



ISAM NEWSLETTER



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THE INTERNATIONAL ATOMIC ENERGY AGENCY PROGRAMME ON IMPROVEMENT OF SAFETY ASSESSMENT METHODOLOGIES FOR NEAR SURFACE WASTE DISPOSAL FACILITIES - ISAM

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ISAM PROGRAMME

The IAEA coordinated research programme on Improvement of Safety Assessment Methodologies for Near Surface Waste Disposal Facilities (ISAM) was completed at the 3rd Research Coordinating Meeting (RCM), held in September 2000 at the IAEA headquarters in Vienna. Three RCMs were held between November 1997 and October 2001,

supported by meetings of the ISAM Co-ordinating Group and of the individual working groups - Scenario Generation and Justification, Modelling and Data Confidence Building, Vault Test Case, RADON Type Facility Test Case, and Borehole Test Case. All these events provided the ISAM participants with opportunities for discussions and enabled a consensus on the main aspects of safety assessment methodologies for near surface waste disposal facilities. The work accomplished by the ISAM working groups has been

documented in the six working group reports, that were finalized in 2001.



C. Torres-Vidal, ISAM Scientific Secretary, joined the Spanish regulatory authority (CSN) in November 2001. The ISAM co-ordinating group had the opportunity to say "good-bye" to Carlos at his farewell party, hoping to see him actively involved in future Agency's waste safety activities.

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ISAM Co-ordinating Group Meeting

The last ISAM Co-ordinating Group meeting was held at the IAEA headquarters from 29 October to 2 November 2001. It had two main objectives - to finalize the ISAM final report and to discuss the scope of a new IAEA co-ordinated research project on application of long-term safety assessment methodologies for near surface disposal facilities. The meeting was attended by D. Graham (ISAM Chairman), M. Kozak (Test Case Leader), P. Heilbron (Modelling Group Leader), J. van Blerk (Scenario Group Leader), G. Dolinar (Confidence Group Leader), E. Kelly (Vault Test Case Leader),

R. Little (consultant), G. Linsley (Waste Safety Section Head), P. Metcalf (Head of Waste Disposable Unit) and B. Batandjieva (ISAM Scientific Secretary). The Co-ordinating Group had an opportunity to meet Phillip Metcalf, who has taken the responsibility for overall co-ordination of the IAEA activities on radioactive waste disposal. It was good to see that the IAEA and the ISAM Co-ordinating Group had similar ideas about possible future activities in the field of safety assessment for near surface waste disposal, such as the follow-up of the ISAM programme.

It was a coincidence that Carlos Torres, who initiated ISAM and managed it for the period 1997-2001, and was P. Metcalf's predecessor had his last week at the IAEA at the time of the Co-ordinating Group meeting. ISAM members wished him well on his return to Spain. Further, the ISAM Co-ordinating Group said farewell to Claire Halsall, who was the ISAM programme secretary in the IAEA. Claire had provided considerable support to ISAM over the years, in particular dealing with many minor emergencies that occur with a large and long-term programme.

D. Graham who has ended ISAM as Chairman, would like to thank everyone who has been involved in ISAM. He has met many new friends as a consequence of the past five years, and looks forward to continuing these friendships when the new CRP starts in late 2002.

The six ISAM working group documents, developed during the last four years, will establish the basis for development of a three-volume report in a

form of a TECDOC on "Improvement of Safety Assessment Methodologies for Near Surface Waste Disposal Facilities". Volume 1 will present an executive summary including an overall description of the programme (its objectives, structure, activities, etc.), the summary of the main lessons learned, and conclusions and recommendation derived from the ISAM programme. Volume 2 will present the ISAM safety assessment methodology and will include the Scenario Generation and Justification, the Modelling and the Confidence Building working group reports. Volume 3 will summarize the work performed for the ISAM test cases (Vault, Radon Type Facility and Borehole) and will combine the three test case reports. During the meeting the ISAM Co-ordinating Group focused

its efforts on revising and finalizing the chapters of the working group reports dealing with lessons learned, and the conclusions that followed from the working groups and test cases activities, as well as on development of the overall conclusions from the ISAM programme. These conclusions will be included into the final report. The Co-ordinating Group has also concluded that technical editing of the final report is recommended before it is published. The technical editing will be undertaken by February 2002 and the report is expected to be published as an IAEA TECDOC by July 2002. By that time the six ISAM working documents from the working groups will be available in hard copy, as well as in electronic format at the ISAM website.

