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FOREWORD

The research abstracts contained in this issue of the Waste Management Research Abstracts No 23/24 (WMRA 23/24) have been collected during recent months and cover the period between March 1994 and June 1998. The abstracts reflect research in progress, or planned, in the field of radioactive waste management. For abstracts of completed research and other published information the reader is advised to consult one of the many available commercial or non-commercial bibliographic information services, such as the International Atomic Energy Agency's (IAEA) International Nuclear Information System (INIS).

Though the information contained in this publication covers a wide range of programmes in many countries, the WMRA should not be interpreted as providing a complete survey of ongoing research and IAEA Member States. Enquiries for further information concerning a particular research abstract should be addressed to the author(s) at his/her institute.

The total number of abstracts published in this volume is 678 which is lower than in the previous volumes. The drop reflects an increase level of quality control, a more stringent selection for subject relevance and a general reduction in research related funding - particularly in the United States which, in the past, accounted for 30-40% of the total research abstracts.

To provide a more readily available means to record and access research in progress data, in November 1997, the IAEA introduced IRAIS (International Research Abstracts Information System), an Internet based system where researchers and the general public may view, search and print WMRA abstracts. IRAIS is available via the Internet at the following URL address:

<http://www.iaea.org/programmes/irais/>

In addition to WMRA 23/24, also included in IRAIS is WMRA 22 which was published in 1995. It should be noted that WMRA 22 data was converted and loaded from a different electronic format. Thus slight differences in content and print format may appear when compared to WMRA 23/24 and future issues. Though already in printed form, WMRA 22 data was "back loaded" to enable full text search and query functions.

The IAEA does not plan to produce any more printed abstract collections. The present abstract collection will be published only in Adobe[™] Acrobat[™] PDF format and is available on CD ROM. CD ROM copies can be ordered from the address listed later.

The PDF files can also be obtained from the following Internet web site:

<http://www.iaea.org/cgi-bin/irais.showwmt.pl?wmpubreq.wmt>

For the next two to three years, only internal working reports of this publication will be issued. It is hoped that users will switch to using IRAIS on the Internet, which supports many more advanced search and indexing facilities, such as the ability to search the full texts of the abstracts. Should there be sufficient demand, it would be possible to produce additional compilations of research abstracts for distribution on CD-ROM or via the Internet.

The Waste Management Research Abstracts is sent free of charge on request to governmental and private organizations and to researchers. To order additional copies of the present issue or of back issues (copies of issue numbers 19, 20, 21 and 22 are still available) please use the electronic request form in IRAIS or address your request to:

Waste Management Research Abstracts
Division of Nuclear Fuel Cycle and Waste Technology
International Atomic Energy Agency
PO Box 100
A-1400 Vienna
Austria

The collection of waste management research abstracts is made possible by the continued participation of researchers who are willing to invest the time and effort necessary to complete abstract forms or to submit information about their research via the Internet. The work of the Resident Missions to the IAEA in Vienna and the other governmental organizations in Member States who co-ordinated the submission of these abstracts is greatly appreciated.

A majority of this report was produced by the IRAIS Publication System which was developed by a team from the IAEA System Development Section. The Publication System has eliminated much of the manual effort required to compile and index the report - thus reducing production cost. Special thanks to the team members; Mary Sherwin, Elena Tomuta, Iouri Pozdniakov, and John Russell.

This report was prepared by Candace Chan-Sands, Scientific Secretary and Editor of WMRA, Division of Nuclear Fuel Cycle and Waste Technology with the assistance of an external expert, Mr. Graham Tebb, consultant.

INTRODUCTION TO WMRA 23/24

It is with pleasure that the International Atomic Energy Agency presents the joint twenty-third and twenty-fourth issues of Waste Management Research Abstracts (WMRA). This issue contains 678 abstracts that describe research in progress in the field of radioactive waste management. The abstracts present ongoing work in 33 countries and an international organization. Although the abstracts, in printed form, are indexed by country, many programmes are actually the result of co-operation among several countries. Indeed, a primary reason for providing this compilation of programmes, institutions and scientists engaged in research into radioactive waste management is to increase international co-operation and facilitate communications.

Data provided by researchers for publication in WMRA 23/24 were entered into a research in progress database named IRAIS (International Research Abstracts Information System). The IRAIS database is available via the Internet at the following URL address:

<http://www.iaea.org/programmes/irais/>

This database will continue to be updated as new abstracts are submitted by researchers world-wide.

