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The research abstracts contained in the Waste Management Research Abstracts Volume 30 (WMRA 30) were collected between June 1 and September 30, 2005. Since the WMRA submission process is Internet-based (discussed below), abstracts may be submitted at any time of the year.

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 IAEA’s International Nuclear Information System (INIS). Please refer to the following URL for INIS:

http://www.iaea.org/programmes/inis/index.html

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

The image that follows illustrates the number of abstracts published per year for the last six WMRA publications. Except for 2003, there has been a steady decline in the number of abstracts submitted to the IAEA. In 2005, only 90 abstracts were published.

The reduction in the number of abstracts per volume might be attributable to:

- decreased international interest in the WMRA, perhaps related to the variety of information sources on the Internet, and/or
- a higher rejection rate for abstracts (some submissions were rejected because key information was missing).
With the implementation of the Internet-based submission for WMRA, and combined with an automated “in-house” administrative system, abstracts in WMRA 25 through WMRA 29 were accessible via the Internet at the URL listed below as soon as they were authorized for publication by the WMRA Programme Officer.

http://www.iaea.org/cgi-bin/irais.showwmt.pl?wmwmra.wmt

Many abstracts for WMRA 30 were authorized and became accessible on the Internet within only a few days of the date that they were submitted to the IAEA.

Individual abstracts may be viewed via the cited URL. In addition, searches may be carried out to find and view abstracts according to various search criteria, such as by publication volume, by waste management topic code, by specific database fields (such as title, country, principal investigator), etc. As such, for WMRA 25 and onward, it is not necessary to wait until a collection of abstracts is published - abstracts may be viewed interactively via the Internet as soon as they are authorized.

Even though individual abstracts are directly accessible via the Internet, collections of abstracts in WMRA 30 and in future WMRA volumes are or will be published on CD ROM to assist persons that may have difficulty accessing abstracts via the Internet.

WMRA 30 is a collection of Adobe Acrobat PDF files. In addition to being published on CD ROM, WMRA 30 may be downloaded from the cited URL. After downloading during a brief on-line session, users can work with WMRA 30 off line. WMRA 23/24 to WMRA 28, also collections of PDF files, may be ordered on CD ROM or downloaded from the cited URL.

The database that holds the abstracts for WMRA 23/24 and onward also contains the abstracts for WMRA 22. It should noted that WMRA 22 data were converted and loaded from a different electronic format. Thus slight differences in content and print format may appear when compared to later WMRA volumes. Although already in printed form, WMRA 22 data were “back loaded” to enable full text search and query functions via the Internet at the cited URL. The collection of abstracts in WMRA 22 is available only in printed form, which may be ordered from the cited URL.

Volumes of Waste Management Research Abstracts are available free of charge, on request, to governmental and private organizations and to researchers. To order copies of WMRA volumes, please use the electronic request form on the cited URL or mail a request to:

WMRA Programme Officer
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 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.

This report was prepared by G.W. Csullog and I. Pozdniakov, Division of Nuclear Fuel Cycle and Waste Technology.
INTRODUCTION TO WMRA 30

It is with pleasure that the International Atomic Energy Agency presents the thirtieth issue of the Waste Management Research Abstracts (WMRA). This issue contains 90 abstracts that describe research in progress in the field of radioactive waste management. The abstracts present ongoing work in various countries and international organizations. Although the abstracts are indexed by country, some 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 30 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:

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

This database will continue to be updated as new abstracts are submitted by researchers world-wide. The abstracts are listed by country (full name) in alphabetical order. All abstracts are in English. The volume includes six indexes: principal investigator, title, performing organization, descriptors (key words), topic codes and country. Figure 1 provides a description of the elements of an abstract. Internet access to WMRA supports a variety of search functions and allows searching by words or phrases included in the texts of the abstracts. When performing searches, users should take note of the following conventions that are typically used in full texts:

- **isotope numbers**: $^{60}$Co, $^{235}$U etc. are represented by Co-60, U-235 etc.
- **chemical formulas**: UO$_2$, H$_2$O, Fe$_2$O$_3$ etc. are represented by UO$_2$, H$_2$O, Fe$_2$O$_3$, etc.
- $\text{m}^2$ is represented by m2
- $\text{m}^3$ is represented by m3
- $\text{ms}^{-1}$ is represented by ‘m per s’ or ‘m/s’ and $\text{Bq m}^{-3}$ by ‘Bq per m$^3$’ or ‘Bq/m$^3$’
- **exponentials** do not use superscripts; for example $10^3$ is written 1E3