Scenario Generation and Justification

The Scenario Working Group (SWG) activities were concluded with the restructuring of the working group document compatible with the final ISAM report. The main text focuses on the three deliverables defined for the group, namely:

- the terminology used in scenario generation;
- the contribution of the ISAM FEPs list to a systematic scenario generation approach, and in particular as used in the three ISAM safety cases; and
- lessons learnt.

Unlike geological disposal, very little evidence was available of the use of systematic

scenario generation methodologies to near-surface disposal systems at the start of the ISAM programme. By

the end of the programme, the situation had changed considerably, with several countries and organizations implementing systematic scenario generation approaches in their national programmes.

Not only did these countries benefit indirectly from the ISAM programme, but it was

The leader of the Scenario Generation and Justification Working Group, Dr. Japie van Blerk (Aquisim Consulting (Pty) Ltd., SA), would like to thank everyone who participated in the Working Group during the course of the programme. Especially those how found the time to contribute actively to the success of the Working Group, even if to comment on the working material produced.

also possible to include their experiences in the ISAM scenario generation activities. Together with the current status of scenario generation in geo-

logical disposal systems, an Appendix will be included in the draft final report summarizing these experiences in near-surface disposal systems. The ISAM FEPs list as developed during the course of the programme, will also be included as an Appendix to the report.

Modelling and Data

The information related to modelling and data activities (last version of the Modelling working group report) will be included mostly in chapter four of the ISAM final report. A considerable amount of technical information will be included in the document i.e.: (i) information about waste classification and disposal systems; (ii) description of some conceptual/mathematical models and discussions about boundary conditions (applications and limitations) used in modelling source terms, vadose zone and saturated zone as well as the biosphere; (iii) development of approaches to progress from conceptual models to mathematical

models to computer codes; (iv) a list containing information about the main codes used in safety assessment throughout the world; (v) a list containing information about the main parameters used in the safety assessment; (vi) some analytical solutions, etc. Technical revision of the first draft of the final report was made during the October meeting, especially the section on mathematical equations. Some omissions were also identified and completed. It should be mentioned that only some examples of mathematical models that can be used will be included in the final document. It was not possible to include all the models

used for modelling source term, geosphere and biosphere. The ISAM Co-ordinating Group also strongly recommended that the draft final document should be subject to a technical review in order to make the necessary cross references between all the ISAM documents before publishing.

In conclusion, the leader of the Modelling and Data working group P. Heilbron (CNEN-Brazil), would like to express his gratitude to those experts around the world who contribute for the success of the ISAM project and especially to the good work done on the modelling and data subject.

Confidence Building

To ensure compatibility with the format and structure of the final ISAM documentation the ISAM Co-ordinating Group decided to revise the existing summary of the Confidence Building Group document. Much of the week was taken up in extracting summaries and recommendations made previously by the Compilations, Quality Assurance, Communications, Uncertainty and Sensitivity Analysis sub-groups. With summary information extracted, a number of sections required editing so that the

reader could easily follow from one section to the next. At the same time several comments, received from participants, were addressed as the text was reworked. One of the issues that needed to be resolved was related to the quality and verification of data that had been received in response to the questionnaires. It was decided that a

The leader of the Confidence Building Group G. Dolinar (AECL, Canada) would like to thank all ISAM participants who contributed to the work of the group and its successful completion.

statement should be included at the beginning of the Appendix of the final report indicating that the information recorded had been received in response to the questionnaires, and that it had not been verified for accuracy. Lastly, some of the achievements of the Confidence Building Group were listed along with some ideas of future work. The latter was considered in discussions for potential future work to be conducted by the IAEA in any proposed follow-up programme to ISAM.

Test Cases

A key aspect of the ISAM approach is its application in an iterative manner. Due to time constraints, only one iteration has been undertaken for the

Vault and Borehole Safety Cases and two iterations for the RADON Safety Case. Further iterations could be undertaken to investigate some of the key

issues identified in this first iteration (for example, modifications to the facility design, reductions in the inventory of certain radionuclides and the investigation

Many of the assumptions and decisions on the development of the ISAM test cases were developed for pragmatic reasons to enable progress with the limited time available. It is recognized

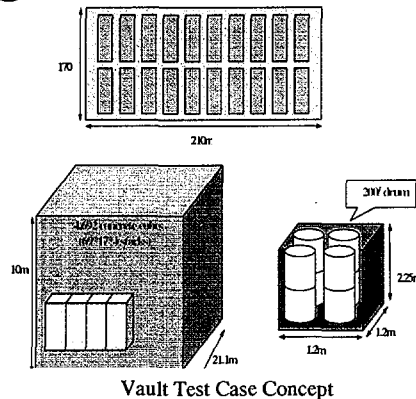
M. Kozak, coordinator of the ISAM test cases, would like to express his profound thanks to all those who contributed to the ISAM Test Cases. Conducting the Test Cases involved a strong, prolonged effort from a large number of participants over a significant period of time. It has been only through the efforts of those individuals that the ISAM test cases have been concluded so successfully.

that real safety assessments will require a more detailed and thorough implementation of the tools and approaches. This will depend strongly upon the assessment context.