The print format of the present volume is similar to that employed in WMRA 22. The abstracts are listed by country (full name) in alphabetical order. All abstracts are in English. The volume includes six indexes by: principal investigator, title, performing organization, descriptors (key words), topic codes and country. Figure 1 provides a description of the elements of an abstract.

It should again be noted that the electronic version of the IRAIS database supports considerably extended search functions and allows searching by words or phrases included in the texts of the abstracts. In performing searches users should take note of the following conventions used in full texts:

isotope numbers: ^{60}Co , ^{235}U etc. are represented by Co-60, U-235 etc.

chemical formulas: UO_2 , H_2O , Fe_2O_3 etc. are represented by UO2, H2O, Fe2O3, etc.

m² is represented by m² but m³ is written out in full as 'cubic metres'

ms⁻¹ is represented by 'm per s' and **Bqm⁻³** by 'Bq per cubic metre'

exponentials are written out, for example '10 to the power of 20' is used in place of 10^{20}

A list of waste management topic codes can be found starting on page vii.

In addition to WMRA, the IAEA produces a further collection of research in progress abstracts - the Radiation Safety Research Abstracts - which covers research in the fields of health physics and radiation protection, the Transport Safety Research Abstracts - covering the area of radioactive material transport. As with WMRA, information regarding these publications and associated activities can be obtained from the relevant scientific secretaries at the International Atomic Energy Agency.

FIGURE 1 Elements of an Abstract

Cuba	
(1)	CUB19980001
(2)	Title: Conditioning of Cuban spent sealed sources
(3)	Topic Code(s): 124 -Waste Immobilization; 125 -Waste Packaging; 126 -Waste Storage
(4)	Title in Original Language: Acondicionamiento de las Fuentes Selladas Gastadas Almacenadas
(5)	Abstract: Various types of sealed radiation sources are widely used in Cuba in industry, medicine and research. Once the radiation sources are considered spent, the Center for Radiation Protection and Hygiene (the organization responsible for radioactive waste management in Cuba) makes their centralized collection. All spent radiation sources are stored at present in the Cuban Storage Facility. There are more than 2700 spent sources. A strategic programme to define the procedures for conditioning of existing spent sealed sources began in 1996. The research was developed under the Cuban Nuclear Agency Project. Three prototypes of waste packages (conditioned drums) for different kind of radiation sources were prepared in 1997. Prefabricated concrete cubes were used for larger spent sources. As most stored sources are industrial Cs sources, four of them were selected to construct a prototype for a conditioned waste package. A 200-litre drum was prepared with concrete filling. The Cs-137 industrial sources were successively placed into the drum (the limit of activity was previously defined). Cement mortar was then poured over the sources. The prepared package with identification number DA-97-01 contains four sources with a total activity of 310 GBQ. The dose rate was 184 mSv/h at 1m.
(6)	WM Descriptor(s): caesium 137; industrial wastes; radiation sources; waste management; waste storage
(7)	Principal Investigator(s): BENITEZ, JUAN CARLOS
(8)	Organization Performing the work: CENTER FOR RADIATION PROTECTION AND HYGIENE (CUBA)
	CENTER FOR RADIATION PROTECTION AND HYGIENE PC. 10600 CIUDAD HABANA
(9)	Other Investigators: Mercedes Salgado; Luis Jova; Alejandro Hernández; Nivardo Garcia; Oscar Martinez Sandalio Madrazo
(10)	Organization Type: Other
(11)	Program Duration: From: 1996-1-1 To: 1998-12-1
(12)	State of Advancement: Research in progress
(13)	Preliminary report(s) available: Yes
(14)	Sponsoring Organization(s): Ministry of Science, Technolog
(15)	Associated Organization(s): none

FIGURE 1 (continued)

1	Reference Number	A unique identifier for each entry, in bold face, starting with the ISO code for the country followed by the year of update (four digits) and a four-digit number assigned in ascending numerical order.
2	Title	English title of the abstract.
3	Topic Code(s)	Radioactive waste management subject category codes. A list of these codes can be found starting on page vii-ix.
4	Title in Original Language	(optional) For work originally prepared in a language other than English, the title in the original language may be included here. Please note that non-Roman characters are not supported.
5	Abstract	All abstracts are printed in English. For the representation of special characters such as chemical formulas, isotope numbers etc. see the information given in the Introduction.
6	WM Descriptor(s)	Descriptors or key words taken from the Radioactive waste management Thesaurus. The assigned descriptors are indexed in this volume and represent an additional search possibility.
7	Principal Investigator	The name of the primary researcher or author contributing to the document. Corporate/organization authors are also cited where applicable.
8	Organization Performing the work	Name and location of the primary author/investigator.
9	Other Investigator(s)	Name(s) of other researcher(s) or collaborator(s).
10	Organization Type	The type of organization where the research is being performed: an institution of higher education; a foundation or laboratory for research and/or development; private industry; or other.
11	Program Duration	The start and finish dates are given in the format YYYY-MM-DD.
12	State of Advancement	State of the research: research planned or in progress.
13	Preliminary report(s) available	Yes or no.
14	Sponsoring Organization(s)	The organization providing the funding for the research.
15	Associated Organization(s)	Any other organization(s) also performing the research.