A list of waste management topic codes can be found starting on page viii.
FIGURE 1   Elements of an Abstract (continued on next page)

1. GFR20030001

2. Title:
   Development and in-Situ Testing of Redundant Fiber Optic Monitoring Systems

4. Title in Original Language:  
   Entwicklung und in-situ Eiprofung redundanter faseroptischer Überwachungssysteme

3. Topic Code(s):
   181 -Methodologies, Analytical Methods, Measurements Instrumentation

5. Abstract:
   One of the issues to be solved in a geological repository is operational in-situ monitoring. Availability of
   appropriate monitoring tools is a major development objective, in order to ensure operational safety and in
   order to respond to a variety of other safety related demands. In-situ monitoring would provide the opportunity
   to increase confidence in the safety of the disposal system by verifying that the repository evolves in the manner
   predicted.

   Long-term effectiveness, low maintenance, reliable functioning with high accuracy, and resistance to various
   mechanical and geochemical impacts are major attributes of monitoring systems devised to be operated at least
   during the operational phase of a repository. In addition, low maintenance and automatic data acquisition
   without disturbing normal operation will help reducing significantly the operational costs.

   Due to these reasons DBE TECHNOLOGY is developing thermo-hydro-mechanical sensing systems based on
   fiber optic technology as the basis for monitoring systems at final disposal sites. Among the different sensing
   and multiplexing techniques available, the sensor development focuses on Fiber Bragg Grating and Intensity
   Modulation Sensing technology along with their corresponding multiplexing technique.

   This project is aimed at in-situ testing of fiber optic sensing systems in different geological formations and
   engineered barrier systems.

6. WM Descriptor(s):
   data acquisition systems; fiber optics; fibre optics; measuring instruments; optical fibers; optical fibres; optical systems; quality assurance; safety; technology development; temperature measurement

7. Principal Investigator:
   Johnmann, Michael W
   DBE Technology GmbH
   Eschenstrasse 55
   D-31224 Peine, GERMANY
   Tel: 05171431530 Fax: 05171431506 E-mail: jobmann@db.de

8. Organization Performing the work:
   DBE TECHNOLOGY GmbH
   Eschenstrasse 55
   D-31224 Peine
   GERMANY

9. Other Investigators:
   Voet, Marc I.D.FOS Research e.e.g.

10. Organization Type:
    Private industry

11. Program Duration:  From 2000/02/01 To 2004/09/30

12. State of Advancement: Research in progress

13. Preliminary reports available: No

14. Sponsoring Organization(s):
    Bundesministerium für Wassertechnologie und Entsorgung

15. Associated Organization(s):
    none

16. Recent publication info:
FIGURE 1 (continued from previous page)

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<th></th>
<th>Reference Number</th>
<th>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.</th>
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<td>Title</td>
<td>English title of the abstract.</td>
</tr>
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<td>Topic Code(s)</td>
<td>Radioactive waste management subject category codes. A list of these codes can be found starting on page vii-ix.</td>
</tr>
<tr>
<td>4</td>
<td>Title in Original Language (optional)</td>
<td>For work originally prepared in a language other than English, the title in the original language may be included here. Please note that non-ASCII characters are not supported.</td>
</tr>
<tr>
<td>5</td>
<td>Abstract</td>
<td>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.</td>
</tr>
<tr>
<td>6</td>
<td>WM Descriptor(s)</td>
<td>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.</td>
</tr>
<tr>
<td>7</td>
<td>Principal Investigator</td>
<td>The name of the primary researcher or author contributing to the document. Corporate/organization authors are also cited where applicable.</td>
</tr>
<tr>
<td>8</td>
<td>Organization Performing the work</td>
<td>Name and location of the primary author/investigator.</td>
</tr>
<tr>
<td>9</td>
<td>Other Investigator(s)</td>
<td>Name(s) of other researcher(s) or collaborator(s).</td>
</tr>
<tr>
<td>10</td>
<td>Organization Type</td>
<td>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.</td>
</tr>
<tr>
<td>11</td>
<td>Program Duration</td>
<td>The start and finish dates are given in the format YYYY-MM-DD.</td>
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<td>12</td>
<td>State of Advancement</td>
<td>State of the research: research planned or in progress.</td>
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<tr>
<td>13</td>
<td>Preliminary report(s) available</td>
<td>Yes or no.</td>
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<td>Sponsoring Organization(s)</td>
<td>The organization providing the funding for the research.</td>
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<td>Associated Organization(s)</td>
<td>Any other organization(s) also performing the research.</td>
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<td>A list of recent, relevant publications.</td>
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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 - DECONTAMINATION 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