Vault Test Case

The final draft of the Vault Safety Case Report was circulated to all those who had expressed an interest in the Vault Safety Case at previous ISAM RCM's. During the final ISAM Co-ordinating group meeting in October 2001, key lessons learned and conclusions were identified. Some of these were generally applicable and were collated with the conclusions of the other ISAM safety cases. Those conclusions that were more specific to the Vault Safety Case were:

- This initial assessment has indicated that the site appears to have relatively good characteristics and is suitable for further investigation and there is potential for significant improvements in performance (e.g. through changes to the facility design, inventory, etc.).
- The Vault Safety Case developed and successfully applied a scenario development and justification procedure to identify a design scenario and several alternative scenarios. It is recognized that this is one of several approaches that can be used which may be equally valid.



- At various stages in the assessment process, it was found helpful to develop a summary flow diagram of the basic steps in particular sub-components of the overall methodology to clarify understanding and for communication purposes. It was also found useful to review these flow diagrams after implementation and modify them in the light of experience.

- In carrying out the safety assessment, it was found to be very helpful to have two participants with different software applications undertaking calculations independently. This gives rise possibility for cross-checking of results; the identification of differences in conceptual and mathematical models and input data; the correction of associated errors; and the identification

understanding of key processes. A range of different conceptual and mathematical models were applied by participants for the design scenario liquid release and human intrusion scenario calculations. The resulting differences were often small (an order of magnitude or less), especially for the key radionuclides. Note this conclusion only applies to this initial iteration of the Vault Safety Case and should not be taken as a more general conclusion. The results of this study indicate that when assessing a near surface disposal facility, it can be important to consider release mechanisms in addition to liquid release. Human intrusion, gaseous and solid release can all be important exposure pathways.

To conclude, the leader of the Vault Safety Case Group, E. Kelly (BNFL, UK) would like to thank all those who expressed an interest in the Vault Safety Case and especially thank the active participants who put a considerable amount of effort into the project, which has yielded a very worthwhile piece of work.

Radon Test Case

A final version of the RADON Type test case and the working

group report were completed. Two iterations of the safety as-

essment methodology were finalized, and the second itera-

tion reflected a revision of the hydrogeological conceptual model. A design-basis scenario was established, along with perturbations of that scenario, and additional scenarios for consideration. The results of the calculations from two participants were presented and the main lessons learned and conclusions drawn have been documented. Some of them

could be summarized as follows:

- The test case was based on a hypothetical mixture of a realistic site description with-

sites. Conceptual and mathematical modeling can be ap-

plied in the calculation of end points, and also to identify missing data necessary for the safety assessment. This second point is particularly important for historic RADON type facilities, when some of information is not available. The complexity of each component of the model, particularly those dealing with groundwater flow and

vaults and waste inventories from different sites. Therefore this Test Case is a good example for application of the ISAM methodology on this type of repositories. The outcome can be used at specific real RADON-type disposal facilities. One of the key outcomes of the RADON Test Case was a rather broad agreement on high-level

assumptions and concepts that should be applied in the assessment context. It was discovered that there was more variability among

transport, depends on the assessment purpose, as

well as available data and knowledge of the system. Combining different kinds of models into a joint system shall be performed with care. Within the ISAM project a limited number of scenarios were considered and calculated. In this Safety Case, solid releases of radionuclides from this near surface facility lead to higher doses than

practices at these facilities than was previously understood.

- The high-level ISAM FEPs list is a very useful tool for safety assessment and the RADON Test Case Group used it in a limited way for scenario development, but used it more as a checklist to audit the scenarios following their development. At the same time the Group noted that it could be helpful to develop a generic list of scenarios specific to RADON-type facilities. This could be carried out on the basis of specific features of typical disposal units at RADON-type facilities, taking into account typical geological and hydrogeological conditions at their

did groundwater releases as a result of either erosion or human intrusion. Though both cases seem unlikely to occur in present conditions, the results show that these scenarios provide the potential for significant doses if institutional control over the site is lost. It also means that long-time study of erosion process at Radon type facilities may be appropriate to obtain specific data for real RADON facilities being under assessment.

