavated soils, involving eight different landowners, were placed on the original burial area of the waste management facility. Measures were also undertaken to stabilize the soils brought on-site and to ensure that there would be no subsequent recontamination of the off-site areas.

**URANIUM MILL TAILINGS REMEDIAL
ACTION PROGRAM**

433

Bierley, D.A.

**Alternate Concentration Limits for the
UMTRA Project**

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 5, 324 pp.; (pp. 1575-1583) (1988, October 3)

The Department of Energy's (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project is charged with the cleanup of 24 inactive uranium mill sites in ten different states. The EPA recently issued proposed groundwater standards (52 FR 36000, September 24, 1987) as a result of the Tenth Circuit Court of Appeals remand. Groundwater protection standards (as per 40 CFR 264.92) for each of the sites are an integral part of the new regulations. The project has the option to apply for background concentrations, maximum concentration limits (MCLs) or alternate concentration limits (ACLs) as part of the components of the site-specific groundwater protection standards. The variety of information and discussion needs for obtaining ACLs for the UMTRA Project sites include risk assessment, groundwater hydrology, environmental issues, and NRC and state involvement. One of the important aspects in any UMTRA ACL demonstration is the concept of as low as reasonably achievable (ALARA). This paper will discuss the various issues and information requirements for obtaining ACLs for the UMTRA Project sites.

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Caldwell, J.A., Jacobs Engineering Group, Inc., Albuquerque, NM

**The Impact of Proposed EPA Groundwater
Standards on UMTRA Project Disposal Cell
Design**

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-15 - 5-41) (1988, October)

In 1987, EPA published draft groundwater standards applicable to all Uranium Mill Tailing

Remedial Action (UMTRA) Project sites. Publication of these standards created a need to evaluate both the performance of previous UMTRA Project disposal cell designs and the extent to which these designs facilitated or led to compliance with the proposed groundwater standards. Such an evaluation yielded guidance for the compilation, on a site-specific basis, of disposal cell designs that will lead to compliance with the proposed EPA groundwater standards.

435

Caldwell, J.A., J.W. Tackston, and R. Portillo, Jacobs Engineering Group, Inc., Albuquerque, NM

**Geotechnical and Water Resource Aspects of
Uranium Mill Tailings Pile Reclamation
Projects**

CONF-860695; HazMat '86: Hazardous Materials Management, Proceedings of a Conference and Exhibition, Atlantic City, NJ, June 2, 1986 (1986)

Design and construction work is currently in progress at more than twenty sites associated with the UMTRA Project - this involves final reclamation of the uranium mill tailings piles so that they are stable for at least 200 years and for up to 1000 years. Remedial action construction plans for the tailings piles involve detailed consideration of the present and possible future groundwater and surface-water impacts of the pile. Since the stabilized pile is ultimately a major geotechnical structure, detailed consideration of the long-term resistance to erosion and containment of radioactive material is also required. A case history illustrates how the critical design criteria governing the remedial action activities at the various piles are applied to the pile at the Lakeview site to provide for long-term protection of the water resource and public health and safety.

436

Caldwell, J.A., T.R. Wathen, and J.R. D'Antonio, Jacobs Engineering Group, Inc., Albuquerque, NM

Criteria for Remedial Work at Inactive

Uranium Mill Tailings Piles

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986 (1986)

This paper is an overview of the design criteria and procedures used by the U.S. Department of Energy for remedial actions at inactive uranium mill sites in the Uranium Mill Tailings Remedial Action Project. Also included is an overview of the standard Review Plan used by Nuclear Regulatory Commission staff in reviewing proposed remedial actions. Resolution of the design criteria and procedures has led to the recent publication and acceptance of four major documents that describe the general technical approaches and design criteria which have been adopted. This paper describes these documents and highlights the important new and innovative aspects of the documents that pertain to the design and construction of remedial action works at inactive uranium mill tailings piles.

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Chem-Nuclear Systems, Inc., Albuquerque, NM

Evaluation of Waste Water Treatment Systems for the Uranium Mill Tailings Remedial Action Project Lakeview, Oregon Site

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 669-679) (1988)

During remedial action at the Lakeview, Oregon, Uranium Mill Tailings Remedial Action Project site, unexpectedly large volumes of contaminated water required quick identification and design of a treatment facility capable of meeting Oregon release limits. A laboratory program was prepared and executed to determine the efficiency and cost-effectiveness of several alternative treatment approaches, and an optimum system was selected, designed and deployed.

438

D'Antonio, J.R., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Status Report Groundwater: The Challenge of UMTRA Completion

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 3-1) (1988, October)

UMTRA is working aggressively towards meeting the intent of the draft EPA Groundwater Protection Standards. Since September 1987, the major UMTRA thrust has been threefold: (1) perform special studies directed towards design enhancements, (2) provide design enhancements where possible, for projects under construction; and (3) evaluate the remaining sites under design for design enhancements under the proposed standards. At this time, the NRC has taken a very guarded approach towards approving proposed cover systems. UMTRA believes current cell designs will meet proposed standards. UMTRA met with NRC the week of October 17, 1988 to discuss results of recent special studies including: Field moisture content validations of completed covers, soil/rock covers, rock durability, soil amendments, freeze-thaw, and erosion protection and constructability questions. When completed, UMTRA will issue final study reports.

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D'Antonio, J.R., J.A. Caldwell, and G.R. Thiers, U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Burying the Nuclear Past

Transactions of the ASCE - Civil Engineering 57(2):55-57 (1987)

The Uranium Mill Tailings Remedial Action Program involves reclaiming 24 tailings piles. The work is done in terms of federal legislation to

protect the environment and people from the potential long-term health impact of radon gas from the piles. Remedial work usually 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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Dery, V.A. K.L. Agogino, and D.E. Mann, Jacobs Engineering Group, Inc., Albuquerque, NM

Ecnic, Menic, Minic, Moc - Where Do Monument Valley Tailings Go?

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 4, 374 pp.; (pp. 1249-1259) (1988, October 3)

This paper describes the decision making process used to select a site for the disposal and stabilization of the uranium mill tailings at the Monument Valley site. During the three years following the spring of 1985, the Department of Energy's Uranium Mill Tailings Remedial Action Project Office went through several site selection processes for the disposal of tailings at the inactive uranium mill site on the Navajo Indian Reservation in Monument Valley, Arizona. The last site selection process was initiated as a direct consequence of the proposed groundwater protection standards (40 CFR 192) published by the U.S. Environmental Protection Agency (EPA) during the fall of 1987. Before the proposed standards were issued, work on the conceptual design (disposal option) for remedial action was near completion. Assessment of the proposed EPA standards revealed that the current design was not in compliance with the regulations. Work on the Environmental Assessment and the Remedial Action Plan stopped. A paper study of alternative disposal sites was initiated at the beginning of 1988, in addition to exploring ways (via new technologies) to use existing and previously rejected disposal options. New criteria for evaluation of all viable options were established in light of the new standards. Probable costs were developed for those

options that had significant environmental risks associated with them so they could be compared with those options of little or no associated risk. As a direct result of this decision making process, an option that was previously rejected because of the high cost, but that had relatively little associated risk, was selected as the recommended option.

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Dupuy, J., and W. Beyeler, Jacobs Engineering Group, Inc., Albuquerque, NM

Design of a Disposal Cell for Uranium Mill Tailings at Collin's Ranch, Oregon: A Case Study in Informal Dynamic Optimization

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 4, 374 pp.; (pp. 1239-1248) (1988, October 3)

The disposal of uranium mill tailings at the DOE's UMTRAP Collins Ranch site near Lakeview, Oregon provides an informative case study in the practical ramifications of groundwater standards. This paper discusses the hydrologic setting, the anticipated impacts of the initial cell design, and the legislative framework in which the design was prepared. Recently mandated compliance with the proposed EPA groundwater standards presented an interesting challenge, as much of the construction, based on the original design, had been completed by the time these criteria were imposed. The design modification options, constrained by existing work at the site, are discussed, along with the methodology used to identify a workable design enhancement.

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Glover, W., Weston (Roy F.), Inc., Albuquerque, NM

Canonsburg Surveillance and Maintenance: A Case History

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456

pp.; (pp. 3-21 - 3-34) (1988, October)

The purpose of this presentation is to provide a history of the Surveillance and Maintenance (S&M) program at the Canonsburg, Pennsylvania Uranium Mill Tailings Remedial Action (UMTRA) site and to relate the Canonsburg experiences to the overall UMTRA S&M program. The Canonsburg site was the first inactive uranium mill tailings sites to be remediated pursuant to the provisions of Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA). The S&M program for Canonsburg was initiated in 1986 with the submittal to the Nuclear Regulatory Commission (NRC) of the Final Canonsburg S&M plan. The primary purpose of the UMTRA project's S&M program is to verify that the remediated tailings disposal facilities are continuing to function as designed. The fundamental surveillance technique is to compare current site conditions to the site conditions at the completion of construction as documented in the site close out inspection report, aerial photographs, site construction photographs, as built drawings and other relevant documentation. The Site S&M Plan provides descriptions of such features to be inspected on a recurring basis. Phase I inspections are scheduled on an annual basis to determine if any observable problems have occurred since the previous inspection that require follow up activities. When problems are discovered during the Phase I inspection a follow-up or Phase II inspection is scheduled to examine them in more detail and determine the need, if any, for contingency repairs.

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Hempill, H.G., J.G. Oldham, and J.S. Long, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Hazardous and Mixed Waste Management at UMTRA Sites

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-111 - 5-139) (1988, October)

During the early stages of the Uranium Mill Tailings Remedial Action Project, there were some serious questions regarding the ownership of and consequently the responsibility for disposal of

hazardous wastes at UMTRA sites. In addition to State and Indian Tribe waste disposal regulations, UMTRA must also conform to guidelines established by the NRC, OSHA, EPA, and DOT. Because of the differing regulatory thrusts of these agencies, UMTRA has to be vigilant in order to ensure that the disposal of each parcel of waste material is in compliance with all regulations. Mixed-waste disposal presents a particularly difficult problem. No single agency is willing to lay claim to the regulation of mixed-wastes, and no conventional waste disposal facility is willing to accept it. Consequently, the disposal of each lot of mixed-waste at UMTRA sites must be handled on a case by case basis.

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Jacobs Engineering Group, Inc., Albuquerque, NM

Characterization and Remedial Planning for Nonradiological Toxicants at UMTRA Project Sites

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 689-693) (1988)

The congressional mandate for the Uranium Mill Tailings Remedial Action (UMTRA) Project is to clean up 24 inactive uranium processing facilities around the United States. However, potentially hazardous nonradioactive materials have been encountered at a number of UMTRA Project sites, sometimes requiring action beyond that necessary to meet the EPA standards. Foremost among these nonradiological toxicants (NRTs) are metals and metalloids such as arsenic, molybdenum, selenium, and vanadium: elements that are closely associated with the tailings matrix. In most cases, there are no clear regulatory guidelines or standards to dictate cleanup levels for these substances. A multidisciplinary task force was organized to manage the handling of NRTs and UMTRA Project sites. It was decided that a general procedure was needed to: (1) characterize NRTs at each site, (2) establish site-specific guidelines for cleanup of these substances to a safe level, and (3) identify

appropriate remedial actions. At the heart of the procedure is a pathway analysis approach for determining the acceptable residual levels of the NRTs that may remain in the soil after a tailings pile has been relocated. The analysis may also be used to determine the engineering values (e.g. cover infiltration rate) required to assure an adequate degree of isolation of the NRTs. The analysis utilizes a technique named DECHEMA that closely parallels the DECOM method already used for radionuclides at mixed waste sites. The methodology employs user-friendly microcomputer software that permits insertion of site-specific parameters to guide the characterization and management of NRTs at all UMTRA Project sites. This paper describes the approach that has been taken on the UMTRA Project toward developing this methodology and implementing it on a trial basis at two sites where NRTs require immediate attention.

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Jacobs Engineering Group, Inc., Albuquerque, NM

Planning at Selected UMTRA Project Sites

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 681-687) (1988)

The Uranium Mill Tailings Remedial Action (UMTRA) Project involves remedial work at 24 mill processing sites in ten states. To date remedial work is complete at two sites, in progress at five others, and the planning for the remaining sites is well advanced. Previous papers have described the construction work and remedial action designs at some of these sites. This paper documents the status of the planning of the remedial action work at four of the lower priority sites; namely, Spook, in Wyoming, Belfield and Bowman, in North Dakota, and Falls City, in Texas. While these sites are of relatively low priority in the UMTRA Project, the engineering work required to bring the sites to a level where they comply with the U.S. Environmental Protection Agency (EPA) standards involves many interesting and unique approaches. This paper describes the different

engineering plans and approaches being adopted for remedial work at the sites listed.

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Jacobs Engineering Group, Inc., Albuquerque, NM

Public Participation in the NEPA Process: Lessons Learned on the UMTRA Project

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 431-436) (1988)

This paper examines interactions between the DOE and the public in communities at or near UMTRA Project sites where the NEPA process has been conducted. Case studies are presented illustrating public issues which have arisen resulting in impacts on the NEPA process and overall project planning. Analyses of lessons learned are offered to assist in the management of future similar efforts.

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Jacobs Engineering Group, Inc., Albuquerque, NM

Prediction of Strains in Earthen Covers

Hydraulic Fill Structures, Proceedings of a Conference, Fort Collins, CO, August 15-18, 1988; (pp. 367-388) (1988)

Generally, two methods are used to dispose of the tailings and contaminated material: (1) excavation, transportation to another site, compaction, and placement of a long-term earthen cover system; and (2) placement of off-pile contaminated materials over the existing tailings pile and covering the entire pile with an earthen cover system. This paper discusses the Falls City, Texas, site and the methods used to characterize the tailings. Also discussed are the prediction techniques used to predict strain and possible cover cracking as a result of differential settlement in order to predict their performance for final design.

448

**Knight, W.C., V. Fry, and R. Sena, Jacobs Engineering Group, Inc., Albuquerque, NM
Conceptual Design of Remedial Actions at Three Navajo Sites**

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986 (1986)

As part of the Uranium Mill Tailings Remedial Action (UMTRA) Project, Jacobs Engineering, under the direction of the U.S. Department of Energy (DOE), prepared conceptual designs for three former uranium processing sites that are on the Navajo Reservation. The objective of the design is to meet the EPA standards for long-term performance by consolidating the tailings and associated contaminated materials with a system of controls that would last 1000 years where reasonably achievable, and at least for 200 years. This report presents the problems and solutions associated with the designs at each site.

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Lechel, D.J., Weston (Roy F.), Inc., Albuquerque, NM

Environmental Benefits from Regulatory Compliance at the Durango, Colorado UMTRA Project Site

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986 (1986)

Radioactively contaminated uranium mill wastes located in Durango, Colorado are slated for cleanup and stabilization in the near future. As part of this cleanup action, at least 18 permits/approvals must be obtained. Compliance with these permits/approvals has provided unanticipated benefits. For this remedial action, compliance will enhance wildlife habitat and improve its availability to the public at large, enhance riparian habitat, and has already yielded exciting new archaeological finds.

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**Lechel, D.J., Weston (Roy F.), Inc., Albuquerque, NM
Tale of Three Cities**

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986; (pp. 41-44) (1986)

Three communities were involved in the Uranium Mill Tailings Remedial Action (UMTRA) Project. The UMTRA Project, born in recognition of the potential health hazards from uncontrolled radioactive uranium mill tailings, was envisioned by the lawmaking body of the U.S. as a cooperative federal-state program to rid affected communities of their hazards. Cleanup decisions and costs were to be shared, albeit the cost burden was to be borne principally by the federal government. And the three affected communities were to have opportunities to voice their concerns and opinions. This paper describes three of those communities and the federal entity, the U.S. Department of Energy, that is charged with the responsibility of controlling those wastes, and the impact of the voices of these communities.

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Lindsey, G., R.E. Rager, and J. Thiers, Sergeant, Hauskins and Beckwith Geotechnical Engineers, Inc., Albuquerque, NM,

Selection of Durable Rock for UMTRA Project Sites

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-13 - 3-18) (1988, October)

The method of determining the quality of rock for erosion protection for stabilizing uranium mill tailings was changed about midway in the life of the UMTRA Project so that some site designs were retroactively affected by introduction of the new criteria. This study compares the new criteria with the previously used method and discusses the cost factors associated with the change.

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Loughead, J.S., R.C. Brod, W.F. Downs, and P.V. Sundberg, Jacobs Engineering Group, Inc., St. Charles, MO

Integration of Aquifer Restoration with Remedial Action at Uranium Mill Tailings Sites

CONF-881054; Proceedings of the 1988 DOE Model Conference, Oak Ridge, TN, October 3-7, 1988, Vol. 1, 375 pp.; (pp. 333-342) (1988, October 3)

Recently proposed groundwater standards for inactive (Title I) uranium mill sites will apply to both disposal cell performance and the cleanup of groundwater underlying the inactive site. Because the majority of Title I sites are either being designed or are already in construction, The Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project is evaluating potential impacts to Title I sites if the groundwater cleanup standard (Subpart B) are promulgated as proposed. While the Nuclear Regulatory Commission (NRC) has stated a willingness to defer groundwater cleanup at Title I sites until after the standards are promulgated, the DOE Technical Assistance Contractor (TAC) is evaluating each UMTRA Project site and associated Remedial Action Plan in light of the following questions: 1) Does the preferred remedy preclude or preempt future groundwater cleanup activities at the site? 2) Do near-term construction activities offer an opportunity to cost-effectively restore groundwater at the site? Some of the conclusions presented are (1) Aquifer is generally not precluded or preempted by construction activities at UMTRA Project sites, and (2) While some construction activities (for example, dewatering during excavation) offer the potential for assisting in groundwater cleanup, this potential is difficult to realize at some sites because of geomechanical and hydraulic uncertainties.