WASTE MANAGEMENT TOPIC CODES

10 - RADIOACTIVE WASTE

100 - RADIOACTIVE WASTE - GENERAL

- 101 - General policies
- 102 - Programme Strategy, Planning and Management
- 103 - Effluents and Discharges
- 104 - Database & Information Systems, including Technology Transfer Systems. Technical Assistance and Costs
- 105 - Waste Minimisation
- 106 - Quality Assurance Aspects
- 108 - Waste Management System Analysis
- 109 - Waste Characterisation (Radionuclide Inventory Determination), including Computer Codes and Measuring Methods and Techniques

110 - LOW AND INTERMEDIATE LEVEL WASTE FROM NFC FACILITIES

- 111 - Gaseous Waste Treatment
- 112 - Liquid Waste Treatment
- 113 - Solid Waste Treatment
- 114 - Waste Immobilization (Bituminization, Cementation, Including Tests of Properties, Leaching Studies)
- 115 - Waste Packaging
- 116 - Waste Storage
- 117 - Waste Disposal
- 118 - Waste Transportation (Methods, Containers, Transportation Means)

120 - RADIOACTIVE WASTE FROM NON-NFC SOURCES

- 121 - Gaseous Waste Treatment
- 122 - Liquid Waste Treatment
- 123 - Solid Waste Treatment
- 124 - Waste Immobilization
- 125 - Waste Packaging
- 126 - Waste Storage
- 127 - Waste Disposal

130 - HIGH LEVEL WASTE

- 131 - Gaseous Waste Treatment
- 132 - Liquid Waste Treatment
- 133 - Solid Waste Treatment
- 134 - Waste Immobilization/Vitrification (including Heat Transfer, Leaching and Other Studies)
- 135 - Waste Packaging (Canister Types, Materials, Corrosion Studies)
- 136 - Waste Storage
- 137 - Waste Disposal (including Spent Fuel)
- 138 - Waste Transportation (Methods, Containers, etc.)

- 140 - SPENT FUEL**
- 141 - Spent Fuel Immobilization/Conditioning**
- 142 - Spent Fuel Packaging (Canisters, Materials. etc.)**
- 143 - Spent Fuel Storage**
- 144 - Spent Fuel Immobilization/Conditioning**
- 145 - Spent Fuel Packaging (Canisters, Materials. etc.)**
- 146 - Spent Fuel Storage**
- 148 - Spent Fuel Transportation (Methods, Casks, etc.)**

150 - ALPHA BEARING/TRU WASTE

- 151 - Gaseous Waste Treatment**
- 152 - Liquid Waste Treatment**
- 153 - Solid Waste Treatment**
- 154 - Waste Immobilization**
- 155 - Waste Packaging**
- 156 - Waste Storage**
- 157 - Waste Disposal**
- 158 - Waste Transportation (Methods, Containers, etc.)**
- 159 - Recovery of Radionuclides from the Waste**

160 - HAZARDOUS/MIXED WASTE

- 161 - Biodegradation/Biotreatment**
- 162 - Liquid Waste Treatment**
- 163 - Solid Waste Treatment**
- 164 - Waste Immobilization**
- 165 - Waste Packaging**
- 166 - Waste Storage**
- 167 - Waste Disposal**
- 168 - Waste Transportation (Methods, Containers, etc.)**
- 169 - Removal/Recycling of Organics**
- 171 - Technologies and Methodologies**
- 174 - Rehabilitation of Mill Tailings**

