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FOREWORD

The research abstracts contained in the Waste Management Research Abstracts Volume 29 (WMRA 29) were collected between May 1 and October 15, 2004. The announced submission period was June 1 to September 30, 2004; however, because 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.

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 29 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), et cetera. 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 29 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 29 is a collection of Adobe Acrobat PDF files. In addition to being published on CD ROM, WMRA 29 may be downloaded from the cited URL. After downloading during a brief on-line session, users can work with WMRA 29 offline. 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 29

It is with pleasure that the International Atomic Energy Agency presents the twenty-ninth issue of the Waste Management Research Abstracts (WMRA). This issue contains 96 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 cooperation 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 cooperation and facilitate communications.

Data provided by researchers for publication in WMRA 29 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.
- \(m^2\) is represented by m\(^2\)
- \(m^3\) is represented by m\(^3\)
- \(ms^{-1}\) is represented by ‘m per s’ or ‘m/s’ and \(Bqm^{-3}\) 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. **Title:**
   Development and in-Situ Testing of Redundant Fiber Optic Monitoring Systems

2. **Title in Original Language:**
   Entwicklung und in-situ Eiprobung redundanter faseroptischer Überwachungssysteme

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

4. **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.

5. **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

6. **Principal Investigator:**
   Jobmann, Michael W

   DBE Technology GmbH
   Eschenstrasse 55
   D-31224 Peine, GERMANY

   Tel: 05171431530 Fax: 05171431506 E-mail: jobmann@db.de

7. **Other Investigators:**
   Voet, Marc I.D.FOS Research e.e.i.g.

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

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

10. **State of Advancement:**
    Research in progress

11. **Sponsoring Organization(s):**
    Bundesministerium für Wasserstoff und Entsorgung

12. **Organization Type:**
    Private industry

13. **Preliminary reports available:**
    No

14. **Associated Organization(s):**
    none

15. **Recent publication info:**
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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
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   332 - Site Characterization, Disposal Technologies
   333 - Landfill site remedial actions

40 - DECONAMINATION AND DECOMMISIONING (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 & TRANS MUTATION
   800 - Actinide & Transmutation Studies