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Matthews, M., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Status Report Long-Term Surveillance and

Maintenance

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-19 - 3-20) (1988, October)

Surveillance and maintenance (S&M) are those activities, such as monitoring, maintenance and emergency measures, which are undertaken at a site after remedial actions are complete in order to protect the public health, safety and in the environment. These activities may be pursuant to a license from the Nuclear Regulatory Commission, or other agency, as appropriate. A working group (1) reviews post-closure S&M requirements, standards, practices and costs; (2) identifies and explores areas of commonality and differences; and (3) makes recommendations for projects' policies, and actions. Applicable regulations are: (1) 40 CFR 192 - active and inactive site standards; (2) 40 CFR 264 - hazardous waste treatment, care, and closure; (3) 10 CFR 161 - NRC licensing requirements for radioactive waste disposal; (4) DOE Order 5480.2 - hazardous and radioactive mixed waste management (with reference to 40 CFR 260-265, RCRA); and (5) DOE Order 5820 - certification of former federal nuclear sites.

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Meyer, H.R., Chem-Nuclear Systems, Inc., Albuquerque, NM

Hazardous And Radioactive Waste: Public Health Issues and Concerns

Papers Presented at the AIChE 1987 National Meeting, Houston, TX (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 have presented a unique training and information program, allowing local individuals to understand and evaluate the relative hazards of the work.

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Morrison-Knudsen Engineers, Inc., San Francisco, CA

Settlement of Uranium Mill Tailings

Hydraulic Fill Structures, Proceedings of a Conference, Fort Collins, CO, August 15-18, 1988; (pp. 310-329) (1988)

Two test embankments were constructed on top of an old tailings deposit near Ambrosia Lake, New Mexico to determine settlement characteristics of hydraulically-deposited uranium mill tailings. Settlements and pore pressures for the in-situ tailings and foundation soils were measured. After these measurements were obtained, one-dimensional consolidation calculations were made using actual loading measured by total stress cells. The calculations resulted in values for key material properties that gave settlement and pore pressure responses in agreement with test embankment data.

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Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN

Progress on the UMTRA Project: The Role of the Inclusion Survey Contractor

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 381-386) (1988)

Oak Ridge National Laboratory serves as the Inclusion Survey Contractor (ISC) for the Department of Energy's Uranium Mill Tailings Remedial Action Project (UMTRAP). The role of the ISC is to assess whether or not each of the estimated 10000-plus vicinity properties associated with UMTRAP is contaminated in excess of applicable standards. To date, the ISC has made recommendations on more than 8500 properties. This paper describes the flow of information through the inclusion process, the role of the ISC, and the inclusion progress to date.

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Rager, R.E., G. Smith, and R. Brody, Sergeant, Hauskins and Beckwith Geotechnical Engineers, Inc., Albuquerque, NM,

Effect of Freezing and Thawing on UMTRA Covers

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-3 - 3-12) (1988, October)

The proposed U.S. Environmental Protection Agency (EPA) groundwater standards (40 CFR 192) require that Uranium Mill Tailings Remedial Action (UMTRA) Project remedial action designs meet low numerical limits for contaminants contained in water or vapor exiting the embankments. To meet the standards, a cover of compacted fine-grained soil is placed over UMTRA Project embankments. One of the functions of this cover is to limit infiltration. The hydraulic conductivity of this infiltration barrier must be low in order to reduce seepage from the cell to the extent necessary to comply with the proposed EPA groundwater standards. Analyses of infiltration barriers covered with rock erosion protection show that the infiltration barriers may become saturated. Accordingly, it is necessary to assure that freezing and thawing of the infiltration barrier materials do not affect the performance of the embankment. A study has been conducted to determine if the hydraulic conductivity of fine-grained clayey soils used or proposed for use in radon/infiltration barriers is affected by repeated freezing and thawing cycles. In addition, a procedure for determining the depth of frost penetration has been developed.

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Rager, R.E., and M.W. Roshek, Sergeant, Hauskins and Beckwith Geotechnical Engineers, Inc., Albuquerque, NM,

Geotechnical and Construction Considerations of the Salt Lake City UMTRA Project

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11,

1986; (pp. 747-751) (1986)

The conceptual design for the Vitro site in the urban Salt Lake City, Utah area, 136 kilometers west to the remote South Clive Site, called for relocating the tailings, mill rubble, and other contaminated soils. The authors briefly describe the layout of the remedial action at both sites, detail problems encountered in implementing the remedial action, and present solutions that will be used to facilitate completion of the project within the second construction season. Construction has provided valuable experience on handling mill tailings during remedial action.

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Richey, R., U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

UMTRA Nonradiological Toxins Cleanup Methodology (DECHEM): A Program for Characterizing and Mitigating Chemical Contamination at UMTRA Project Sites

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-55 - 3-70) (1988, October)

Remedial investigations at uranium mill tailings sites have indicated that metallic toxicant such as arsenic, molybdenum, and selenium may be more mobile than the radiological constituents that have generally been emphasized in remedial planning. This means that residual chemical contamination may pose potential health risks after remediation of the radioactive component has been achieved. Regulatory guidelines are presently lacking for the cleanup of metallic toxicant from subpile soils or adjacent areas of windborne or waterborne contamination. A procedure has been developed in support of the Uranium Mill Tailings Remedial Action (UMTRA) Project to guide the characterization and remedial planning for these elements at the twenty-four UMTRA Project sites. The procedure generates site-specific cleanup criteria based on acceptable levels of health risk associated with exposure to the most hazardous

toxicant.

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Thiers, G.R., T.R. Wathen, and L.L. Farnes, Morrison-Knudsen Engineers, Inc., San Francisco, CA

Tailings Stabilization Experience at the Canonsburg UMTRA Site

CONF-860205; Geotechnical and Geohydrological Aspects of Waste Management, Proceedings of the Eighth Symposium, Fort Collins, CO, February 5, 1986. A.A. Balkema Publishers, Accord, MA; (pp. 509-516) (1986)

Stabilization of uranium mill tailings at the Canonsburg UMTRA site is scheduled for completion in 1985. The paper discusses: (1) segregation of materials having various levels of contamination; (2) placement and compaction clay cover material; (3) placement of filters, bedding and riprap; and (4) operation of sedimentation basin, final disposal of basin liner, and operation and salvage of contaminated water treatment plant.

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Titus, F.B., Jacobs Engineering Group, Inc., Albuquerque, NM

Effects of the Proposed EPA Groundwater Standards on the Uranium Mill Tailings Remedial Action Project

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 5-13) (1988, October)

Potential groundwater contamination beneath the 24 tailings piles that are to be stabilized under the UMTRA Project was intended in early project plans to be minimized by placing disposal piles over thick stratigraphic sequences of tight (minimally permeable) formations, and by designing covers that contained low permeability soil/clay infiltration barriers. The early decision to locate stabilized piles over tight formations now exacerbates the

problem of complying with recent standards, since the contaminants percolate to groundwater that moves only slowly through strata having low permeabilities. Innovative solutions have been evaluated that are aimed at further minimizing long-term infiltration, geochemically fixing contaminants in place before they reach groundwater, or otherwise minimizing contaminant flux.

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Tucker, M.K., U.S. Department of Energy, Grand Junction Project Office, Grand Junction, CO

**Status Report Vicinity Property Remedial
Action Standards, Verification and Certification**

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-71 - 3-82) (1988, October)

Under the authority of the Atomic Energy Act, the Uranium Mill Tailings radiation Control Act (UMTRAP), and 40 CFR 192 (EPA Standards for Remedial Action at Inactive Uranium Processing Sites), remedial action standards have been developed for formerly utilized sites under the Remedial Action Program (FUSRAP), facilities involved in the Surplus Facilities Management Program (SFMP), and facilities participation in the Uranium Mill Tailings Action Program (UMTRAP). The verification procedures for FUSRAP/SFMP and for UMTRAP are very similar, except for the extent of certification. It is recommended that DOE management review the discrepancy between the existing FUSRAP/SFMP requirement of 100% independent verification and the existing UMTRAP requirement of 10% independent verification. It is also recommended that DOE management determine whether the RAC Post Remedial Action Report could suffice as the certification docket for FUSRAP/SFMP and UMTRAP due to the number of differences in the certification process for FUSRAP/SFMP and UMTRAP.

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U.S. Bureau of Land Management, Cheyenne, WY

**Proposed Withdrawal and Opportunity for
Public Meeting - Wyoming**

Federal Register 53(208):43479-80 (1988, October 27)

The Department of Energy has filed an application to withdraw 80 acres of public mineral estate approximately 40 miles northwest of Douglas, Wyoming. The application proposes withdrawing the federal mineral estate while purchasing the private surface, in order to stabilize, in place, an uranium mill tailings area, known as the Spook Site. This notice will temporarily segregate the land for up to two years from the location and entry under the United States mining laws. The lands will remain open to mineral leasing with the concurrence of the Department of Energy, the Nuclear Regulatory Commission, and the Bureau of Land Management. During this period, the Department of Energy will prepare the necessary National Environmental Policy Act compliance documentation and justification for Secretarial consideration of the withdrawal application. The withdrawal is requested for a period of five years pending permanent Congressional action.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

**Impact of Groundwater Protection Standards
on UMTRA Project**

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 671-674) (1988)

In September 1987, the U.S. Environmental Protection Agency (EPA) proposed health and environmental standards to correct and prevent groundwater contamination beneath and in the vicinity of the Uranium Mill Tailings Remedial Action (UMTRA) Project sites. The standards, which are consistent with the Resource

Conservation and Recovery Act (RCRA), address final disposal, aquifer cleanup, and supplemental standards. Complying with the proposed standards will result in significant impacts to the UMTRA Project in terms of cost. As a first step toward estimating the total project groundwater restoration costs, the conditions, requirements, and aquifer restoration costs at five sites were considered: Gunnison, Colorado; Riverton, Wyoming; Lakeview, Oregon; Tuba City, Arizona; and Falls City, Texas. For each site, preliminary groundwater restoration schemes were proposed and evaluated, and base costs were estimated in 1988 dollars. To forecast total project costs, the five site-specific evaluations and their lowest cost estimates were extrapolated to the remaining 19 UMTRA Project sites. To estimate a total program cost based on the lowest site remedial action construction costs described above, the ratio of total program cost to the site remedial action costs for the current UMTRA Project was calculated. On the basis of the preliminary analyses described above, if aquifer restoration were required at the 24 UMTRA Project sites, the total program cost may be in excess of \$1 billion.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE to Hold Public Meeting on Tailings Cleanup Near Mexican Hat

DOE News (880722):1 (1988, July 22)

The U.S. Department of Energy (DOE) and the Navajo nation will hold a public information meeting regarding plans and schedules for the cleanup of uranium mill tailings sites near Mexican Hat, Utah and Monument Valley, Arizona. Remedial action at Mexican Hat was originally scheduled to begin in 1990, while Monument valley was scheduled for 1991. Construction is expected to begin in 1988 and extend over three years.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Issues Record of Decision on Cleanup of Grand Junction Tailings

DOE News (880722):1 (1988, July 22)

The U.S. Department of Energy (DOE) has issued the Record of Decision (ROD) concerning cleanup of radioactive mill tailings from the inactive Climax uranium processing site at Grand Junction, Colorado. Issuance of the ROD concludes compliance activities required under the National Environmental Policy Act (NEPA) before cleanup of the tailings may proceed. Contaminated materials from the tailings site and associated vicinity properties will be transported to the Cheney Reservoir site, buried partly below ground, and covered with layers of earth and rock. The mode of tailings transportation (truck or truck/train combination) will be determined by a competitive bidding process. Among the factors to be considered in evaluation bids are the bidders safety plan, environmental impact mitigation plan, transportation option/scheme, and schedule. In March, 1987, the DOE released a final Environmental Impact Statement (EIS) examining environmental impacts from the Cheney Reservoir disposal option and four other remedial action alternatives. Radiation exposure, transportation impacts, air quality effects, land use impacts, and costs were among the issues evaluated in comparing the alternatives.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Announces Award of Demolition Contract

DOE News (880805):1 (1988, August 5)

The U.S. Department of Energy (DOE) announced today that a contract to demolish existing mill buildings at the inactive Phillips-United Nuclear uranium mill tailings site at Ambrosia Lake, New Mexico, has been awarded to Envirex Demolition, of Huntington Station, New York. The contract provides for the demolition of mill buildings and other existing structures on the premises. Envirex has selected Coronado Wrecking of Albuquerque, New Mexico as a principal sub-tier contractor. Envirex Demolition was selected because it possesses specialized equipment to perform the demolition work and was the most cost competitive bidder for the demolition contract. Contracts involving site preparation and asbestos removal

were awarded earlier and asbestos removal is expected to be completed in late July. Demolition activities will then proceed and are scheduled to be completed in May 1989. The fourth contract will be awarded for construction of the stabilized tailings pile which is scheduled to begin in Fall 1988 and be completed in 1990.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE to Issue Request for Proposals for Grand Junction UMTRA Project Site

DOE News (880812):1 (1988, August 12)

The U.S. Department of Energy (DOE) announced today that MK-Ferguson Company will issue a Request for Proposals (RFP) August 15, 1988, for subcontractors to perform remedial action construction activities at the inactive Climax uranium mill site in Grand Junction, Colorado. Remedial action at the inactive Climax mill site will consist of the relocation of approximately 4 million cubic yards of tailings, which includes vicinity property material, to the Cheney Reservoir site 18 miles southeast Grand Junction. The RFP will include both rail/truck and truck as transportation options. Remedial action at the Grand Junction UMTRA Project site is anticipated to begin October 1988. The successful proposer will be required to meet established measures with regard to transportation, construction, noise level, and air and water quality. Persons wishing information on the Grand Junction Request for Proposal should contact Jerry Hymas, MD-Ferguson Company, Procurement Manager, toll-free at 1-800-423-4379.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Releases Environmental Assessment on Remedial Actions at Green River, Utah

DOE News (880817):1 (1988, August 17)

The U.S. Department of Energy (DOE) has published an Environmental Assessment regarding planned remedial actions at the former Union

Carbide uranium mill tailings site located near Green River, Utah. The Environmental Assessment has been mailed to local, state, and federal officials involved with the mill tailings cleanup project, as well as private citizens who have expressed an interest in the project. In the Environmental Assessment, DOE outlines the various options that are considered for disposal of the residual radioactive material and discusses the environmental consequences of DOE's preferred option. Removal and stabilization of the Green River tailings pile outside of the floodplain of Brown's Wash on the former Union Carbide site has been identified as the preferred alternative. The Green River Environmental Assessment and the Finding of No Significant Impact were published on July 6, 1988. The finding of No Significant Impact documents DOE proposed remedial action and indicates 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 Announces Award of Contract

DOE News (880831):1 (1988, August 31)

Nielsons, Inc., of Cortez, Colorado, has been awarded a contract to perform activities during the first phase of cleanup of two inactive uranium mill tailings sites at Rifle, Colorado. Work under this contract will begin immediately and extend over 12 months, employing about 40 people. The contract for Phase I of the cleanup provides for demolition of mill buildings and other existing structures on the premises. The contract scope also includes construction of decontamination pads, drainage control features, a field office, a security fence, and other facilities to prepare for permanent tailings disposal under the Uranium Mill Tailings Remedial Action (UMTRA) Project. Site characterization studies performed earlier identified asbestos and other hazardous materials present at one of the Rifle sites. The hazardous materials will be transported from the site in accordance with U.S. Environmental Protection Agency regulations. The Rifle sites are among 24 sites nationwide to be cleaned up under the UMTRA Project.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Groundbreaking Ceremony to Commemorate Rifle Cleanup Activities

DOE News (880914):1 (1988, September 14)
The State of Colorado and the U.S. Department of Energy (DOE) will hold a groundbreaking ceremony September 26, 1988, to commemorate the start of remedial action on the two inactive Union Carbide uranium processing sites located at Rifle, Colorado. The remedial action will provide for the disposal of over 4.1 million cubic yards of tailings and other contaminated materials in compliance with U.S. Environmental Protection Agency (EPA) standards. The first phase of construction activities is expected to employ approximately 40 people over a 12 month period. The Rifle sites are two of the nine Colorado UMTRA Project sites planned for cleanup under the Uranium Mill Tailings Radiation Control Act of 1978. Jacobs Engineering Group, Inc. is DOE's Technical Assistance Contractor on the UMTRA Project. MK-Ferguson, Company Inc. is the Remedial Action Contractor.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Awards Mill Tailings Cleanup Contract to Farmington, NM, Company

DOE News (881006):1 (1988, October 6)