The work performed by the Radon Test Case Group seemed not possible to be accomplished without considerable efforts of many people from different countries. The leader of this group, Mr. A. Gousskov (MosRadon, Russian Federation) would like to thank everybody, who was involved in the group activities, and especially C. Torres, M. Kozak, R. Little, P. Heilbron, for their interest, guidance and assistance in this work, and also other people involved in the Radon Test Case, including first of all Ms. D. Grigaliuliene for the AMBER calculations, colleagues and managers of MosNPO "Radon" for appreciation and support to this project.

Borehole Test Case

The final version of the Borehole Safety Case report had been distributed to participants before the final ISAM coordinating group meeting was held at the end of October 2001. No further comments were received, which enabled the report to be finalized in the



Vaalputs site (South Africa)

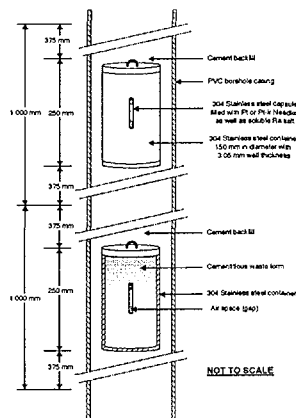
required format. In particular, key lessons learned and conclusions were identified. Some of these were generally applicable and were added to the conclusions of the other ISAM test cases. Lessons that are specific to the Borehole Safety Case are the following:

- The Borehole Safety Case followed the ISAM methodology, and although not applied to its full extent, proved useful in performing safety assessments for near-surface (up to several tens of meters) borehole disposal facilities in a structured manner.

- It is considered that the Borehole Test Case has fulfilled the objectives defined for the test case. In particular, it can be concluded with reasonable assurance that the concept proved to be suitable under the specific site and

land use conditions. This conclusion suggests that the concept is suitable for the disposal of spent radiation sources under the arid conditions described in the assessment context.

- A first iteration of the methodology was completed and serves as a basis for future iterations. This preliminary assessment can be enhanced, as more resources are available. Both the results and the decision-making process should be judged from this perspective.



Borehole Disposal Concept

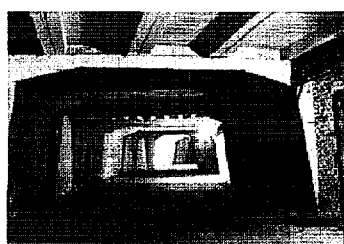
- Formal methods for developing scenarios or conceptual models from them were not used in the Borehole Test Case, owing to time limitations. However, the ISAM FEPs list proved to be very useful as an audit trail and to facilitate model development. Interaction matrixes complemented this process, but were used only to a limited extent.

The leader of the Borehole Safety Case Group K. Vivier from South Africa, would like to express his gratitude towards everyone contributing to the success of the safety case.

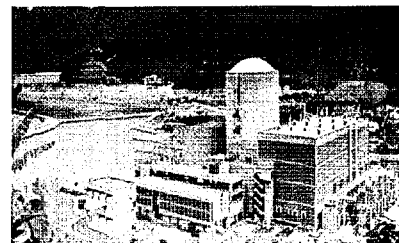
ISAM CD-ROM

During its final meeting the ISAM Coordinating Group concluded that it would be considerably beneficial to develop a CD-ROM to facilitate the distri-

bution of ISAM documents, i.e. final report, national safety cases (e.g. Australia, Brazil, Spain, France), participant lists and other relevant information. The ISAM participants can still contribute to the CD-ROM with information about their national radioactive waste management programmes that will be included in the "National Cases" section. Relevant materials MS-Word documents as well as pictures/videos of radioactive



Richard Repository (Czech Rep.)



Alvaro Albrto NPP, Brazil

waste repositories with description) can still be sent to Ms. B. Batandjjeva (IAEA), but not later than 30 April 2002.

IAEA Conference on Issues and Trends on Radioactive Waste Management – 2002

The co-ordinating group considered the IAEA conference on Issues and Trends on Radioactive Waste Management, to be held in 9-13 December 2002 would provide a good opportunity to present the outcome of

the ISAM programme and to advertise the start-up of the new

At present the ISAM mailing list consists of 692 experts from 72 countries. Most of the specialists have expressed interest in the follow-up project, which is encouraging and highlights the success of the ISAM and the need to build up on this success.