180 - WASTE CHARACTERIZATION

- 181 - Methodologies, Analytical Methods, Measurements Instrumentation**
- 182 - Waste from form characterization**
- 183 - Waste packages characterization**
- 184 - Mixed waste characterization**
- 185 - Radionuclide characterization in storage tanks**
- 186 - Radionuclide characterization in drums**
- 187 - Radionuclide characterization in-situ**
- 188 - Radionuclide scanning**
- 191 - ROHE in waste management facilities**
- 192 - ROHE in laboratories**
- 193 - ROHE in site characterization**
- 194 - ROHE in D&D**
- 195 - ROHE in drums characterization and retrieval**
- 196 - ROHE in characterization and retrieval of buried waste**
- 197 - ROHE in characterization and retrieval of liquid waste served in underground**

20 - ENVIRONMENTAL IMPACT/ASSESSMENT STUDIES

200 - ENVIRONMENTAL IMPACT/ASSESSMENT

- 201 - Dispersion and Migration of Radionuclides**
- 202 - Dispersion and Migration Models**
- 203 - Gas Diffusion Studies**
- 204 - Impacts from Landfill Sites**

210 - BIOLOGICAL UPTAKE AND TRANSFER

- 211 - Biological Uptake Mechanisms and Models**

220 - ENVIRONMENTAL TRANSFER

- 221 - Environmental Transfer Models**
- 222 - Microbial Effects**
- 223 - Effects of Gaseous Releases**

230 - RADIOLOGICAL ASSESSMENT

- 231 - Radiological Assessment Models**
- 232 - Environmental Risk Assessment**
- 233 - Long Term Environmental Impact**

240 - ENVIRONMENTAL MONITORING

- 241 - Monitoring Programmes**
- 242 - Monitoring Techniques**

30 - FACILITY AND/OR SITE SPECIFIC STUDIES

300 - FACILITY/SITE - GENERAL

- 301 - General Planning and Management**
- 302 - Site Survey and Characterization**
- 303 - Earth Science Models and Studies**
- 304 - Safety Assessment and Performance Studies**
- 305 - Design, Construction, Commissioning**
- 306 - Barrier Studies and Tests**

310 - STUDIES FOR NEAR SURFACE DISPOSAL FACILITIES

- 312 - Site Survey and Characterization**
- 313 - Earth Science Studies and Models**
- 314 - Safety Assessment and Performance Studies**
- 315 - Design, Construction, Commissioning**
- 316 - Barrier Studies/Tests/Impacts**

320 - STUDIES FOR GEOLOGICAL REPOSITORIES

- 321 - General Planning and Management**
- 322 - Site Survey and Characterization**
- 323 - Earth Science Studies and Models**
- 324 - Safety Assessment and Performance Studies**
- 325 - Design, Construction, Commissioning**
- 326 - Barrier Studies/Tests/Impacts including Near Field Effects**
- 327 - Waste Emplacement**
- 328 - Natural Analogue Studies**

330 - STUDIES FOR LANDFILL SITES

331 - General Planning, Regulatory Concern, Limits

332 - Site Characterization, Disposal Technologies

333 - Landfill site remedial actions

40 - DECONAMINATION AND DECOMMISSIONING (D & D)

400 - D&D - GENERAL

401 - D&D Programme Strategy, Planning and Management

402 - Nuclear Power Reactor Decommissioning

403 - Research Reactor Decommissioning

404 - Non-Reactor Facility Decommissioning

410 - DECONTAMINATION TECHNOLOGIES

411 - Mechanical Decontamination Methods

412 - Chemical Decontamination Methods

413 - Electrochemical Decontamination Methods

414 - Ultrasonic/Microwave Decontamination Methods

415 - Decontamination by Melting

416 - Other Methods and Techniques

420 - DECOMMISSIONING TECHNOLOGIES

421 - Dismantling Techniques

422 - Use of Explosives

423 - Robotics, Remote Operations

430 - MANAGEMENT OF DECOMMISSIONING WASTE

50 - ENVIRONMENTAL RESTORATION

501 - Project Planning and Management

502 - Feasibility Studies

503 - Environmental Risk Evaluation including models

504 - Economic Studies

505 - Criteria

511 - Site Characterization

512 - Unknown

521 - Decontamination of Soils

522 - Decontamination of Groundwaters

523 - Waste Retrieval, Emplacement of Barriers

524 - Management of Restoration Waste

60 - LEGAL, REGULATORY AND GOVERNMENTAL ISSUES

601 - Criteria for Exempt Levels

602 - Facility/Site Licensing Process

611 - Waste Policy Acts

70 - PUBLIC INFORMATION/INTERACTION

701 - Public Information Programmes, Public Participation

702 - Information Centres

703 - Education and Training

704 - Socioeconomic Aspects

80 - ACTINIDE & TRANSMUTATION

800 - Actinide & Transmutation Studies