The U.S. Department of Energy (DOE) announced today that CDK Contracting Company of Farmington, New Mexico has been awarded the contract to perform cleanup activities at the inactive Union Carbide uranium mill tailings site at Green River, Utah. The contract is scheduled to run 390 calendar days which includes a winter shutdown period. As many as 55 jobs will be required to perform the remedial action during peak construction periods. Work to be performed under the contract includes installation of a perimeter security fence, decontamination of existing mill buildings, and excavation and relocation of the tailings and other contaminated materials to a disposal cell approximately 600 feet south of the existing tailings pile. The tailings and

other contaminated materials will be consolidated in a disposal cell and covered with one foot of compacted earth to inhibit radon emanation and water infiltration. A five foot thick layer of sand, gravel and fill will then be added as erosion protection. CDK will be supervised by MK-Ferguson Company, DOE's Remedial Action Contractor on the Uranium Mill Tailings Remedial Action (UMTRA) Project.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Extends Deadline for Tailings Proposals

DOE News (881006):1 (1988, October 6)

The U.S. Department of Energy (DOE) has extended until October 20, 1988, the deadline for submission of proposals to perform remedial action at the inactive Climax uranium mill tailings site at Grand Junction, Colorado. The proposal due date had been extended earlier from the original deadline of September 22, 1988, to October 6, 1988. The new deadline is needed to provide additional time for prospective proposers to respond to an addendum to the Request for Proposal (RFP) regarding a new tailings haul route alternative. To respond to the RFP addendum, proposers may elect to incorporate into their proposals a design for the temporary haul road, a plan for obtaining any required easements and permits, a restoration plan for restoring the land at the completion of the haul, and other features they consider appropriate to perform the work. Remedial action at the inactive Climax uranium processing site will consist of the relocation of approximately four million cubic yards of tailings and other contaminated materials to the Cheney Reservoir disposal site 18 miles southeast of Grand Junction. Persons wishing information on the Grand Junction RFP should contact Jerry Hymas, MK-Ferguson Procurement Manager, toll-free at 1-800-443-4379.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Tailings Proposal Due Date Extended to November 3

DOE News (881025):1 (1988, October 25)

MK-Ferguson Company, the Remedial Action Contractor (RAC) for the U.S. Department of Energy (DOE) on the Uranium Mill Tailings Remedial Action (UMTRA) Project, announced today that the deadline for submission of proposals to perform remedial action construction activities at the inactive Climax uranium mill site at Grand Junction, Colorado, has been extended to November 3, 1988. The proposal due date had been set for October 20, 1988. Remedial action at the inactive Climax mill site will consist of the relocation of approximately four million cubic yards of tailings and other contaminated materials to the Cheney Reservoir disposal site 18 miles southeast of Grand Junction. A stabilized tailings pile will be constructed at the disposal site in accordance with U.S. Environmental Protection Agency (EPA) standards for the UMTRA Project. Persons wishing information on the Grand Junction RFP should contact Jerry Hymas, MK-Ferguson Procurement Manager, toll-free at 1-800-443-4379.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

President Extends UMTRA Project

DOE News (881114):1-2 (1988, November 14)

The President extended the UMTRA bill from 1990 to 1994. The extension is also needed to enable DOE to prepare detailed remedial action designs in response to new, more stringent groundwater protection standards for tailings cleanup proposed by the U.S. Environmental Protection Agency. The UMTRA Project provides for the cleanup of 24 inactive uranium processing sites located in 10 states and on certain Indian lands. The purpose of the remedial action is to minimize or eliminate potential public health hazards resulting from possible exposure to residual radioactive materials on the processing sites and associated properties. Cleanup has been completed at the Canonsburg, Pennsylvania and Shiprock, New Mexico sites. Work is presently underway at six sites across the western United States.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Begins Green River Cleanup Activities

DOE News (881122):1 (1988, November 22)

The U.S. Department of Energy and the State of Utah broke ground, initiating remedial action activities at the Green River Uranium Mill Tailings Remedial Action (UMTRA) Project site near Green River, Utah. The ceremony was held at the inactive Union Carbide uranium processing site located one mile southeast of Green River. The ground-breaking was for the \$4.5 million cleanup project. The remedial action will provide for the disposal of approximately 203,000 cubic yards of tailings and other contaminated materials in compliance with U.S. Environmental Protection Agency standards. The tailings and other radioactive material will be relocated to a disposal cell approximately 600 feet south of the existing tailing pile. The material will be consolidated partially below-grade and covered with earth and rock to inhibit radon emanation, protect groundwater, and ensure the long-term stability of the stabilized tailings pile.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Phase I To Begin At Climax Tailings Site

DOE News (881123):1 (1988, November 23)

MK-Ferguson Company, the Remedial Action Contractor (RAC) for the U.S. Department of Energy (DOE) on the Uranium Mill Tailings Remedial Action (UMTRA) Project, announced that a subcontract has been awarded to Ames Construction Company of Aurora, Colorado, for performance of Phase I construction activities at the inactive Climax uranium mill tailings site at Grand Junction. Ames Construction was issued a Notice to Proceed with activities to prepare the Climax site for tailings removal to be conducted under a Phase II subcontract. Activities to be performed under Phase I include demolition of most existing mill structures and construction of access control facilities, decontamination pads, a

wastewater retention basin, temporary offices, and support facilities. All Phase I work will take place within the boundaries of the Climax mill site. Proposals for performance of Phase II are currently under evaluation. Award of Phase I will not affect this evaluation. Phase II will consist of relocation of approximately four million cubic yards of tailings and construction of a stabilized tailings pile. Congress authorized cleanup of the Climax mill site and 23 other inactive uranium processing sites under Title I of the Uranium Mill Tailings Radiation Control Act of 1978.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

Phase II Subcontract Awarded For Grand Junction Tailings Cleanup

DOE News (881207):1-3 (1988, December 7)

On December 7, 1988, a MK-Ferguson subcontract was awarded to Industrial Constructors Corporation (ICC) of Missoula, Montana for Phase II cleanup activities at the inactive Climax uranium mill tailings site at Grand Junction, Colorado. MK-Ferguson Company, the DOE's Remedial Action (UMTRA) Project, provides construction management and will be responsible for all work performed under the subcontract. Phase II is scheduled to start now and run through Fall 1993, with tailings transport extending over 30 months beginning in Fall 1989. A ten-month period following remedial action is required to enable the Nuclear Regulatory Commission to certify the completed site prior to the Congressionally mandated end of the UMTRA Project in September 1994. More than 225 workers will be employed during peak construction periods. It is estimated that 245 jobs will be supported indirectly. MK-Ferguson issued a Request for Proposal (RFP) August 15, 1988 after which four firms submitted proposals. The ICC proposal was considered favorably primarily because of its proposed safety and environmental plans.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE to Present Tailings Site Selection Results

DOE News (890309):1 (1989, March 9)

The U.S. Department of Energy (DOE) in cooperation with the State of Colorado will present the results of the alternate site selection process for disposal of the Gunnison uranium mill tailings on Tuesday, March 14, 1989, at a meeting of the Gunnison County Board of Commissioners. The meeting will begin at 3 P.M. in the Commissioners Room of the Gunnison County Courthouse, 200 East Virginia Avenue. The DOE and the state have been conducting the alternate tailings disposal site selection process since late summer 1987. The candidate site found most suitable for permanent disposal of the tailings will be announced at the March 14 meeting. Five locations within a 15-mile radius of Gunnison were examined. Analysis of data from drilling programs at the five locations has recently been concluded. The candidate sites were then evaluated and ranked according to feasibility and cost.

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U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, NM

DOE Selects Landfill Site for Gunnison Tailings Disposal

DOE News (890309):1 (1989, March 20)

The U.S. Department of Energy (DOE) has selected an area near the existing Gunnison county landfill for permanent disposal of tailings from the inactive uranium processing site at Gunnison, Colorado, under the Uranium Mill Tailings Remedial Action (UMTRA) Project. The DOE and the State of Colorado conducted an alternate site selection process beginning in August, 1987, to determine a suitable site to accept the tailings. Five locations were evaluated based on geotechnical, hydrological, environmental and economic factors. The landfill site ranked highest overall. The selection was endorsed by officials from Gunnison County and the City of Gunnison after DOE presented its findings to the Gunnison County Board of Commissioners March 14, 1989. The cost of the Gunnison tailings cleanup effort is currently estimated at \$24.6 million. This expenditure is expected to support 187 jobs at its

peak and will generate \$13.8 million in gross labor income.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Technical, Political and Institutional Challenges Associated with the Uranium Mill Tailings Remedial Action Project

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 343-349) (1988)

The Uranium Mill Tailings Remedial Action (UMTRA) project was created in 1978 with passage of the Uranium Mill Tailings Radiation Control Act (Public Law 95-604), which required cleanup of twenty-four inactive uranium processing sites and an estimated 5000 vicinity properties containing residual radioactive materials from the processing sites. Remedial action planning and implementation have been carried out in a complex interrelationship of technical, political and institutional issues. It is the objective of this presentation to provide a summary of the types of issues confronting the remedial action program, and the various ways the Department of Energy (DOE) and its contractors have closely worked with the numerous federal, state and Indian tribal agencies and the public to successfully implement the remedial action program.

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U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM

Technical Approach Document

DOE/UMT-8015375; 215 pp. (1988, April)

This document describes the general technical

approaches and design criteria adopted by the U.S. Department of Energy (DOE) in order to implement Remedial Action Plans (RAPs) and final designs that comply with EPS standards. This document is a revision to the original document. Major revisions were made to the sections in riprap selection and sizing, and groundwater; only minor revisions were made to the remainder of the document. The U.S. Nuclear Regulatory Commission (NRC) has prepared a Standard Review Plan (NRC-SRP) which describes factors to be considered by NRC in approving the RAP. Sections 3.0, 4.0, 5.0, and 7.0 of this document are arranged under the same headings as those used in the NRC-SRP. This approach is adopted in order to facilitate joint use of the documents. Section 2.0 (not included in the NRC-SRP) discusses design considerations; Section 3.0 describes surface-water hydrology and erosion control; Section 4.0 describes geotechnical aspects of pile design; Section 5.0 discusses the Alternate Site Selection Process; Section 6.0 deals with radiological issues (in particular, the design of the radon barrier); Section 7.0 discusses protection of groundwater resources; and Section 8.0 discusses site design criteria for the RAC.

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U.S. Department of Energy, Grand Junction Project Office, Grand Junction, CO

Uranium Mill Tailings Remedial Action Project Vicinity Property Program

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 351-356) (1988)

The Department of Energy Uranium Mill Tailings Remedial Action (UMTRA) Grand Junction Project Vicinity Property Program is a \$165 million program for the removal and disposal of uranium mill tailings that were used in the construction of approximately 4000 residences, commercial buildings, and institutional facilities in the City of Grand Junction and surrounding Mesa County, Colorado. This paper discusses the UMTRA Vicinity Property Program and the economic benefits of this program for the City of Grand

Junction and Mesa County, Colorado. The Bureau of Reclamation Economic Assessment Model (BREAM) was used to estimate the increases in employment and increases in personal income in Mesa County that result from the Vicinity Property Program. The effects of program-related changes in income and taxable expenditures on local and state tax revenue are also presented.

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U.S. Department of Energy, Washington, DC

Availability of Environmental Assessment and Finding of No Significant Impact Incorporating Floodplain Statement of Findings - Remedial Action at the Green River Uranium Mill Tailings Site, Green River, UT

Federal Register 53(163):32096-32100 (1988, August)

The Department of Energy (DOE) has published an Environmental Assessment of Remedial Action at the Green River Uranium Mill Tailings Site, Green River, Utah, for the proposed remedial action on residual radioactive materials at the inactive uranium mill site near Green River, Utah. On the basis of the analyses in the Environmental Assessment (EA), 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). DOE has also prepared a Floodplain Assessment as part of the EA. The EA is available for public review.

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U.S. Department of Energy, Washington, DC

Compliance with the National Environmental Policy Act: Record of Decision for Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, CO

Federal Register 53(169):33518-28 (1988, August 31)

Persuant to the council on Environmental Quality Regulations implementing the procedural provisions of the National Environmental Policy Act (NEPA) and the U.S. Department of Energy guidelines for compliance with the NEPA, the Office of the Assistant Secretary for Nuclear Energy of DOE is issuing a Record of Decision on remedial actions at the former Climax Uranium Company uranium mill site at Grand Junction, Colorado. The Final Environmental Impact Statement, Remedial Actions at the former Climax Uranium Mill Site, Grand Junction, Mesa County, Colorado, was issued in December, 1986. Since that time, new information has been collected on tailings transport by slurry pipeline, the potential economic impacts of the proposed action, and the ability of the proposed action to comply with proposed U.S. Environmental Protection Agency (EPA) groundwater protection standards. In addition, the location of the disposal cell and volumes of contaminated, borrow, and restoration materials have changed. As a result of the new information and potentially significant changes to the proposed action, an analysis was prepared to determine whether to supplement the Environmental Impact Statement. The analysis indicated that the proposed changes were not relevant to environmental concerns and that the new information would have little bearing on the proposed action or its impacts.

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

National Emission Standards for Hazardous Air Pollutants (NESHAPS): Extension of Deadlines Under Standards for Radon-222 Emissions from Licensed Uranium Mill Tailings

Federal Register 53(192):39058 (1988, October 4)

This notice proposes an extension of deadlines for application and certification under 40 CFR 61.252(b) (1) and (c) and for decision by the Administrator on an application under 40 CFR 61.252(d) or (e). This extension is needed to provide additional time for uranium milling operators to decide whether or not to build new tailings impoundments, and to give the U.S. Environmental Protection Agency (EPA) more time to decide whether or not to grant extra time to mill

and possibly change its present mill tailings National Emission Standards for Hazardous Air Pollutants (NESHAP). This will reduce the regulatory burden on industry and allow EPA to reconsider the radionuclide NESHAP.

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U.S. Nuclear Regulatory Commission,
Washington, DC

**Custody and Long-Term Care of Uranium Mill
Tailings Sites**

Federal Register 53(165):32396-32403 (1988,
August 25)

The Nuclear Regulatory Commission (NRC) is considering general licenses that would permit NRC to license the custody and long-term care of decommissioned uranium or thorium mill tailings sites after remedial actions under the Uranium Mill Tailings Radiation Control Act (UMTRCA) have been completed. Commission action is needed to provide a procedure that ensures the maintenance of closed sites in a manner sufficient to protect the public health and safety and the environment. This action is necessary to meet the requirements of Titles I and II of the UMTRCA. In the Uranium Mill Tailings Radiation Control Act of 1978 the Congress recognized that uranium mill tailings may pose a potentially significant radiation health hazard to the public. One of the enactments of Congress is to provide governmental long-term care for the sites after the remedial actions are finished. Title I of UMTRCA defined the statutory authority and roles of DOE and NRC with regard to the remedial action program for inactive uranium mill tailings sites. Title II of UMTRCA contains similar requirements for NRC licensing of presently active

uranium or thorium mill tailings sites following their closure and operating license termination. These proposed regulations will complement other UMTRCA required regulations which have been completed and cover activities through closure.

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UNC Geotech, Inc., Grand Junction, CO

**Analysis of the Impact of the Byproduct Rule
on the U.S. Department of Energy's Grand
Junction Remedial Action Programs**

CONF-880201; Waste Management '88: Waste
Processing, Transportation, Storage and
Disposal - Technical Programs and Public
Education, Post, R.G. (ed.), Proceedings of a
Conference, Tucson, AZ, February 26-March 3,
1988, Vol. 1; (pp. 945-950) (1988)

The byproduct rule resolved numerous issues with regard to the management of U.S. Department of Energy (DOE) radioactive waste which is also hazardous under the Resource Conservation and Recovery Act (RCRA). It did so by clarifying that radioactive waste that is hazardous under RCRA is subject to regulation under both RCRA and the Atomic Energy Act (AEA), with the exception of materials that are defined as byproduct under Section 11(c)(2) of the AEA, specifically uranium and thorium mill tailings. However, when remedial actions at sites involving uranium or thorium mill tailings are conducted, it is still necessary to examine each remedial project in its entirety in order to determine the applicability of EPA requirements. The background, regulatory status, and compliance approach of three DOE Remedial Action Projects involving mill tailings are examined.

URANIUM MILL TAILINGS MANAGEMENT

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Abt, S.R., R.J. Wittler, J.F. Ruff, D.L. LaGrone, M.S. Khattak, J.D. Nelson, N.E. Hinkle, and D.W. Lee, U.S. Nuclear Regulatory Commission, Division of Low-Level Waste Management and Decommissioning, Washington, DC; Oak Ridge National Laboratory, Oak Ridge, TN

Development of Riprap Design Criteria by Riprap Testing in Flumes - Phase II: Followup Investigations

NUREG/CR-4651 (Vol. 2); ORNL/TM-10100 (Vol. 2); 107 pp. (1988, September)

Flume studies were conducted in which riprap embankments were subjected to overtopping flows. Embankment slopes of 1, 2, 8, 10, and 20% were protected with riprap containing median stone sizes of 1, 2, 4, 5, and/or 6 in. Riprap layer thickness ranged from 1.5 D-50 to 4 D-50. Riprap design criteria for overtopping flows were developed in terms of unit discharge at failure, interstitial velocities and discharges through the riprap layer thickness and gradation on riprap stability, and potential impacts of integrating soil into the riprap layer for riprap stabilization. A riprap design procedure is presented for overtopping flow conditions.