CRP on the application of safety assessment methodologies for near surface disposal facilities. Further consideration is needed to better define how ISAM can contribute to the conference.

ISAM Website

The ISAM Co-ordinating Group considered the need for restructuring of the existing ISAM web site and the upkeep of the information collected under the ISAM programme. In addition an important aspect considered by the IAEA is the

possible incorporation of the ISAM information into the IAEA web site. This question is also relevant to the management and co-ordination of the new IAEA CRP, that will follow the ISAM programme.

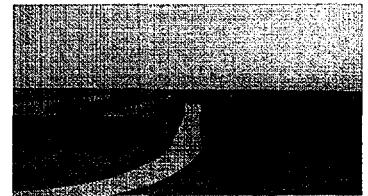
The last information on ISAM activities is available on :

<http://cobweb.businesscollaborator.com/bscw/bc.cgi>

New IAEA Project -ASAM

The successful completion of the ISAM programme led to discussion of its possible follow up. Proposals on relevant topics of interest were developed at the 3rd RCM held in September 2000. These suggestions were discussed and further developed by the ISAM Co-ordinating Group at its final meeting in October 2001 in order to comply with the objective of the new CRP – Application of Safety Assessment Methodologies for Near Surface Disposal Facilities (ASAM). The role of the safety assessment in the decision making process in terms of intervention, upgrading, or remediation is an important aspect for further consideration.

Performance of periodic safety assessment and its role in deciding on the safety of a waste disposal facility is another area of interest, especially for re-



Northwest Repository (China)

**1ST RESEARCH CO-ORDINATING
GROUP MEETING OF THE IAEA
RESEARCH COORDINATING
PROGRAMME ON APPLICATION
OF LONG-TERM SAFETY
ASSESSMENT METHODOLOGIES
FOR NEAR SURFACE WASTE
DISPOSAL FACILITIES – ASAM
(2002-2005)**

**11-15 NOVEMBER 2002, IAEA,
VIENNA, AUSTRIA**

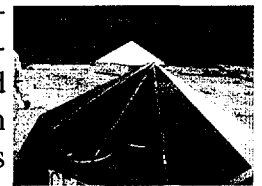
positories built according to past safety requirements and standards. It seems that development of regulatory review plan for safety case will be use-

ful, as well as guidance on establishing priorities in performance of long-term safety assessment for near surface waste disposal facilities. Confidence building in the overall safety assessment process and in the safety case with focus on presentation of the results is another area proposed for the new CRP. The specific technical subjects that are considered of common interest for many experts are the evaluation and justification of engineered barriers perform-

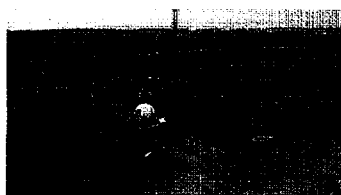
ance, of human intrusion and institutional control over waste disposal facilities. The potential near surface waste repository types that are considered of interest are vault and borehole

type, mining tailings and RADON type disposal facilities. The new IAEA programme is planned to commence in November 2002 and last for three years. It is expected that participants will be regulators, opera-

tors, safety assessors, researchers and experts with different types



Zagorsk disposal site (Russian Federation)



Püspökszilágy Repository (Hungary)

Experts wishing to express interest in the new project are kindly requested to contact Ms. B. Batandjieva (IAEA), e-mail: [B. Batandjieva@iaea.org](mailto:B.Batandjieva@iaea.org). Proposals and suggestions for specific topics and facilities to be addressed in ASAM are more than welcome.

of knowledge and experience in the field of RAW disposal and safety assessment of disposal facilities.

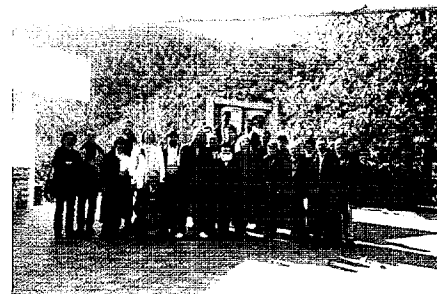
IAEA Related Activities

September—December 2001

IAEA Regional Training Course on Safety Assessment Methodologies for Near Surface Disposal Facilities, 12-23 November 2001, Madrid (Spain)

The training course was part of the IAEA regional project RER/9/067 "Application of Safety Assessment Methodologies for Near Surface Disposal Facilities". The training course, organised by the IAEA in collaboration with CSN, CIEMAT and ENRESA (Spain), was attended by **27 participants** from

Armenia, Belarus, Bulgaria, Croatia, Czech Republic, Hungary, Lithuania, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, Ukraine, Turkey, and the host country Spain. This was the third course in this field, organized for the countries of this region and held in Spain.