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Apps, M.J., M.J.M. Duke, and L.G. Stephens-Newsham, Alberta University, SLOWPOKE Reactor Facility, Edmonton, Alberta, Canada

Study of Radionuclides in Vegetation on Abandoned Uranium Tailings

Journal of Radioanalytical Nuclear Chemistry 123(1):133-147; CONF-87(0430); Methods and Applications of Radioanalytical Chemistry, Proceedings of an International Conference, Kona, HI, April 5, 1987; (pp. 133-147) (1988, July)

A study was carried out of the uptake of uranium

and other radionuclides by plants growing on abandoned tailings from an uranium mining operation. Assay methods included instrumental neutron activation analysis, delayed neutron counting, fission track imaging, and counting of natural radioactivity. Care was taken to avoid contamination of the plant material and a number of methods are described to identify such contamination. All plants observed showed high uptake of radionuclides, compared to plants studied from naturally uriferous and control areas. Graminoid (grass-like) plants showed significant uptake in the aboveground parts while woody plants showed exceedingly high uranium accumulation in the root portions. These results have significance in determination of the spread of radioactive material from such sites.

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Atomic Energy Control Board, Ottawa, Ontario, Canada

Cost of Decommissioning Uranium Mill Tailings

INFO-0198; 99 pp. (1986, April)

This report identifies several key operations that are commonly carried out during decommissioning of 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 long-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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Bailey, P.J.

Planning the Decommissioning of the Nabarlek U Project

Health Physics 50(2):309 (1986, February)

The factors involved in planning the decommissioning of a uranium mining project are discussed in a general way. An attempt is made to look at the costs versus benefits implicit in the work.

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Blowes, D.W., and R.W. Gillham, University of Waterloo, Institute for Groundwater Research, 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)

Investigates the physical and chemical interactions between groundwater and surface water in an area of inactive uranium mill tailings. Findings indicate that groundwater can be a major component of streamflow during runoff events in inactive tailings areas, and can have a major influence on runoff quality. The groundwater contribution to streamflow represents an important pathway of contaminant migration to the biosphere.

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Cadwallader, M.W., Gundle Lining Systems, Inc., Houston, TX

Cost Effective Tailings Pond and Heap Leach Pad Liners: A Case History

Small Mines Development in Precious Metals, Reno, NV (1987)

Heap leach mining requires liners in order to contain leaching solutions for both economic and

environmental incentives. The use of HDPE geomembrane liners for heap leaching is discussed in this paper. Comparison is made to clay liners, with inclusion of economic considerations. Several heap leach projects incorporating geomembranes are discussed.

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Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada

Numerical Simulation Studies of the Groundwater Discharge to Streams from Abandoned Uranium Mill Tailings

INIS-mf-11336; 35 pp. (1984, June)

This report presents an evaluation of the results of simulation studies of groundwater discharge to streams from abandoned uranium mill tailings and the effects of this discharge on the flux of contaminants to surface water systems. In particular, a discussion of the sensitivity of subsurface discharge to specific geometric, climatic and hydrogeologic factors is presented. Simulations were carried out using a two-dimensional numerical finite-element unsaturated-saturated flow model. A total of twenty-six simulations were made. The first twenty-four of these considered a tailings medium with homogeneous and isotropic hydraulic properties and with textural properties similar to those of sandy geological materials. In addition, two simulations were carried out for tailings materials with hydraulic properties that are similar to those of silt-loam. The results indicated that the actual quantity of subsurface discharge depends on many factors including rainfall rate and duration, surface slope, and texture. However, for the medium-fine sand material, subsurface discharge was always a significant component of the total discharge. Within the context of uranium tailings management this implies that large quantities of contaminants from subsurface sources of medium-textured tailings can be expected to be discharged to streams during stormflow events. Therefore there is reason to suspect that untreated runoff from such tailings will contain significant concentrations of contaminants for long periods of time.

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Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada

Modelling of Contaminant Migration in Acidic Groundwater Plumes at Uranium Tailings Impoundments: ADNEUT3

INIS-mf-11337; 110 pp. (1984, June)

This report describes the creation and application of ADNEUT3, the latest addition to the ADNEUT (Acid-Drainage NEUTralization) family of computer programs for simulating acid-drainage transport and neutralization. The creation of ADNEUT3 involved the expansion of ADNEUT1 to allow variable input conditions such as changing input solution with time, variable initial amounts of minerals through the simulated streamtube, variable velocities through the streamtube, and variable solubilities for relevant minerals dependent on aqueous chemical composition. Concepts for simulating acid-drainage neutralization are reviewed and ADNEUT3 is then applied to a field-study site of acidic contaminant migration from the Nordic Main uranium-tailings impoundment near Elliot Lake, Ontario. A sensitivity study is first implemented to calibrate ADNEUT3 to the results of the 1979 to 1983 field studies. Then ADNEUT3 is used to define probable past conditions at the site which are not reliably known. In particular, ADNEUT3 is used to help identify: (1) the approximate year when acidic seepage began leaving the tailings impoundment (1966-1967), (2) the past chemical composition of the seepage (somewhat more acidic for a short period of time), and (3) the location of the source area within the tailings for the acidic seepage (near the impoundment dam, close to the field site). Finally, ADNEUT3 is used to predict future contaminant migration. Results indicate that hundreds of years are required under present conditions for the most acidic water with associated high levels of contaminants to migrate about 100 m from the tailings impoundment. The cause of this slow movement is the significant neutralization capacity of the aquifer. If acid production within the tailings decreases in the future, migration rates of contaminants will also decrease.

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Cherry, J.A., R.W. Gillham, and R.V. Nicholson, Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada; University of Waterloo, Department of Earth Sciences, Waterloo, Ontario, Canada

Study of Kinetic Controls on Pyrite Oxidation with Application to Abandonment of Pyritic Uranium Tailings

INIS-mf-11338; 76 pp. (1984, November)

A laboratory investigation was undertaken to further clarify the controls on pyrite oxidation in carbonate-buffered solution. The behavior of oxidation rates over extended periods of time and reaction progress was examined. The effects of variation in localized moisture content in the presence of unlimited oxygen in the gas filled pores was also studied. Flow through systems were used in which granular pyrite or silica sand and pyrite mixtures were maintained under partially-saturated moisture conditions. Gas with atmospheric levels of oxygen was also passed continuously through the samples. The results of oxidation runs that had been on-going for about 10 thousand hours were compared to predictions of a model based on shrinking core theory. Experimental evidence suggests that over the course of about one year, resistance to oxidation increases as would occur if a reaction coating were formed on the pyrite surface. When compared to the theoretical behavior expected for such a process, only slight deviation is observed for the experimental data. Extended reaction progress of three separate grain-size fractions was simulated. Stages of vigorous oxidative treatment that were used to simulate extended reaction progress resulted in spurious behavior of the oxidation in the alkaline solution. The results do, to some extent, reflect behavior predicted by the shrinking core model. The effect of moisture content variation on oxidation rates was studied with the use of an unsaturated cell in which it was possible to control and maintain specified moisture content conditions while monitoring the rate of oxidation. The results of the experiment involving the unsaturated reaction cell show that the changes in local moisture content do not affect the rate of oxidation when oxygen is in continuous supply.

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Clulow, F.V., N.K. Dave, T.P. Lim, and N.R. Cloutier, 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

Uptake of Ra-226 by Established Vegetation and Black Cutworm Larvae, AGROTIS IPSILON (Class Insecta Order Lepidoptera), on U Mill Tailings at Elliot Lake, Canada

Health Physics 55(1):31-35 (1988, July)

Radium-226 levels in samples from an inactive uranium tailings site at Elliot Lake, Ontario, Canada, were: 9140 +/- 500 mBq/g dry weight in the substrate; 62 +/- 1 mBq/g dry weight in rye, *Secale cereale*, and less than 3.7 mBq/g dry weight in oats, *Avena sativa*, the dominant species established by revegetation of the tailings; and 117 +/- 7 mBq/g dry weight in washed and unwashed black cutworm larvae. Concentration ratios were: vegetation to tailings 0.001 to 0.007; black cutworms to vegetation 3.6 and black cutworms to tailings 0.01. The values are considered too low to be considered a hazard to herring gulls, *Larus argentatus*, which occasionally feed on cutworms.

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

Hydrologic Design for Riprap on Embankment Slopes

NUREG-1263; 80 pp. (1988, September)

Waste impoundments for uranium tailings and other hazardous substances are often protected by compacted earth and clay, covered with a layer of loose rock (riprap). The report outlines procedures that could be followed to design riprap to withstand forces caused by runoff resulting from extreme rainfall directly on the embankment. The Probable Maximum Precipitation for very small areas is developed from considerations of severe storms of

short duration at mid-latitudes. A two-dimensional finite difference model is then used to calculate the runoff from severe rainfall events. The procedure takes into account flow both beneath and above the rock layer and approximates the concentration in flow which could be caused by a nonlevel or slumped embankment. The sensitivity to various assumptions, such as the shape and size of the rock, the thickness of the layer, and the shape of the embankment, suggests that peak runoff from an armored slope could be attenuated with proper design. Frictional relationships for complex flow regimes are developed on the basis of flow through rock-filled dams and in mountain streams. These relationships are tested against experimental data collected in laboratory flumes; the tests provide excellent results. The resulting runoff is then used in either the Stephenson or safety factor method to find the stable rock diameter. The rock sizes determined by this procedure for a given flow have been compared with data on the failure of rock layers in experimental flumes, again with excellent results. Computer programs are included for implementing the method.

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Davis, A., and D.D. Runnells, Camp Dresser and McKee, Inc., Denver, CO

Geochemical Interactions Between Acidic Tailings Fluid and Bedrock: Use of the Computer Model MINTEQ

Applied Geochemistry 2(2):231-241 (1987)

Contamination of groundwater in domestic water wells has been documented in the vicinity of a uranium mill near Canon City, south-central Colorado. 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.

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Denham, D.H., F.T. Cross, and J.K. Soldat, Pacific Northwest Laboratory, Richland, WA

Health Effects Estimation: Methods and Results for Properties Contaminated by Uranium Mill Tailings

HTD-Vol. 76; CONF-860425; Radon and Its Decay Products: Occurrence, Properties, and Health Effects, Hopke, P.K. (ed.), Proceedings of the 191st American Chemical Society National Meeting, New York, NY, April 13-14, 1986. American Chemical Society, Washington, DC; (pp. 513-525) (1987)

This paper describes methods for estimating potential health effects from exposure to uranium mill tailings and presents a summary of risk projections for 57 mill tailings contaminated properties (residences, schools, churches, and businesses) in the United States. The methods provide realistic estimates of cancer risk to exposed individuals based on property-specific occupancy and contamination patterns. External exposure to gamma radiation, inhalation of radon daughters, and consumption of food products grown in radium-contaminated soil are considered. Most of the projected risk was from indoor exposure to radon daughters; however, for some properties the risk from consumption of locally grown food products is similar to that from radon daughters. In all cases, the projected number of lifetime cancer deaths for specific properties is less than one, but for some properties the increase in risk over that normally expected is greater than 100%.

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Deutsch, W.J., and J.W. Thackston

Aquifer Restoration Considerations at Inactive Uranium Mill Tailings Sites

CONF-860695; HazMat '86: Hazardous Materials Management, Proceedings of a Conference and Exhibition, Atlantic City, NJ, June 2, 1986 (1986)

Environmental hazards associated with inactive uranium mill tailings are being evaluated as part of the Uranium Mill Tailings Remedial Action (UMTRA) Project. Twenty-four sites in ten states are covered in this \$900M project. One of the primary potential health hazards identified at these

sites has been the contamination of groundwater by seepage of tailings solution from the pile into the underlying aquifers. Remedial action measures at these sites must minimize future contamination of groundwater resources and consider the feasibility of aquifer restoration. The tailings constituents that have been found in groundwater at contaminant levels according to the EPA drinking water standards are cadmium, molybdenum, nitrate, selenium, sulfate, and uranium. The design of an aquifer restoration method to eliminate these relatively mobile contaminants from the groundwater must consider the chemistry of the elements, local hydrogeologic conditions, size of the contaminant plume, level of contamination, and the available treatment technology. The decision to implement aquifer restoration must be based on the current and predicted value of the water resource, the overall effect of restoration on the aquifer system, an evaluation of the uncertainty inherent in the restoration method, and the cost of restoration. At several sites it has been found that restoration of the groundwater may not be feasible because of the volume of water that must be treated and/or the lack of data to show that available treatment methods will be effective. This paper describes existing groundwater contamination at several sites, explores the options available for restoration, and discusses the decision making process used to evaluate the restoration alternatives.

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Environment Canada, Environmental Protection Service, Ottawa, Ontario, Canada

Long-Term Ecological Behaviour of Abandoned Uranium Mill Tailings - Growth Patterns of Indigenous Vegetation on Terrestrial and Semi-Aquatic Areas

EPS-3/HA/2; 117 pp. (1984, December)

Semiaquatic and terrestrial areas on abandoned or inactive uranium mill tailings in Ontario were studied in order to identify the growth characteristics of the naturally invading species dominating these areas. Semiaquatic areas of tailings sites have been invaded by cattails. These species formed wetland communities which varied in size, but all were essentially monocultures of

Typha latifolia, *T. angustifolia*, or of the hybrids *T. glauca*. Sedges, *Scripus cyperinus* (wool-grass) and *Phragmites australis* (reed-grass), were found in transition zones between the cattail stand and the dry section of the tailings site. The expansion of the cattail stands appeared to be controlled by the hydrological conditions on the site, rather than the chemical characteristics of the tailings.

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Feenstra, S., D.W. Reades, J.A. Cherry, D.B. Chambers, G.G. Case, and B.G. Ibbotson, Golder Associates, Inc., Toronto, Ontario, Canada

Manual for the Sampling of Uranium Mine Tailings

INIS-mf-11133; 179 pp. (1983, April)

The purpose of this manual is to describe the requisite sampling procedures to provide a basis for the application of uniform high-quality standards to detailed geotechnical, hydrogeological, geochemical and air quality measurements at Canadian uranium tailings disposal sites. The report describes the objective and scope of a sampling program, the preliminary data collection, and the procedures for sampling of tailings solids, surface water and seepage, tailings porewater, wind-blown dust, and radon.

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Gee, G.W., M.D. Campbell, H.D. Freeman, and J.F. Cline, Pacific Northwest Laboratory, Richland, WA

Assessment of Cover Systems at the Grand Junction, Colorado, Uranium Mill Tailings Pile: 1987 Field Measurements

PNL-6762; 64 pp. (1989, February)

Four Pacific Northwest Laboratory (PNL) scientists and a technician conducted an on-site evaluation of radon gas exhalation, water content profiles, and plant and animal intrusion for a series of cover systems located on the uranium mill tailings pile at Grand Junction, Colorado. These six plots were sampled extensively down to the radon control layer

(e.g. asphalt or wet clay) for soil moisture content and permeability. Radon gas emission through the surface was also measured. Soil samples were collected and analyzed in the lab for particle-size distribution, particle density, bulk density, and ambient water content. Prairie dog burrows were excavated to discover the extent to which they penetrated the barriers. Plant type, density, and cover characteristics were measured.

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Hart, K.P., University of New South Wales, Department of Applied Mathematics, Kensington, Australia

Radon Exhalation from Uranium Tailings

Dissertation Abstracts International 48(03-B):823; Thesis (Ph.D.) (1986)

A study has been made of the emanation of radon-222 and its subsequent diffusion through porous media. This work has application to the prediction of radon release from bare and covered uranium tailings piles and the design of tailings rehabilitation systems. Release of radon to the environment involves two processes; liberation from the mineral grain in which it is formed and diffusion through porous media. The first process is characterized by the radon emanation coefficient; the second by the diffusion coefficient. Radon emanation coefficients were measured for a variety of Australian ores and tailings. Carnotite ores from Western Australia have lower emanation coefficients than uraninite ores. Absolutely dry materials have very low emanation coefficients but these increase markedly with the addition of a small amount of water less than 2 wt %. This behavior can be qualitatively explained by the ability of adsorbed water to trap the radon recoil atom. On average, water-saturated ores and tailings emanate about four times as much radon as dry materials. Analytical equations were derived to describe steady-state radon diffusion through uranium tailings and multiple layers of earthen cover materials. Exact solutions were compared to approximate methods proposed by other workers. Unsteady-state diffusion was also analyzed using classical methods, where appropriate, and numerical methods for more complex situations. Theoretical analysis was complemented by laboratory studies

using columns packed with tailings and cover materials. Radon flux and interstitial radon concentrations were measured and the data analyzed using the analytical equations to determine the diffusion coefficients and tortuosity factors as a function of the properties of the media. Of the variables affecting the diffusion coefficient, moisture content has by far the greatest effect. For dry and water-saturated materials, the diffusion coefficient can be calculated from the molecular diffusivity in either air or water, using appropriate values for the tortuosity factor.

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Ibrahim, S.A., and F.W. Whicker, Colorado State University, Fort Collins, CO

Comparative Uptake of U and Th by Native Plants at a U Production Site

Health Physics 54(4):413-419 (1988, April)

During a 3- to 4-year period, concentrations of U-238, U-234, Th-230, Th-232, and Th-228 were determined in soils and native vegetation at various sites around a typical uranium mining and milling operation in Wyoming. Plant/soil concentration ratios (CR) for uranium and thorium isotopes were estimated for: (1) exposed, weathered tailings, (2) the edge of a tailings impoundment, (3) an area downwind from exposed tailings, (4) a reclamation area, and (5) several background, native range locations. The U-238/U-234 concentration ratio of 0.9 to 1.1 in soil and vegetation indicated near-radioactive equilibrium of both radionuclides at all locations. Mean concentrations of the uranium and thorium isotopes in background soil ranged from 44 to 52 mBq/g. Concentrations of U-238 and Th-230 in soil and vegetation were elevated above background at all sites disturbed by mining and milling activities. Uranium concentrations in tailings and invading vegetation were an order of magnitude greater than in the background locations, whereas Th-230 concentrations were elevated above background by some two orders of magnitude. No demonstrable differences in radionuclide concentrations between plant groups and collection years were found. The observed CR values for U-238 and Th-230 of 0.81 and 0.69 for vegetation growing on exposed tailings were elevated above native range by factors of 9.0

and 3.6, respectively, and generally higher than other published values. Exceptionally high CR values for Th-230 (1.9 to 2.9) observed near the tailings impoundment demonstrate that under certain conditions, vegetation can accumulate Th-230 to a much greater extent than previously reported. Vegetation concentrations were lower for Th-232 relative to Th-230 and Th-228 at locations where they are present at similar soil concentrations.

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Ibrahim, S.A., and F.W. Whicker, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Plant/Soil Concentration Ratios of Ra-226 for Contrasting Sites Around an Active U Mine-Mill

Health Physics 55(6):903-910 (1988, December)

Concentrations of Ra-226 were determined in native vegetation and underlying substrate (soil and tailings) at various sites around a conventional open-pit, acid leach uranium production operation in Wyoming. Plant/soil concentration ratios (CRs) for Ra-226 were estimated for various sites, including weathered tailings; a tailings impoundment shoreline; downwind from exposed tailings; a mine overburden reclamation area; and several background locations. Radium-226 concentrations for vegetation and substrate and CR values from the perturbed sites were evaluated above background. The highest vegetation concentration (1.3 Bq/g) was found in a grass which had invaded exposed, weathered tailings. Levels of Ra-226 in soil and vegetation and CR values decreased with distance from the tailings impoundment edge. CR values varied significantly among sites, but few differences were found between plant species groups. The observed CR values ranged from 0.07 Bq/g at the background and reclamation areas to 0.4 Bq/g downwind from the tailings area. Average CR values for plants growing on exposed tailings and within one meter from the impoundment edge were 0.15 and 0.3 Bq/g, respectively. CR values of Ra-226 for plants on tailings substrate were comparatively low in contrast to other radionuclides in the uranium chain. We speculate that in the case of sulfuric

acid leached tailings-derived material, Ra-226 is sequestered as sulfate, which is highly insoluble relative to the sulfates of the other elements (e.g., uranium and thorium) resulting in reduced availability for plant uptake.

509

Kilborn Mining Corporation, Saskatoon, Saskatchewan, Canada

Cost Study on Waste Management at Three Model Canadian Uranium Mines - Final Report

INIS-mf-11132; 247 pp. (1984, March)

A waste management cost study was initiated to determine the capital and operating costs of three different uranium waste management systems which incorporate current technologies being used in Canadian uranium mining operations. Cost estimates were to be done to a thirty percent level of accuracy and were to include all waste management related costs of a uranium ore processing facility. Each model is based on an annual uranium production of 1,923,000 kg U (5,000,000 lb U₃O₈) with a total operating life of 20 years for the facility. The three models, A, B, and C, are based on three different uranium ore grades, 0.10 percent U₃O₈, 0.475 percent U₃O₈, and 1.5 percent U₃O₈ respectively. Yellowcake production is assumed to start in January 1984. Model A is based on a conceptual 7180 tons per day uranium ore processing facility and waste management system typical of uranium operations in the Elliot Lake area of northern Ontario with an established infrastructure. Model B is a 1.512 tons per day operation based on a remote uranium operation typical of the Athabasca Basin properties in northern Saskatchewan. Model C is a 466 tons per day operation processing a high-grade uranium ore containing arsenic and heavy metal concentrations typical of some northern Saskatchewan deposits.

510

Lewis, B.G., Northwestern University, Evanston, IL

Mechanisms for Radon-222 Transport in

Vascular Plants, and Uptake of Radium-226 in C-3 and C-4 Species: Final Report for Period August 5, 1985-December 31, 1987

DOE/ER/60369-T1; 49 pp. (1988, May)

Previous work in our laboratory had provided quantification of plant exhalation of radon-222. This present work focused on the mechanisms of the phenomenon. Experiments with radon diffusion through paraffin indicated that plant epicuticular wax would present essentially no barrier to radon, unlike its effect on water vapor diffusion. Thus, radon and water transport in the plant appear to be decoupled primarily in the leaf mesophyll. Transport of radon from root to leaf appears to be primarily as convective flow in the xylem fluid, but diffusion of radon from the fluid into air spaces within the plant probably occurs. Experiments with plants in solution culture indicated that, generally, C-3 species tended to have higher tissue concentrations of radium-226, but these differences were less marked, and could even be reversed, for C-3 and C-4 plants within the same genus. Manipulating solution culture pH was not dramatically effective in reducing radium-226 uptake.

511

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

Soil Erosion Rates from Mixed Soil and Gravel Surfaces in a Wind Tunnel: A Preliminary Report

PNL-6677; 62 pp. (1988, December)

Tests of wind erosion were performed in a controlled-environment wind tunnel to support the development of natural-material protective barriers for long-term isolation of radioactive waste. Barrier performance standards currently being developed for internal and external barrier performance are expected to mandate a surface layer that is resistant to wind erosion. The purpose of this study was to initiate a series of tests to determine suitable soil and gravel mixtures for such a barrier and to test worst-case surface layer conditions under the influence of high wind speeds. Six mixed soil and gravel surfaces were prepared,

weathered to represent natural wind-blown desert areas, and subjected to controlled wind erosion forces in a wind tunnel. The applied erosive forces, including surface shear forces, were characterized to provide a means of relating wind tunnel results with actual field conditions. Soil particle losses from the surfaces caused by suspension, saltation, and surface creep were monitored by aerosol sample probes and mass balance measurements.

512

MacDonell, M.M., Northwestern University, Evanston, IL

Uptake of Radium-226 from Uranium Mill Tailings by C-3 and C-4 Plants and Implications for Transport of Radium-226 and Radon-222 into the Disposal Site Environment (Leaf Area, Distribution, Transpiration, Vegetated, Photosynthetic)

AAD86-21825; (pp. 2544-2666) (1986)

Radium-226 entry into plants grown on uranium mill tailings at pH 6.5 appears to be governed primarily by movement of tailings solution into the plant. The lower transpiration ratios of C-4 photosynthetic plants as compared to C-3 plants result in lower tissue concentrations of radium-226. In each case, the distribution of radium-226 within the plants studied: corn (C-4), dwarf sunflower (C-3), tall fescue grass (C-3), and four species of Panicum (two C-3 and two C-4) exhibited an acropetal gradient, decreasing from the roots where the concentrations are relatively high to the apex of the plant. Tissue concentrations of Ra-226 decreased over time, attributable to increases in biomass while total Ra-226 levels remain constant. Release of radon from vegetated tailings was found to be directly related to the total leaf area of the plant following introduction into the plant of tailings solution. Thus, the plant pathway is shown to be an important mechanism for the transport of radium-226 and radon-222 from mill tailings into the environment. Current tailings disposal site reclamation efforts should consider the effects of the photosynthetic nature of the vegetation species and its total leaf area to reduce the potential for introduction of these elements into the site environment.

513

Mann, H., and W.S. Fyfe, University of Western Ontario, Department of Geology, London, Ontario, Canada

The Uranium Content of Waters from the Elliot Lake Area, Northern Ontario, Canada: Uranium Mining District, Georgian Bay and Lake Huron

Uranium 4(3):227-244 (1988)

Concentration of dissolved uranium vary over a factor of greater than 10,000 in natural and tailings waters of the Elliot Lake mining district. This results from the hydrolysis and oxidation of mineral phases in the tailings impoundments, promoted in turn by the oxidation of pyrite to sulphuric acid during infiltration of precipitation. Enhanced levels of dissolved U in the Serpent River may be due to the intrinsically uraniferous nature of the Huronian sedimentary rocks which comprise part of the drainage basin, as well as the contaminant U 'spike' released from the tailings discharge.

514

Melis Consulting Engineers Limited, Saskatoon, Saskatchewan, Canada; Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada

Radium Removal from Canadian Uranium Mining Effluents by a Radium-Selective Ion Exchange Complexer

INIS-mf-11158; 148 pp. (1984, July)

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 ion exchange complexer was shown to be efficient in removing radium from contaminated water of uranium mining operations, with the ultimate loading capacity of the resin on one type of water treated being determined as approximately 1600 Bq/cu cm of new resin. The results showed that

the resin was effective in removing radium but not any other contaminants.

515

Morin, K.A., and J.A. Cherry, Morwijk Enterprises, Vancouver, British Columbia, Canada

Migration of Acidic Groundwater Seepage from Uranium-Tailings Impoundments: (3) - Simulation of the Conceptual Model with Application to Seepage Area A

Journal of Contaminant Hydrology 2(4):323-342 (1988)

The conceptual model for contaminant migration is coded into a family of computer programs named ADNEUT. Program framework, execution time and cost, efficiency, accuracy based on comparisons with other programs, and sensitivity of simulated results to input data provide insight into the benefits and limitations of ADNEUT. Simulations with ADNEUT show that the neutralization zone is composed of a sequence of several subregions through which a theoretical step-function increase in pH and change in other aqueous constituents occur from the inner core to the outer zone. The pH, aqueous chemistry, and retardation of each subregion are the result of the dissolution of, and buffering by, one of the minerals of the conceptual model. The behavior of a subregion affects the behavior of all downgradient subregions, resulting in a complex scenario of dependence for subregions at a site. ADNEUT is used to examine probable past behavior of a contaminant plume prior to monitoring.

516

Morin, K.A., J.A. Cherry, N.K. Dave, and T.P. Lim, Morwijk Enterprises, Vancouver, British Columbia, Canada

Migration of Acidic Groundwater Seepage From Uranium-Tailings Impoundments: (2) - Geochemical Behavior of Radionuclides in Groundwater

Journal of Contaminant Hydrology 2(4):305-322

(1988)

The delineation of radionuclide behavior requires (1) the calculation of total element concentration by the summation of concentrations of each element's isotopes (the isotopic concentrations are calculated from the isotopes' radioactivities), (2) the evaluation of solid-liquid interactions using total element concentrations, and (3), for particular isotopes, the evaluation of the extent to which parental geochemical behavior causes a deviation in the isotope's behavior from that of its total element. A computerized speciation program, WATRAD, is used to evaluate aqueous complexation and mineral saturation indices of radium, actinium, thorium, and uranium. Data from Seepage Area A on isotopes of these four elements plus Pb-210 show that the geochemical behavior of radionuclides can be best defined on an individual isotopic basis rather than on an elemental basis.

517

Morin, K.A., J.A. Cherry, N.K. Dave, T.P. Lim, and A.J. Vivyurka, Morwijk Enterprises, Vancouver, British Columbia, Canada

Migration of Acidic Groundwater Seepage From Uranium-Tailings Impoundments: (1) - Field Study and Conceptual Hydrogeochemical Model

Journal of Contaminant Hydrology 2(4):271-303 (1988)

Tailings seepage drains downward into the aquifer and then migrates laterally away. Results of the field study indicate the seepage can be divided into three geochemical zones: (1) the inner core, which is essentially unaltered, acidic seepage from the tailings; (2) the neutralization zone, in which inner-core water is neutralized and aqueous concentrations decrease significantly; and (3) the outer zone, which contains both neutralized water from the neutralization zone and pH-neutral process water from the uranium milling operation. Yearly comparisons from 1979 to 1984 indicate the neutralization zone and inner core are migrating downgradient at a rate of about 1 meter/year, which is about 1/440 of the groundwater velocity. The mechanisms that produce the retardation and the

decreases in aqueous concentrations are part of the conceptual model. The main features of the conceptual model are solid-liquid interactions, particularly mineral precipitation-dissolution, and buffering effects of dominant aqueous species.

518

Morison, I.W., Department of Primary Industry and Energy, Canberra, Australia

Australian Policy on Management of Uranium Mine/Mill Wastes

CONF-880401; Radiation Protection Principles in Nuclear Energy, Proceedings of an International Conference, Sydney, Australia, April 18-22, 1988. International Atomic Energy Agency, Vienna, Austria, Vol. 2; (pp. 151-158) (1988)

Under the Federal system of Government in Australia, in which individual states are primarily responsible for mining activities, public health and environment protection, national control is exercised through the Federal Government's export powers backed by national codes of practice. The Federal Government also maintains a role in the Northern Territory similar to that of state authorities. An outline is given of the approach to mine/mill waste management incorporated into the Australian code of practice, and its provisions to effectively limit the contamination effects of long lived radionuclides during and after mining and milling operations.

519

Morris, R.C., Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO

Environmental Effects of Rn-222 Fluence Rate from Reclaimed Uranium Mill Tailings

DOE/EV-10305-T1; Thesis (Masters); 79 pp. (1987, April)

The Rn-222 fluence rate from 2 plots with uranium mill tailings buried beneath 30 cm of overburden and 30 cm of topsoil were measured. An

additional 30 cm of clay covered the tailings on 1 of the plots, and each plot was subdivided into bare soil and vegetated subplots. A control plot, identical to the plot without a clay cap but having no tailings, was also measured. In addition to fluence rate, moisture in each of the plot layers, atmospheric pressure, air temperature, and relative humidity during each sampling period were measured. Linear correlation, two-way ANOVA, and stepwise multiple regression were used to analyze the effects on the plot characteristics and the environmental variables on Rn-222 fluence rate. While several environmental variables had influence, the most important effect on Rn-222 fluence rates from these plots was the combination of a clay cap and a vegetated surface. The mean fluence rate from the plot having both these characteristics was over 3 times that of the vegetated plot without a clay cap and 14 times that of the bare plot with a clay cap. The interaction effect may be due to the proliferation of roots in the moist clay and active transport of dissolved Rn-222 to the surface in water. This speculation is supported by the observation that on vegetated plots with a clay cap, the moisture content of the clay had an enhancing effect on fluence rate. The interaction of a clay cap and vegetation to enhance Rn-222 fluence rate has regulatory implications. As reclamation plots mature, i.e. as roots grow into the clay cap and tailings, fluence rates which were below EPA limits may begin to exceed them. It may be necessary to design plots without a clay cap in order to keep Rn-222 fluence rates below the regulatory limits.

520

Morrison-Knudsen Engineers, Inc., Boise, ID

Geochemical Aspects of Seepage from Mill Tailings

Proceedings of a Society of Mining Engineers Annual Meeting, Phoenix, AZ, January 25-28, 1988; (pp. 1-6) (1988)

The large geochemical differences between tailings and groundwater create a disequilibrium in the groundwater with respect to the soils when seepage from tailings enters the groundwater. Precipitation and dissolution reactions, involving the major

chemistry, occur to return the perturbed system to chemical equilibrium between groundwater and minerals. Retardation of trace elements depends upon the chemical character of the groundwater and the adsorption substrates. In the case of uranium mill tailings, the mobility of contaminants is controlled primarily by precipitation/dissolution reactions which neutralize the pH, modify the Eh (redox potential), and produce highly adsorptive substrate for retardation of trace elements.

521

Office of the Supervising Scientist for the Alligator Rivers Region, Sydney, Australia

Alligator Rivers Region Research Institute: Annual Research Summary 1986-1987

Australian Government Publishing Service, Canberra, Australia, 135 pp. (1987)

The Institute researches the effects on the environment of uranium mining operations in the Alligator Rivers Region of the Northern Territory. The research program covers the following main areas: biological testing, ecological monitoring, environmental radioactivity, environmental chemistry, environmental modeling, plant ecology, geomorphology, and hydrogeology.

522

Oresegun, M.O., and A.I. Babalola, Ibadan University, Physics Department, Nigeria; International Atomic Energy Agency, Vienna, Austria

Annual Indoor Dose Burden Estimates in Dwellings Built in Nigeria with Radioactive U-Th Rich Tailings

CONF-880401; Radiation Protection Principles in Nuclear Energy, Proceedings of an International Conference, Sydney, Australia, April 18-22, 1988. International Atomic Energy Agency, Vienna, Austria, Vol. 2 (1988)

Tailings from the tin mining industry in Nigeria have been used extensively for various purposes. Of utmost concern to the Federal Radiation

Protection Service is their use in the construction of residential buildings. These tailings have been found to have high activities of naturally occurring radionuclides, particularly U-238, Th-232 and K-40. Gamma spectroscopic analysis of the building materials revealed the following activity concentrations: Th-232 - $8.873 \times 10(E+3)$ Bq/kg; U-238 - $4.3105 \times 10(E+3)$ Bq/kg; and K-40 - $1.342 \times 10(E+3)$ Bq/kg. The radium equivalent was $1.5606 \times 10(E+4)$ Bq/kg, which is two orders of magnitude greater than the internationally acceptable limit recommended for residential buildings. On the spot gamma exposure rate monitoring gave values ranging from 5.34 to 175 mGy/a. The annual dose burden in air was estimated using the Stranden model. Results show that the occupants of such houses may be receiving doses in excess of the maximum permissible dose for occupationally exposed persons. Remedial action, i.e. demolition and removal of the affected soils and walls, is recommended.