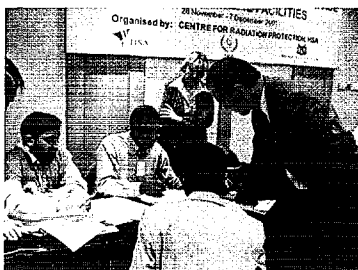
Technical visit at the El Cabril Disposal Site, Spain

IAEA Regional Training Course on Safety Assessment Methodologies for Near Surface Disposal Facilities, 26 November to 7 December 2001, Singapore

The training course was part of the IAEA regional project RAS/4/016 "Preparation for the Disposal of Low and Intermediate Level Waste with Emphasis on Non-power Sources" organized under the Regional Co-operative Agreement (RCA) for Research Development and Training Related to Nuclear Science and Technology for Asia and the Pacific. The train-

ing course was the final activity of the RAS/4/016 Project and was organized by the IAEA in collaboration with the Govern-

ment of Singapore and hosted by the Singapore Health Sciences Authority. The course was attended by **22 participants** coming from Bangladesh, China, India, Indonesia, Korea, Malaysia, Mongolia, Myanmar, Pakistan, Philippines, Thailand, Vietnam, and the host country Singapore. This was the first course of this nature in the region.



Practical Session

IAEA Training Material on Safety Assessment of Near Surface Low and Intermediate Level Waste Disposal Facilities

The training material is being developed under the IAEA Project RER/9/067 "Application of Safety Assessment Methodology for Near Surface Disposal Facilities" (2001-2002). The material has been used in the Agency's training courses on Safety Assessment Methodologies for Near Surface Disposal Facilities, held in Madrid and Singapore in 2001. A third con-

sultants meeting was held from 10-16 December 2001 to review the second version of the document and also reflect the feedback from the two training courses (comments of lecturers and participants). The detailed comments of M. Kozak (USA) and G. Smith (UK) contributed to the development of the next version of the document.



P. Lietava (Cz. Rep.), I. Simon (Spain), R. Little (UK) and A. Gousskov (Russia), who worked on drafting the material

2002

- The main activities of the IAEA in the field of or related to the safety assessment for near surface disposal facilities envisaged for 2002 are as follows:
 - 1st RCM of the IAEA CRP on Application of Safety Assessment Methodologies for Near Surface Waste Disposal Facilities, 11-15 November 2002;
 - Technical Meeting on Safe Disposal of Sealed Sources and Other Waste in Borehole Disposal Facilities (22-26 April 2002);
 - IAEA Conference on Issues and Trends on Radioactive Waste Management – 9-13 December 2002;
 - Regional Training Course on Safety Assessment Methodologies for Near Surface Disposal Facilities, Russian Federation (24 June—5 July 2002);
 - Workshop on Upgrading Near Surface Disposal Facilities (Budapest, Hungary, 13-17 June 2002);
 - Workshop on Waste Acceptance Criteria for Near Surface Disposal of Radioactive Waste (7-11 October, Prague, Czech Republic);
 - Regional Training Course on Radioactive Waste Management (L. America, 19-30 August 2002);
 - Regional Training Course on Radioactive Waste Management (W. Asia, 28 October-1 November 2002);
 - Development of Training Material on Derivation of Waste Acceptance Criteria;
 - Development of Training Material on Safe Radioactive Waste Management;
- The main documents to be developed this year are as follows:
 - Final report (TECDOC) and a CD-ROM on Safety Assessment Methodologies for Near Surface Waste Disposal Facilities (July 2002)
 - Development of Training Material on Long-term Safety Assessment for Near Surface Waste Disposal Facilities (incl. A CD-ROM);
 - CD-ROM with proceedings of the IAEA Regional Training Course in Singapore (26 Nov. – 7 Dec. 2001);
 - CD-ROM with proceedings of the IAEA Regional Training Course in Madrid (12-23 Nov. 2001, in preparation);
 - Review of Radioactive Waste

Disposal Practices in Eastern Europe (second edition).

- Review of Radioactive Waste Management Practices in East Asia and the Pacific (incl. CD-ROM).

If you would like to receive more information, please contact:



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