523

Paige, C.R., O.E. Hileman, and W.J. Snodgrass, McMaster University, Department of Chemistry, Hamilton, Ontario, Canada; IEC Beak Consultants Limited, Mississauga, Ontario, Canada

Formation of Hetero-Epitaxial Deposits of Lead, Barium and (Barium/Lead) Sulfates on Mica Surfaces

Journal of Radioanalytical and Nuclear Chemistry 127(5):341-348 (1988, July 15)

As part of an investigation concerning the fate of Ra-226 during uranium ore milling and long-term tailings storage hetero-epitaxial deposits of barium sulfate, lead sulfate, and mixed barium/lead sulfate were grown on mica surfaces. The deposits formed readily on the substrate from supersaturated aqueous solutions of the parent ions and might be strongly adherent. Calcium sulfate formed deposits on mica at much higher levels of supersaturation than lead or barium sulfate.

524

Pan, Y., and Z. Pan, Ministry of Nuclear

Industry, Bureau of Uranium Mining and Metallurgy, Beijing, China

Some Opinions on Environmental Management of Waste Rock Piles and Tailing Pools at Uranium Mines and Mills

Radioactive Waste Management, Proceedings of a Conference, Hunan, China, September 21, 1986. China Atomic Energy Press, Beijing, China; (pp. 94-99) (1987)

The characteristics of waste rock and tailings at uranium mines and mills and their environmental contamination behaviors are described. Based on 30 years practice in uranium mining and milling, the opinions on principles and measures of management of waste rock piles and tailing pools are given.

525

Perez Estevez, C., and M. Sanchez Delgado, Empresa Nacional del Uranium, S.A., Madrid, Spain

Test Program for the Design of a Radon Barrier

Nuclear Europe 8(11-12):40-41 (1988, November-December)

Spain's radioactive waste management agency (ENRESA) is in charge of the decommissioning and remedial action for an inactive uranium mill on the outskirts of Andujar town in the southern province of Jaen. Decommissioning to be done at the sight consists of: dismantling all the facility's equipment and systems; demolishing the structures; dumping all the equipment, demolition debris, etc., in a pile adjacent to the tailings pile; reshaping the actual tailings pile by flattening its side slopes from a gradient of 2-in-1 to 5-in-1; and covering the tailings with a multilayer system of radon and infiltration barrier (clay), filter media (sand) and erosion barrier (rock and gravel).

526

Pickup, G., R.J. Wasson, R.F. Warren, D. Tongway, R.L. Clark, and M. Brandt CSIRO,

Institute of Natural Resources and Environment, Division of Water Resources Research, Canberra, Australia

A Feasibility Study of Geomorphic Research for the Long-Term Management of Uranium Mill Tailings

CSIRO Divisional Report 87/2; 65 pp. (1987)

Provides a plan for geomorphic research needed for proper long-term management of mill tailings from the Ranger uranium mine in the Northern Territory. The proposed research will provide information about both the risk of above-grade disposal of the tailings and the implications of the escape of tailings from a containment structure.

527

Price, L.S., Key Lake Mining Corporation, Saskatoon, Saskatchewan, Canada

Uranium Tailing Management and Waste Waters Control at Key Lake

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986; (pp. 289-292) (1986)

The Key Lake tailings management area and associated water treatment system has been carefully designed as an integrated package. The design is intended to avoid or eliminate the potential environmental problems inherent in more traditional tailings disposal concepts. This approach has a higher pre-operation capital cost but lower costs during operation and will have much lower final decommissioning costs than most management concepts.

528

Roberts, M.J., A. Buchnea, and M.P. Filion, MacLaren Plansearch, Inc., Toronto, Ontario, Canada

Cost-Benefit Analysis of Close-Out Options for a Uranium Mill Tailings Area

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986; (pp. 252-257) (1986)

Decommissioning alternatives for the completed Rabbit Lake tailings area were investigated. Conceptual designs and preliminary cost estimates were prepared for decommissioning the tailings in-situ and relocating them to the Rabbit Lake pit. Preliminary pathways analysis was carried out to determine the public dose resulting from each scenario. Based on a comparison using the ICRP 37 method, the preferred scenario was in-situ reclamation with a simple cover.

529

Rumble, M.A., U.S. Forest Service, Rocky Mountain Forest Experimental Station, Rapid City, SD

Radiation Dosimetry on Revegetated Uranium Mill Tailings in Western South Dakota

Northwest Science 60(3):145-149 (1986)

Covering tailings with 30 cm of shale and 60 cm of topsoil reduced gamma radiation exposure below ground to rates similar to the control area. Soil covering of 30 cm was adequate to reduce gamma radiation exposure rates aboveground to background levels. Gamma exposure rates to small mammals were correlated to measurements below ground near the surface. Gamma radiation exposure to small mammals inhabiting uranium mill tailings exceeded standards recommended for the general public.

530

Senate OKs Bill on Tails, Enrichment, Import Fees

Nuclear News 31(7):91-92 (1988, May)

The Senate has passed an omnibus uranium bill (Senate Bill 2097, the "Uranium Revitalization, Mill Tailings and Enrichment Act of 1987") to create a government-owned corporation, U.S. Enrichment Corporation, that would take over the national uranium enrichment enterprise. This proposal,

which must be considered by the House of Representatives, would also establish a fund to clean up mill tailings sites, and would impose user fees against utilities contracting for foreign uranium in amounts greater than a sliding scale of percentages written into the bill.

531

Smith, A., Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada

Report on the Collection of Data Relevant to the Canadian National Uranium Tailings Program

INIS-mf-1116!; 310 pp. (1984, October)

In December of 1983, Systemhouse Limited was awarded a contract to collect data relevant to the Canadian National Uranium Tailings Program and to convert it into a machine readable format. The work was carried out in four phases, namely, data identification, data collection, data transcription/conversion, and data verification. The main priority was to identify as much relevant data as possible. The identified data was prioritized against a predefined criteria established in conjunction with the project scientific authority. A total of 428 studies were identified as being relevant. Data from 19 of these were converted to machine-readable format, giving information on 2398 samples from 78 boreholes.

532

Thomson, B.M., P.A. Longmire, and D.G. Brookins, University of New Mexico, Department of Civil Engineering, Albuquerque, NM

Geochemical Constraints on Underground Disposal of Uranium Mill Tailings

Applied Geochemistry 1(3):335-343 (1986)

The investigation has shown that short-term degradation of groundwater due to backfill disposal of the sand fraction of uranium tailings is negligible. Long-term effects, defined as those occurring after mining operations cease and the mine fills with water, are predicted to also be very

pollutants through chemical reduction and precipitation, as well as adsorption onto aquifer materials.

533

U.S. Nuclear Regulatory Commission,
Washington, DC

Testing and Inspection of Remedial Actions at Inactive Uranium Mill Tailing Sites

CONF-860205; Geotechnical and Geohydrological Aspects of Waste Management, Proceedings of the Eighth Annual Symposium, Fort Collins, CO, February 5, 1986. A.A. Balkema Publishers, Accord, MA; (pp. 329-337) (1986)

The options presently being considered and implemented by the DOE for stabilization of the inactive tailings consists of: (1) stabilization of tailings in place, (2) stabilization on-site, and (3) relocation and stabilization of tailings at another location. The detailed design and construction procedure for each remedial action depends upon the site-specific plan selected by the DOE.

534

U.S. Nuclear Regulatory Commission,
Washington, DC

Final NRC Regulations on Tailings Disposal

Nuclear News 31(1):52-53 (1988, January)

The Nuclear Regulatory Commission (NRC) has amended its regulations governing the disposal of uranium mill tailings and thorium by-product material. The revised regulations incorporate two principal Environmental Protection Agency standards: (1) licensees and applicants must install a liner under surface impoundments, excavations, natural depressions, or diked areas, designed to hold accumulations of liquid wastes; and (2) if specified hazardous materials, both radioactive and nonradioactive, enter the groundwater near a licensed mill tailings site, they must not exceed certain concentration limits, which may be the same as natural background levels. The revised NRC rules also require licensees to establish a detection

and compliance monitoring program to detect any leakage from the disposal area and to ensure that the groundwater complies with standards set by the Commission.

535

U.S. Nuclear Regulatory Commission,
Washington, DC

NRC Considers Licensing Long-Term Tailings Care

Nuclear News 31(13):52 (1988, October)

The Nuclear Regulatory Commission (NRC) has published an advance notice of proposed rulemaking on establishing general licenses for the custody and long-term care of decommissioned uranium or thorium mill tailings sites after the completion of remedial actions under the Uranium Mill Tailings Radiation Control Act (UMTRCA). According to the NRC, licensing of the UMTRCA Title I (inactive) and Title II (currently active) sites would provide a mechanism for ensuring that they are maintained in a manner that would protect the public health and safety and the environment and would meet UMTRCA requirements. At present, the NRC is considering incorporating two general licenses into 10 CFR 40 - one applicable to Title I sites, and the other applicable to Title II sites. After completion of remedial action work and compliance with applicable closure standards, a surveillance and maintenance plan (SMP) would be submitted to the NRC.

536

Venkataraman, S., Bhabha Atomic Research Centre, Health Physics Division, Bombay, India

Approach to Assess Seepage of Uranium Mill Tailings in Well Waters Around Jaduguda

Bulletin of Radiation Protection 10(4):33-36 (1987, October-December)

Median concentration of uranium, radium-226, manganese, chloride, sulphate, and total hardness of seepage water from uranium mill tailings pond are found to be 0.70 mg/l, 1.5 pCi/l, 10.5 mg/l, 396 mg/l, 1725 mg/l and 1636 mg/l respectively.

Uranium and radium-226 content of seepage water is found to be of the same order as found in background waters. But the values of manganese, chloride, sulphate and total hardness are of the same order as in tailings overflow effluent. Indian drinking water standards for manganese, chloride, sulphate and total hardness are 0.1 mg/l, 250 mg/l, 250 mg/l and 300 mg/l respectively. When we compare the concentration of chemical constituents of seepage water with Indian drinking water standards, the chemical constituents such as chloride, sulphate and total hardness of seepage water are more but of the same order of magnitude. The concentration of manganese (10.5 mg/l) is about hundred times higher than Indian drinking water standard which clearly indicates that it is due to contamination from tailings pond. Thus among the chemical constituents, dissolved manganese can be used as an indicator of pollution, in well waters around the uranium complex at Jaduguda. With this approach, results of dissolved manganese found in well waters during environmental surveys were discussed.

537

Weston (Roy F.), Inc., Albuquerque, NM

Geotechnical Properties of Hydraulically Placed Uranium Mill Tailings

Hydraulic Fill Structures, Proceedings of a Conference, Fort Collins, CO, August 15-18, 1988; (pp. 227-254) (1988)

The reclamation of 24 uranium mill tailings piles under the DOE Uranium Mill Tailings Remedial Action (UMTRA) program has provided an opportunity to compare the material properties of uranium tailings from different processing operations and different mineral belts. These results have shown that although the tailings have had different grinding processes and have come from different parts of the country, the material properties fit into a very close band of results. This paper presents the compilation and comparison of data from uranium mill tailing piles data collected as part of the UMTRA program.

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Decommissioning of Uranium Mines and Mills-Canadian Regulatory Approach and Experience

Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Manitoba, Canada, September 7-11, 1986; (pp. 471-486) (1986)

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 involved 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. Included were those implemented at the three decommissioned sites.

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Woo, M.K., and J.J. Drake, McMaster University, Department of Geography, Hamilton, Ontario, Canada

A Study to Model the Effects of Uranium Mine Tailings on a Permafrost Environment

Environmental Studies - Indian and Northern Affairs Canada 53:1-41 (1988)

The one-dimensional model for a vertical column of the tailings simulates the daily temperature and moisture profiles using inputs of air temperature, precipitation, solar radiation and lateral inflow to the tailings. If the tailings are flooded, the model simulates the ice cover and the effects of the floodwater upon the thermal regime. Crucial for

permafrost areas is the coupling of the water and energy fluxes. Energy is used to melt the snow, evaporate the water, and through thawing of the active layer, provide storage capacity of the groundwater. Water and ice distributed within and on the tailings affect the surface albedo, the thermal properties of the soil which in turn alters the rates of heat conduction, frost penetration and thawing front propagation. A thick frozen zone ensures little groundwater leakage, but the lack of storage capacity often leads to surface outflow that may transfer contaminants out of the tailings. Detailed descriptions of different components of the model are given in the programmer's manual including program listing and a definition of the parameter values.

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Xiao, B., Radiation Monitoring Center for Uranium Mining and Milling, Hengyang, China

Measurement and Assessment of Radon and Its Daughters in Environment of Uranium Tailings Pool

Youkuangye (China) 6(3):43-47 (1987, August)

The monitoring results of radioactive and nonradioactive harmful materials in the

environment surrounding a uranium tailing pool are reported. The distribution of radon and its daughters in the environment is investigated. The results show that the radon exhalation rate of upper layer tailings is averaged to 1.92 ± 0.35 Bq/sq m/s; the mean concentration of radon and its daughters in the air above the pool is 42.8 ± 6.0 Bq cu m, $(1.02 \pm 0.09) \times 10(E-1)$ uJ/cu m, respectively; and the radon concentration in various sectors in a distance of 1-3 km from the pool decreases to 9.3 ± 0.8 Bq cu m (about the same as background level). The average annual effective dose equivalent to radon daughters taken by the workers on the pool is 0.723 mSv, and to the gamma radiation, 1.93 mSv. The sum is 6.7% of dose limit for occupational radiation workers. The additional annual effective dose equivalent to the nearby residents is $2.1 \times 10(E-2)$ mSv from radon daughters and $5.6 \times 10(E-2)$ mSv from gamma radiation. The sum is about 7.7% of the dose limit for the public. It is recommended that decommissioning tailing pools be covered with soil and plants. The experiment shows that radon exhalation rate decreases to 0.302 Bq/sq m/s and gamma radiation rate to $1.13 \times 10(E-1)$ uGy/h when a tailing pool is covered with clayey soil of 0.5 m thickness.

TECHNICAL MEASUREMENTS CENTER

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Field Method for Determining Thorium-230 in Soils

UNC/GJ-48(TMC); DOE/ID/12584-39; 8 pp. (1989, May)

The U.S. Department of Energy (DOE) Office of Remedial of Remedial Action and Waste Technology established the Technical Measurements Center at the DOE Grand Junction, Colorado, Projects Office to develop and/or recommend measurement methods for use in support of its remedial action programs. This report describes a field method for the determination of Th-230 in soils for remedial action projects. The method involves a cold acid digestion, organic extraction, and precipitation of Th-230 for counting by alpha spectrometry. An internal Th-230 spike is added early in the method to eliminate the need to determine losses through the separation steps. A step-by-step procedure is included in the report. The method requires a small portable or mobile laboratory equipped with electrical power and ventilation. All additional equipment is commercially available and no special equipment is required. Chemical wastes for each analysis are stored for appropriate disposal off-site. Analysis completed per day depends on the number of alpha spectrometers available.

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Soil-Based Uranium Disequilibrium and Mixed Uranium-Thorium Series Radionuclide Reference Materials

UNC/GJ-37(TMC); DOE/ID/12584-34; 12 pp. (1988, December)

The Technical Measurements Center (TMC) prepared approximately 200 pounds each of six different soil-based nuclide reference materials. One set of three materials was prepared from a mixture of uranium oxide material and a soil diluent. This set (NRM-1, NRM-2, and NRM-3)

contains a large amount of uranium compared with the amount of radium present, and is referred to as the disequilibrium set. The NRM-1, NRM-2 and NRM-3 sets were prepared to contain approximately 15, 45, and 90 pCi/g of U-238, respectively. Another set of three reference materials was prepared from a mixture of uranium ore, thorium ore, and a soil diluent. This set (NRM-4, NRM-5, and NRM-6) contains nuclides from both the U-238 decay series and the Th-232 decay series, and is referred to as the mixed-nuclide set. The NRM-4 reference material was prepared to contain approximately 10 pCi/g each of U-238, Ra-226, and Th-232; the NRM-5 reference material was prepared to contain approximately 20 pCi/g each of U-238, Ra-226, and Th-232; and the NRM-6 material was prepared to contain approximately 40 pCi/g each of U-238, Ra-226, and Th-232. C.W. Sill of the Idaho National Engineering Laboratory and the UNC Analytical Chemistry Laboratory measured concentrations of U-238, U-234, and Ra-226 in the disequilibrium set and U-238, U-234, Th-230, Ra-226, Pb-210, and Th-232 in the mixed-nuclide set using independent methods. The results for each nuclide obtained by Sill and the results for the nuclides obtained by UNC were compared. The difference was found to be less than 5 percent, which is within the TMC standards defined for this and similar projects.

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Rapid Determination of Thorium-230 in Mill Tailings by Alpha Spectrometry

Analytical Chemistry 59(21):2556-2558 (1987)

A rapid procedure has been developed for the determination of Thorium-230 in mill tailings using ALPHA spectrometry following lithium metaborate fusion and purification by solvent extraction. The source for ALPHA spectrometry is prepared by coprecipitation with cerium fluoride. The procedure has been applied to samples collected at Department of Energy remedial action sites, demonstrating an accuracy of 2.5% and a precision of 5%. The detection limit is 0.3 pCi/g. With this procedure, a single analyst can analyze 15 samples/day.

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Two New Field Measurements for D&D: Rapid Th-230 Determinations and Detection of RAD Waste in and Surrounding Sewer or Process Lines

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 5-43 - 5-57) (1988, October)

The Technical Measurements Center has developed a rapid Th-230 field measurements method. The field method is much faster than the conventional practice of sending soil samples to a laboratory for analysis. Including the time to take a soil sample, the method yields a result in about one hour. Miniature gamma-ray and beta detectors have been coupled to a portable scaler through a long, flexible adaptation of a plumber's snake. Both detector assemblies and, in particular the gamma detector, are state-of-the-art in miniaturization and durability. The detector assemblies are small enough to easily pass through a three-inch sewer trap. Future proposed work will add a surface unit to locate the detector in the buried line. Other applications of the gamma unit are logging shallow boreholes and probing for radiometric contamination under slabs instead of drilling through the slab.

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Exposure-Rate Calibration Using Large-Area Calibration Pads

DOE/ID/12584-25; UNC/GJ-42(TMC); 18 pp. (1988, September)

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology established the Technical Measurements Center (TMC) at the DOE Grand Junction Projects Office (GJPO) in Grand Junction, Colorado to standardize, calibrate, and compare measurements made in support of

DOE remedial action programs. A set of large-area, radioelement-enriched concrete pads was constructed by DOE in 1978 at the Walker Field Airport in Grand Junction for use as calibration standards for airborne gamma-ray spectrometer systems. The use of these pads was investigated by the TMC as potential calibration standards for portable scintillometers employed in measuring gamma-ray exposure rates at Uranium Mill Tailings Remedial Action (UMTRA) project sites. Data acquired on the pads using a pressurized ionization chamber (PIC) and three scintillometers are presented as an illustration of an instrumental calibration. Conclusions and recommended calibration procedures are discussed, based on the results of these data.

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Year-Long Comparison of Two Techniques to Monitor Outdoor Radon Concentrations at Shiprock, New Mexico

DOE/ID/12584-26; UNC/GJ-43(TMC); 29 pp. (1988, August)

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology established the Technical Measurements Center (TMC) at the DOE Grand Junction Projects Office (GJPO) in Grand Junction, Colorado to standardize, calibrate, and compare measurements made in support of DOE remedial action programs. Outdoor radon concentration measurements were made by the TMC in Shiprock, New Mexico during the period November 15, 1983 through November 5, 1984 to compare two different methods of measuring radon in an attempt to determine the feasibility of using passive alpha-track detectors to assess the adequacy of remedial action undertaken at the Shiprock uranium mill tailings pile. The results of the first three quarters of monitoring have been detailed in previous reports. An analysis of the data from the fourth quarter of monitoring at Shiprock reveals a somewhat poorer correlation between the two sets of measurements than was seen in the third quarter of this study, but a better correlation than was found for the first and second quarters. The results of a nearly year-long exposure of alpha-track

detectors were in much better agreement with the annual-average results of the second measurement method than were any of the quarterly results. The results of a calibration exposure of several alpha-track detectors in an environmentally controlled radon chamber differed significantly from the detector manufacturer's calibrations. Several conclusions can be drawn concerning the use of alpha-track detectors for monitoring outdoor radon concentrations at DOE remedial action project sites based on findings obtained during the course of this study. The most significant conclusion is that alpha-track detectors require a year-long exposure to provide a reliable estimate of the annual-average outdoor radon concentration. Annual averages calculated from quarterly exposures are more prone to errors occurring during the track-counting process.

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Evaluation of the Performance Characteristics of Radon and Radon-Daughter Concentration Measurement Devices Under Controlled Environmental Conditions

UNC/GJ-44(TMC); DOE/ID/12584-29; 95 pp. (1989, April)

The U.S. Department of Energy Division of Remedial Action Projects (now the Office of Remedial Action and Waste Technology) established the Technical Measurements Center (TMC) in 1982 at the Grand Junction, Colorado, Projects Office (GJPO). The TMC conducted a study to expose 10 radon and 7 radon-daughter concentration measurement devices in the DOE/GJPO Radon/Radon-Daughter Environmental Chamber for a series of 24 controlled-environment tests. The tests evaluated the devices' response to temperature, relative humidity, dew point, condensation-nuclei concentration, radon-daughter/radon equilibrium ratio, and nonuniform radon and radon-daughter concentration. Devices were evaluated for linear response as a function of concentration. In addition to response to environmental parameters, the evaluation included determining the utility of the devices in providing reasonable assurances of

compliance with the radon and radon-daughter concentration standards for DOE remedial action programs. This reasonable assurance criterion is based on a coefficient of variation of 25 percent for devices deployed for year-long measurements and a coefficient of variation of 18 percent for devices deployed for intermittent sampling. Some of the criteria addressed are as follows: (1) acceptability of precision and accuracy, (2) Effect on performance by environmental conditions, and (3) TMC recommendations for use in DOE remedial action programs.

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Performance of Diffusion-Barrier Scintillation Cells Under a Variety of Controlled Environmental Conditions

DOE/ID/12584-35; UNC/GJ-46(TMC); 18 pp. (1989, February)

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology established the Technical Measurements Center (TMC) at the Grand Junction, Colorado, Projects Office (GJPO), in part, to develop and evaluate new devices for the DOE remedial action projects. The TMC charged the GJPO Radon Laboratory, under the management of UNC Geotech (UNC), with developing and testing a passive scintillation-type, time-averaging radon monitor. Two types of monitors were developed, a diffusion-barrier scintillation cell (DBSC) and a diffusion-barrier liquid scintillation cell (DBLSC). The performance of the DBSCs was tested under different relative humidities, temperatures, and wind speeds. The test results of the DBSCs showed no statistically significant change in accuracy due to the environmental test conditions. Radon-concentration measurement results for diffusion-barrier charcoal canisters (DBCC), exposed along with the DBSCs, did show significant effects due to wind and temperature, but no effects due to relative humidity. The performance of the DBLSCs under a variety of environmental conditions was not tested because a sufficiently sensitive device could not be developed using the existing GJPO liquid-scintillation counting system and nontoxic

counting medium.

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Construction and Characterization of the RH/RL Radium Calibration Pads

UNC/GJ-45(TMC); DOE/ID/12584-31; 28 pp. (1989, January)

The Technical Measurements Center (TMC) provides calibration facilities for the standardization of field measurements. This report presents the results of the design, construction, and characterization of 14 calibration pads enriched in radium-226. The 14 pads comprise 7 sets with a high and low activity pad in each set. The pads are concrete cylinders, approximately 5 feet in diameter by 2 feet in height. They are intended for use in calibrating portable field instruments that are used by remedial action contractors to make direct, in-situ measurements of radium-226, thorium-232, and potassium-40.

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Technical Measurements Support to DOE Remedial Action Programs

CONF-880201; Waste Management '88: Waste Processing, Transportation, Storage and Disposal - Technical Programs and Public Education, Post, R.G. (ed.), Proceedings of a Conference, Tucson, AZ, February 26-March 3, 1988, Vol. 1; (pp. 371-380) (1988)

The Technical Measurements Center (TMC) at the Department of Energy (DOE) Grand Junction Projects Office provides technical support to DOE remedial action programs. Selected results from field and laboratory studies are presented under three categories: calibration facilities and reference materials, evaluation of instruments and measurement methods, and development of instruments and measurement methods.

**GENERAL REMEDIAL ACTION
PROGRAM STUDIES**

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Surface Contamination Guidelines

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-83 - 3-101) (1988, October)

The DOE surface contamination guidelines, used by FUSRAP and SFMP, were adopted from those which have been followed by the AEC/NRC for termination of licenses, since the early 1970s. Although later versions have been developed, the July 1982 version is the basis for the DOE guidelines. These guidelines are divided into four general groupings of radionuclides; groupings were developed based on the permissible air concentrations in unrestricted areas in effect during the early 1970s. There are other sources surface contamination guidelines, for example, NRC Regulatory Guide 1.86 and draft ANSI N13.12. Most states use the NRC guidelines, but several states have chosen to develop their surface contamination limits. FUSRAP and SFMP have used these guidelines for about four or five years. Only minor problems were encountered until recently, when a site with multiple radionuclides, painted surfaces, and dusty surfaces created some problems in measuring contamination levels and interpreting the results. It is recommended that a comprehensive protocol for application of the surface contamination guidelines be prepared. All monitoring personnel must continue to strive to improve procedures and equipment for optimal sensitivity and accuracy. Finally, some changes in the guidelines, such as reducing the uranium levels and raising the limits on the most restrictive radionuclide grouping - similar to the most recent draft of the ANSI N13.12 guidelines - might be appropriate.

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Defense Environmental Restoration Program

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-21) (1988, October)

The Defense Environmental Restoration Program (DERP), established by the Congress in 1984, provides increased emphasis and visibility for an expanded and accelerated effort in cleanup actions at toxic and hazardous waste sites on DOE installations and provides for cleanup of properties formerly used by the DOD. There are about 3800 sites on active installations with the potential for contamination. The Installation Restoration program, an integral part of the Environmental Restoration program, identifies contamination and provides appropriate studies and remedial actions at these potential sites. Additionally, there are approximately 7200 identified potential hazardous toxic waste sites on properties formerly owned or used by the DOD which require investigation as to the degree of DOD responsibility, if any. This includes possible requirements for the removal of unsafe and hazardous buildings, structures and debris. The Building Demolition/Debris Removal subelement of the Environmental Restoration Program addressed the cleanup of these sites. Other Hazardous Waste Operations are also included under the restoration program. This involves initiatives related to the reduction of DOD hazardous waste generated and disposed; research, development and demonstration with respect to hazardous wastes and site cleanups, including safer, more cost-effective methods of unexploded ordnance detection and disposal; and clearance of active and former ranges. This activity represents a small percentage of the total restoration effort. The DERP is centrally managed in the Office of the Secretary of Defense and is carried out by the Military Services and Defense Agencies. For FY 1988, the Congress appropriated \$402.8 million for environmental restoration efforts in the central Environmental Restoration, Defense transfer account. The FY 1989 request of \$500.0 million provides for a real growth increase to comply with cleanup requirements mandated by law.

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Capitol Hill Perspective on Environmental Compliance at Federal Facilities

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-3) (1988, October)

In recent months, Congress has held several hearings on Federal facility compliance with environmental requirements. Federal agencies, particularly the DOE, have not had a sympathetic reception by Congress. Federal facilities are generally perceived as "scofflaws," being described by some members of Congress as the "worst polluters." In addition, environmental groups have been very effective in using the media to create a poor image of DOE with the public and Congress. This unfavorable political climate may result in tougher environmental legislation applicable to Federal facilities when, in reality, a more reasonable approach may be required. For example, there are currently five new bills being considered by Congress dealing with Federal facility compliance including one which will make EPA the ultimate enforcer over DOE environmental problems. In short, Congress does not view Federal facility compliance programs as credible. Because of the current political climate, DOE is at a critical juncture in proving to Congress that environmental protection is equal in importance to the DOE's other missions. Just complying with existing environmental requirements, however, is not enough. Even when in compliance, debates over past problems reflect on the current actions. DOE must develop more credibility in its environmental compliance programs to avoid unnecessary legislation. The DOE must devise ways of being responsive to Congressional inquiries. There are several ways to accomplish this task. Environmental audits have been favorably reviewed by Congress as the basis for Congressional oversight of Federal facility compliance. Cleanup problems should be openly identified and established early. Finally, DOE must demonstrate its willingness to comply (e.g. through the development of

enforceable agreements with EPA and the States).

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Remedial Actions and the Need to Communicate About Risks

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 2-15 - 2-28) (1988, October)

Risk communication as a discipline is quite new. It has arisen because the most obvious risks often are not the most serious ones, and because traditional regulation cannot reach many risks. Communicating effectively about risks can help people (1) put risks in context, (2) understand the trade-offs that must be made between reducing risks and the costs of doing so, (3) become informed participants in decisions about risk management, and (4) understand the residual risks that remain after action has been taken. Each of these objectives can be important in communication about remedial action. Seven risk communication recommendations for remedial action are: (1) identify and address community concerns, especially those that are not part of a usual risk assessment; (2) work to establish and protect credibility; (3) account for typical reactions to low-level risks; (4) recognize that characteristics of risk matter (e.g. is it involuntary, unfamiliar, dreaded, unfair, catastrophic, etc); (5) use comparable risks to help put the risk in context - but be sure that they have enough similar characteristics; (6) account for individual characteristics (e.g. is it safe for my children to play in the yard); (7) treat the media as a legitimate partner.

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EPA Perspective on Federal Facility

Agreements

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-5) (1988, October)

Although the Department of Energy's (DOE's) image with Congress and the media concerning environmental compliance may be poor, the Environmental Protection Agency (EPA) sees DOE's recent attitude toward the environment as good. DOE was the first federal Agency to sign an enforcement agreement, the first to establish a 3008 consent order, the first to support the model Inter-Agency Agreement, the first to sign a 106 Consent Order, and the first to agree to dispute resolution. The Department's good relationship with EPA has been characterized recently by flexibility and good communications. EPA believes, therefore, that both the Agency's and DOE's credibility have increased as a result. DOE and EPA must continue to move forward. In particular, EPA would like to emphasize less study of a problem and more cleanup. Strong, enforceable agreements will allow this goal to be met by letting EPA take more risks in its decision making. Currently EPA is developing an enforcement strategy for federal facilities. This strategy will address identifying federal facilities of concern, increasing enforcement and compliance monitoring activities at those facilities, implementing the model agreements, resource planning, and the establishment of an agency management system for federal facilities. There are over 1000 federal facilities which are listed on the EPA compliance docket. Over 200 federal facilities are expected to be included on the National Priority List (NPL). Increased EPA attention may increase the ability of the various federal agencies to obtain the necessary funding. Also EPA is developing a GoCo enforcement strategy for government contractors. In the hazardous waste enforcement program, three criteria are being considered for determining when to proceed against a contractor: (1) Degree of contractor control over the hazardous waste management activity, (2) who is actually performing the work, and (3) degree of Departmental cooperation. In summary, EPA considers federal facilities to be subject to the same RCRA/CERCLA requirements as private industry.

The only difference being the sources of funding. Continued progress concerning federal facility compliance is necessary to avoid draconian legislation or an EPA change of attitude.

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Department of Energy Hazardous Waste Remedial Actions Program: Quality Assurance Program

CONF-881077; Proceedings of the Fifth Annual National Energy Division Conference, San Antonio, TX, October 23, 1988; (10 pp.) (1988)

This paper describes the Quality Assurance Program developed for the Hazardous Waste Remedial Actions Program Support Contractor Office (HAZWRAP SCO). Key topics discussed include an overview of the HAZWRAP SCO mission and organization, the basic quality assurance program requirements and the requirements for the control of quality for the Department of Energy and Work for Others hazardous waste management programs, and the role of ensuring quality through the project team concept for the management of remedial response actions. The paper focuses on planning for quality assurance for this remedial waste management process from preliminary assessments of remedial sites to feasibility studies. Some observations concerning the control of quality during the implementation of remedial actions are presented.

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Environmental Radiation Standards

CONF-880729; Proceedings of the 33rd Annual Health Physics Society Meeting, Boston, MA, July 4, 1988; (79 pp.) (1988)

The document describes a presentation which reviewed current and proposed radiation standards, recommendations, and guidelines for limiting radiation exposures of the public. Reviewed is the

regulatory framework for limiting routine releases of radioactivity to the environment and the resulting public exposures, and estimates of risk corresponding to standards, recommendations, and guidances.

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An Overview of the Department of Energy Defense Programs Environmental Restoration Programs

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 2-63 - 2-80) (1988, October)

The Department of Energy (DOE) established the Environmental Restoration (ER) Program in 1987 to coordinate the remediation of Defense Programs (DP) inactive hazardous waste sites and to take corrective actions for any releases of hazardous wastes from any waste management unit which meets the definition of a past disposal site. While DOE has supported environmental restoration activities, the management and coordination have not always been focused and the funds spent on those activities have not always been visible. To optimize the use of the funds, a separate budget category was identified to meet the corrective action requirements for inactive sites under the Resource Conservation and Recovery Act (RCRA) 3004(u) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA). Management responsibility for the ER Program was assigned to the Office of Defense Waste and Transportation Management (DWTM). Significant progress has been made in the Program's first year. The final draft of the ER Program Management Plan (PMP) was prepared in early 1988 and forwarded by HQ to the field operations offices for implementation. The PMP develops the systems and procedures for management of the Program, including the

identification of roles and responsibilities, work breakdown structure, and documentation requirements. The initial draft of the ER Program in Implementation Plan (PIP) was completed in 1988. The ER PIP represents the first comprehensive effort to develop an assessment of overall cost and schedule for the Program. It includes a summary of planned activities by participation program installations, regulatory drivers, cost and schedule summaries, and issues and conclusions. In the coming fiscal year, the PIP and the PMP will be updated, with the emphasis on documentation requirements and implementation of DOE Order 4700.1, Project Management System. Other activities planned for FY 1989 include the development of a remedial actions cost-estimating model, release site inventory data base, and additional review of the Program Optimization System (POS) model and its application within the ER Program. While the Program has made tremendous progress, it has not yet sufficiently matured to provide credible long-term cost estimates or schedule baselines. The acceptance criteria for site cleanup continues to be an issue with most states waiting for guidance from EPA before establishing their standards.

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DOE Groundwater Protection Strategy

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 2-1 - 2-13) (1988, October)

The Office of Environment, Safety and Health (EH) is developing a Department of Energy-wide (DOE) "Groundwater Quality Protection Strategy" to express DOE's commitment to the protection of groundwater quality at or near its facilities. This strategy responds to a September 1986 recommendation of the General Accounting Office. It builds on EPA's August 1984 "Ground-Water Protection Strategy," which establishes a classification system designed to protect groundwater according to its value and

vulnerability. The purposes of DOE's strategy are to highlight groundwater protection as part of current DOE programs and future Departmental planning, to guide DOE managers in developing site-specific groundwater protection practices where DOE has discretion, and to guide DOE's approach to negotiations with EPA/states where regulatory processes apply to groundwater protection at Departmental facilities. The strategy calls for the prevention of groundwater contamination and the cleanup of groundwater commensurate with its usefulness. It would require long-term groundwater protection with reliance on physical rather than institutional control methods. The strategy provides guidance on providing long-term protection of groundwater resources; standards for new remedial actions; guidance on establishing points of compliance; requirements for establishing classification review areas; and general guidance on obtaining variances, where applicable, from regulatory requirements. It also outlines management tools to implement this strategy. The strategy's status is as follows. A DOE work group was formed in December 1987. A DOE-wide staff-level review of a draft strategy was completed in Spring 1988 and is currently being revised based on the comments received. EH plans to issue the strategy as a DOE Notice by Summer 1989. Implementing Orders and appropriate revisions to existing Orders will follow within one year.

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NRC Residual Radioactivity Release Criteria

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-27) (1988, October)

The U.S. Nuclear Regulatory Commission (NRC) is expanding its current policy on the release of residual radioactivity for unrestricted use. With the development and promulgation of the Decommissioning Rule Amendments in June 1988, the Commission recognized the urgent need to develop further guidance and expanded radiological

criteria regarding acceptable levels of radioactive contamination for unrestricted release of lands, structures, materials, and equipment. The expanded criteria are intended to provide additional guidance to licensees in planning for decontamination and decommissioning activities and to ensure a uniform approach and consistent decisions in agency determinations of unrestricted release of low levels of radioactivity. Current NRC radiological release criteria provide (1) acceptable levels of surface contamination by classes of radionuclides and (2) acceptable volumetric concentrations in soil for the uranium and thorium series of radionuclides. The current criteria represent de facto below regulatory concern (BRC) levels, i.e. levels below which residual radioactive property may be released for unrestricted use and exempt from further regulation. The expanded guidance, being generically developed on a dose-risk basis, will be consistent with the revised dose system recommended by the International Commission on Radiological Protection and with the revised regulations in 10 CFR 20. The expanded guidance will also be consistent with the proposed Commission Policy statement on Exemptions from Regulatory Control for Practices Whose Public Health and Safety Impacts Are Below Regulatory Concern. The guidance will be developed in two phases. The first phase will address the release of residually radioactive land and structures for unrestricted use while the second will address the release of residually radioactive tools and equipment and the recycle of other materials. In each case, the radiological criteria will be developed for volumetric as well as surface contamination, on an isotope-by-isotope basis. Additional guidance is currently being developed by the NRC in terms of a primary BRC dose limit and derived surface and volumetric secondary screening levels for determining compliance. Contaminated land or structures in compliance with the primary dose limit would be considered ALARA without analysis. Contamination levels exceeding those specified by the secondary screening levels may still be considered candidates for exemption. The Commission will consider such circumstances on a case-specific basis.

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**Allowable Residual Contamination Levels of
Radionuclides in Soil from Pathway Analysis**

CONF-871075; Waste Problems, Proceedings of
the Oak Ridge Model Conference, Oak Ridge,
TN, October 13, 1987; (14 pp.) (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. Identified was 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. The latest version of DECOM was obtained and modified 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. A version of DECOM as a LOTUS spreadsheet was created, using the same models as the BASIC version of DECOM. The specific modeling approaches taken, the regulatory framework that guided efforts, the strengths and limitations of each approach, and areas for improvement were all discussed. Also demonstrated is how the LOTUS version of DECOM can be applied to specific problems that may be encountered during ORNL RAP activities.

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**Minutes from Department of Energy/Hazardous
Waste Remedial Actions Program Research
and Development Technology Needs
Assessment Review Meeting**

DOE/HWP-78; Hazardous Waste: Remedial
Actions Program Research and Development
Technology Needs Assessment Review,
Proceedings of a Meeting, Salt Lake City, UT,
November 1, 1988; (pp. 1-76) (1989, January)

On November 1-2, 1988, representatives of the Department of Energy (DOE) Headquarters, DOE Operations Offices, DOE contractors, and the Hazardous Waste Remedial Actions Program met in Salt Lake City, Utah, to select and prioritize candidate waste problems in need of research and development. The information gained will be used in planning for future research and development tasks and in restructuring current research activities to address the priority needs. All Operations Offices were represented by DOE staff and by contractor delegates from the area. This document summarizes the results of the meeting and lists the priority waste problems established.

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**Integrated Data Base for 1988: Spent Fuel
and Radioactive Waste Inventories, Projections,
and Characteristics**

DOE/RW-0006 (Rev. 4); 276 pp. (1988)

The Integrated Data Base (IDB) Program has compiled current data on inventories and characteristics of commercial spent fuel and on both commercial and U.S. government-owned radioactive wastes through December 31, 1987. 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 (DOE/EIA) projections of U.S. commercial nuclear power growth and the expected defense-related and private industrial and institutional (I/I) 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.

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DOE Integration of the NEPA and CERCLA Processes

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 2-29 - 2-43) (1988, October)

It is the Department of Energy's (DOE) policy to satisfy the requirements of NEPA and CERCLA. It is DOE's intention to satisfy the requirements of both laws with a single, integrated set of documentation. The primary instrument for DOE's integrated NEPA/CERCLA process will be the RI/FS process. The RI/FS process will be supplemented, as needed, to meet the procedural and documentation requirements of NEPA. Thus, the integrated document shall be an RI/FS environmental impact statement (EIS). The scheduling of the RI/FS EIS documentation development is critical to total project planning. The Office of Environment, Safety, and Health (EH) has tentatively estimated that eight months is required for review and approval of any primary document. In addition, EH has estimated seven and one half years will be required to obtain a Record of Decision (ROD) for an integrated RI/FS EIS document. Although this time period may be shortened through innovative implementation of remedial action plans, it underscores the importance of factoring RI/FS EIS document review early in the project planning stage. Because of the length of time required for an integrated RI/FS EIS process, EH will only review and comment on five

primary documents which include: (1) Project Plan, (2) Remedial Investigation Report (Draft and Final), (3) Feasibility Study Report (Draft and Final), Proposed Plan, and (5) Record of Decision. In order to expedite the review and comment period, EH will not attempt to review and comment on all primary and secondary documents. The appropriate Program or Field Office will be responsible for scheduling EH review times into the overall program schedule.

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Use of Requirements-Type Logic Trees to Guide Complex Environmental Remediation Activities

EGG-M-88491; CONF-890207; Waste Management '89, Proceedings of a Conference, Tucson, AZ, February 29, 1989; (11 pp.) (1989)

A requirements-tree technique has been developed to help guide remedial actions through the complex network of regulatory and technical requirements. Application of this rigorous logic-diagram technique to one complex remedial action, involving radioactive mixed waste at the Idaho National Engineering Laboratory, provided useful results. Additional applications of the technique, in a wide variety of situations, will help to determine the range of its usefulness.

566

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A Review of Geoscience Characteristics and Disposal Experience at the Commercial Low-Level Radioactive Waste Disposal Facility Near West Valley, New York

NUREG/CR-5431; PNL-6970; 82 pp. (1989, August)

The West valley Commercial Low-Level Radioactive Waste disposal site is located about 48 km south of Buffalo, New York. Operation of the site began in

1961 by Nuclear Fuel Service and was terminated in 1975. The disposal trenches at the site are excavated about 5 m into glacial till that has a thickness of about 28 meters. About 65,000 cu m of the waste containing approximately 710,000 Ci were disposed at the site during the operational period. Groundwater movement through the till is predominantly downward as indicated by measurement and numerical simulation of hydraulic head. Radionuclides do not appear to have migrated more than 3 m either laterally or vertically from the waste disposal trenches. Numerical simulations of tritium, Sr-90, and C-14 migration are able to reproduce the observed concentration in the till beneath selected trenches. Uncertainty remains with respect to the continuity and heterogeneity of the hydrostratigraphic units and the spatial distribution of hydraulic conductivity and effective porosity. More work is needed to better define the waste inventory and any long-term changes that might be expected. Erosion poses a potential threat to the long-term integrity of the disposal area.

567

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ARAR Identification Plan

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-43 - 3-54) (1988, October)

Section 121, Cleanup Standards, of the Superfund Amendments and Reauthorization Act (SARA) of 1986, addresses the issue of "how clean is clean" by incorporating the concept of applicable or relevant and appropriate requirements (ARARs) into the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Section 121 addresses both Federal and State ARARs and provides waivers for certain specific situations. The Environmental Protection Agency (EPA) has issued guidance for identifying when a requirement is applicable or when it is relevant and

appropriate. EPA has further broken down ARARs into specific types and has issued criteria for determining the point of compliance for an ARAR. EPA, through its revisions to the National Contingency Plan (NCP), has identified other criteria protective of human health and the environment. Finally, the ARAR identification process is a process that continues throughout the Remedial Investigation/Feasibility Study (RI/FS).

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Model Provisions for DOE Federal Facility Agreements

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-7) (1988, October)

Section 120 (e) of the Superfund Amendments and Reauthorization Act (SARA) requires that Interagency Agreements (IAG) be developed between EPA and federal agencies which are the lead Agencies in CERCLA cleanup actions. Over the past several years, DOE has been negotiating with EPA and States to develop IAGs at various sites. The result of these negotiations has been consolidated in a Model Federal Facility Agreement (FFA) which goes beyond the SARA requirements. The model FFA addresses DOE cleanup actions from the investigation phase through remedial activities. It provides for State involvement in the decision making process, integrates RCRA and CERCLA requirements, provides for stipulated penalties, and is enforceable. Negotiation of FFA's allow DOE, EPA, and the States to perform their roles in the remedial action process in an efficient and timely manner.

569

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**Using Cost/Risk Relationships in Restoring
Radiologically Contaminated Sites**

CONF-8709263; Nuclear Power Performance and Safety, Proceedings of an International Conference, Vienna, Austria, September 28-October 2, 1987. International Atomic Energy Agency, Vienna, Vol. 5; (pp. 193-207) (1988)

In the event of a major radiological accident at a nuclear power plant, large populated areas could become severely contaminated. In the United States of America, 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 [one billion is equal to $10(E+9)$]. 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 in establishing the recovery criteria. The 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.

570

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**DOE Environmental Compliance Policy
Perspectives and Priorities**

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 1-1) (1988, October)

Over the last several years, the Department of Energy (DOE) has increasingly come under attack regarding its compliance with various environmental statutes, particularly the Resource Conservation Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Recent Congressional hearings have emphasized that DOE must become more proactive in environmental areas and that the Department's national security mission and budget constraints can no longer be used as a shield against environmental compliance. Several initiatives have been launched to help the Department meet this goal. Efforts to prioritize environmental problems for resolution are underway through DOE's nearly completed environmental survey program. A report addressing prioritization of identified environmental problems for the Defense Program's facilities should be issued shortly. In order to foster cooperation, several compliance agreements have been established between DOE, EPA, and the States. DOE has also resolved to work with EPA in solving problems, as evidenced by the resolution of the By-Product issue which had shielded DOE, in many instances, from RCRA compliance. DOE has also begun a major planning effort to identify Departmental needs (including budget requirements) for resolving environmental problems. The Department is actively working with EPA to adapt Agency guidances to meet DOE needs. DOE Headquarters is also establishing compliance coordinators for each operations office to provide assistance in negotiations, technical issues, and compliance issues. In summary, DOE must regain credibility for its environmental compliance program. To regain this credibility, the Department must have a realistic plan, fix environmental problems as soon as possible, and be accountable for its actions.

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**Proceedings of the Remedial Action Programs
Annual Meeting**

CONF-8810239; Proceedings of a Conference,

Gaithersburg, MD, October 18-20, 1988, 456 pp. (1988, October)

Within the DOE's Office of Nuclear Energy, the Office of Remedial Action and Waste Technology manages a number of programs whose purposes are to complete remedial actions at DOE facilities and sites located throughout the United States. These programs include the Surplus Facilities Management Program, the Formerly Utilized Sites Remedial Action Program, the Uranium Mill Tailings Remedial Action Program, and the West Valley Demonstration Project. The programs involve the decontamination and decommissioning of radioactively-contaminated structures and equipment, the disposal of uranium mill tailings, and the cleanup or restoration of soils and groundwater that have been contaminated with radioactive hazardous substances. Each year the DOE and DOE-contractor staff who conduct these programs meet to exchange information and experience in common technical areas. This year's meeting was hosted by the Surplus Facilities Management Program and was held near DOE Headquarters, in Gaithersburg, Maryland. The material is organized according to: (1) Environmental Compliance - Policy; (2) Environmental Compliance - Practice; (3) Reports from Working Groups; (4) D&D Technology; (5) Remedial Action Technology.

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Comparison of Doses, Before and After Remedial Action

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (p. 3-139) (1988, October)

The Division of Facility and Site Decommissioning Projects at DOE-Headquarters is evaluating potential doses from vicinity properties before and after remedial action at several sites using the RESRAD computer code. A preliminary review was completed for nineteen Colonies vicinity

properties. This review indicated potential doses before remedial action at these sites ranged from about 43 to 2 mrem/year and after remediation between 5 and 0 mrem/year. These estimates indicate the conservatism in the DOE-derived soil decontamination remedial action. Following remedial action, the potential doses are on the order of those being considered to be below regulatory concern by EPA and NRC.

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The Remedial Action Priority System (RAPS): Comparison Between Simulated and Observed Environmental Contaminant Levels

PNL-SA-15887; Superfund '88: Hazardous Waste, Proceedings of the Ninth National Conference and Exhibition, Washington, DC, November 28, 1988; (39 pp.) (1988, August)

The Remedial Action Priority System (RAPS) is an objective, physics-based, fully integrated multimedia environmental assessment methodology. RAPS assesses environmental issues associated with hazardous and radioactive mixed-waste sites based on relative human health risk and limited site information. The purpose of this paper is to report on the results associated with applying components of the RAPS methodology to a variety of sites with different contaminant release mechanisms. These applications illustrate the type of data typically required to implement the methodology and several of the types of contaminant releases (e.g. direct discharge, French drain, cribs, tile field, and stacks) that can be considered by the methodology. They thus demonstrate the applicability of the methodology at a wide variety of sites. The various components of the RAPS methodology have been implemented at actual sites where contaminant levels have been monitored in the environment. The monitored contaminant levels are compared with simulated contaminant levels associated with the application to the RAPS methodology at these sites. The purpose of the comparison is to demonstrate the applicability of implementing RAPS to a wide variety of hazardous waste sites and releases of contaminants into the environment.

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Remedial Action Priority System (RAPS): Mathematical Formulations

DOE/RL-87-09; 323 pp. (1987, August)

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 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 RAPS methodology provides the U.S. Department of Energy with a management tool for assistance in prioritizing funding and human resource allocations for further investigations and possible remediations at its inactive waste sites. Use of RAPS will help DOE ensure that those sites posing the highest potential risk are addressed first.

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Residual Radioactivity Guidelines: A Cost-Benefit Consideration

Transactions of the American Nuclear Society 55:112-114; Proceedings of the 1987 American Nuclear Society Winter Meeting, Los Angeles, CA, November 15-19, 1987; (pp. 112-114) (1987)

The U.S. Department of Energy (DOE) has established radiological protection guidelines for cleanup of residual radioactive material located at sites administered under the Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program. The methods and data for deriving site-specific guidelines and procedures for implementing DOE policy for reducing residual radioactivity to levels that are as low as reasonably

achievable specify that, under reasonably foreseeable conditions, the annual radiation dose received by a member of the general public from residual radioactivity at a given site must not exceed 100 mrem (the basic dose limit) if the site is to be released for unrestricted use. This paper examines the relative effects of annual dose limits and cleanup costs on the allowable concentration of residual radioactivity. Two sites are analyzed: site A, a small site (1.4 ha) contaminated with uranium (an alpha emitter), and site B, a large site (77 ha) contaminated with Cs-137 (a beta-gamma emitter). For this analysis, uranium is assumed to consist of U-238, U-234, and U-235 in their naturally occurring activity concentration ratio.

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Guidelines Supplement and RESRAD Code

CONF-8810239; Remedial Action Programs Annual Meeting, Proceedings of a U.S. Department of Energy Conference, Gaithersburg, MD, October 18-20, 1988, 456 pp.; (pp. 3-103 - 3-137) (1988, October)

A manual (guidelines supplement), which provides information for implementing DOE's residual radioactive material guidelines, and a computer code (RESRAD) which implements this manual, have been developed for the U.S. Department of Energy (DOE) to derive guidelines for residual radioactive materials at sites identified by the Formerly Utilized Remedial Action Program (FUSRAP) and remote sites identified by the Surplus Facilities Management Program (SFMP). A guideline is defined as a radionuclide concentration or a radiation or radioactivity level that is acceptable if a site is to be certified for unrestricted release. The derived radionuclide concentration guidelines in soil are based on the requirement that the 50-year committed effective dose equivalent to a hypothetical individual who lives or works in the immediate vicinity of an identified site should not exceed a dose of 100 mrem/yr following decontamination.

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