

# Publishable Executive Summary



The Integrated Project known as ESDRED (Engineering Studies and Demonstrations of Repository Designs) is a joint research effort by major national radioactive waste management agencies (or subsidiaries of those agencies) and by research organisations, representing nine European countries. ESDRED is co-ordinated by the French National Radioactive Waste Management Agency (ANDRA) and is part of the European Union's 6<sup>th</sup> Euratom Framework Programme for Nuclear Research and Training. The five year Project has a total budget of EURO 18.7 million, of which 7.3 million is from the EU's Framework Programme.

The 13 partners (Contractors) in this project are:

**Radioactive Waste Management agencies:**

ANDRA, France  
ENRESA, Spain  
NAGRA, Switzerland  
NIREX, United Kingdom  
ONDRAF/NIRAS, Belgium  
POSIVA, Finland  
SKB, Sweden

**Technological R&D organisations:**

AITEMIN, Spain  
CSIC, Spain  
DBE TECHNOLOGY, Germany  
ESV EURIDICE EIG, Belgium  
GRS, Germany  
NRG, the Netherlands

ESDRED is focused on technology and has three main objectives. The first is to demonstrate, at an industrial scale, the technical feasibility of some very specific activities related to the construction, operation and closure of a deep geological repository for high level radioactive waste. The work is organised inside four (4) Technical Modules and essentially involves the conception, design, fabrication and demonstration of equipment or products for which relevant proven industrial counterparts (mainly in the nuclear and mining industry) do not exist today. At all times this work is meant to be carried out within the framework of compliance regarding the requirements for operational safety, long term safety, retrievability and monitoring.

Each of the four technical Modules involves from 3 to 7 Contractors and as many as 6 different national disposal concepts may be represented. The programmes within these Modules are provided below:

**Module # 1: Buffer Construction Technologies** for horizontal disposal concepts

**Module # 2: Waste Canister Transfer and Emplacement Technology** for horizontal and vertical disposal concepts

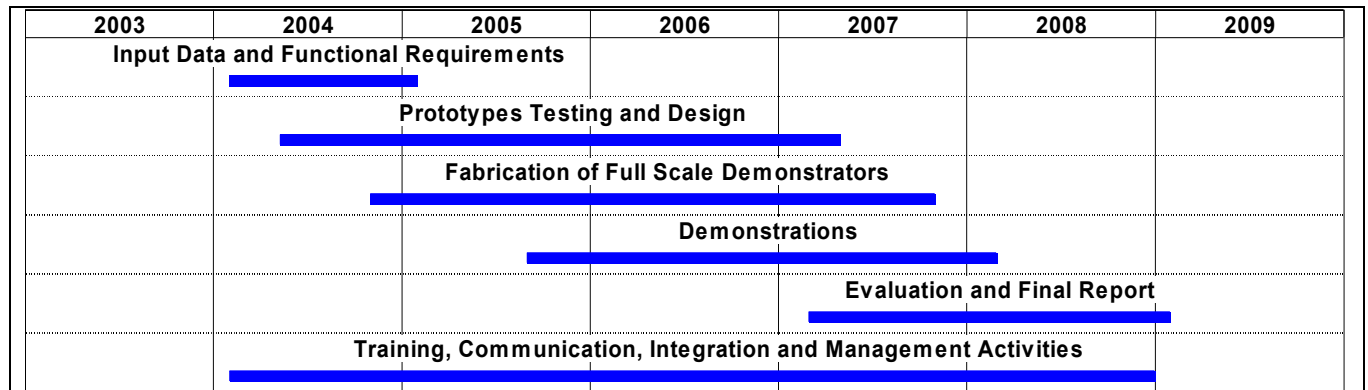
**Module # 3: Heavy Load Emplacement Technology** for horizontal disposal concepts

**Module # 4: Temporary Sealing (using low pH cement) Technology** for construction of sealing plugs and for rock support using shotcrete techniques

A second and equally important objective is to promote a shared European vision in the field of radioactive waste disposal technology. This is accomplished through the INTEGRATION process, which is one of the key objectives that identify EURATOM's 6<sup>th</sup> Framework Programme. Among other things integration involves working together within Work Packages and/or Modules; sharing information; comparing one another's input data and functional requirements for consistency; ensuring that, where possible, fabricated components are compatible; and coordination of demonstration activities.

The third objective involving communication and training is deemed to be sufficiently important to merit a separate Module. Among other things it involves the dissemination of knowledge by way of press releases, pamphlets, technical articles and presentations, videos and eventually an international event. Training, with a focus on New Member States, is to be accomplished via conferences, workshops, courses and possibly some secondments.

A general project schedule is shown in **Figure 1** below:



**Figure 1:** General Schedule of the ESDRED Project

The second year of the project, which terminated at the end of January 2006, can again be characterized as a success given that the major objectives for the period were achieved:

- In particular each of the 4 Technical Modules produced (or is about to) a second Deliverable dealing with “Prototype testing and Design”. These documents are intended to be the basis on which the “Fabrication of Full scale Demonstrators” or “Demonstrations” per se can be initialized.
- Secondly the Experts Committee (appointed by the ESDRED Consortium) produced its first assessments of the project (based on various Deliverables).
- Management tools, previously developed for the program, were refined and include extensive use of a dedicated FTP site by all the Partners. Similar ease of communication is now also established with the EC Project Officers via the EC’s CIRCA site primarily used for the uploading of electronic versions of the Technical Deliverables.
- ESDRED also worked extensively on the preparation of a Waste Management Technology Course to be delivered later this year to Students from a Romanian University, on the planning of a Conference/Workshop to be convened in Prague and on the content and organisation of an “International Event” to be held at the end of the Project.
- Finally, Integration continues to improve especially in terms of communication and cooperation between the 13 partners. For example all the ESDRED Partners were mobilized to attend a demonstration of ANDRA’s “Prototype Pushing Robot” in Lille France in October 2005.

In conclusion, one may say that, at this stage of the Project, no major deviations to the Work Programme have been identified either in terms of Work Schedule or with regard to Objectives and Technical Content.

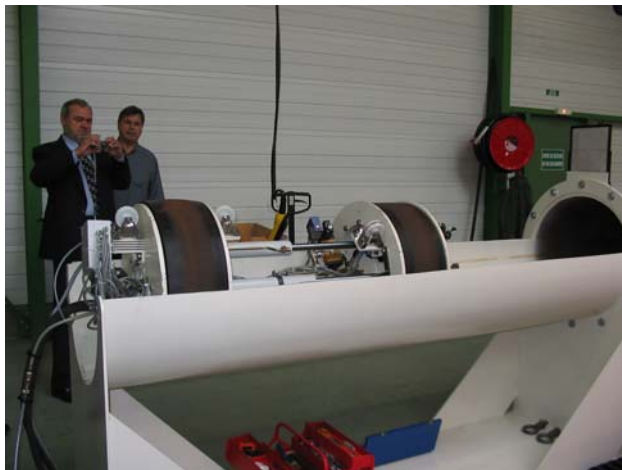
## THE TECHNICAL WORK ACCOMPLISHED DURING THE SECOND YEAR INCLUDES:

### Module 1: (Buffer Construction Technology)

The various buffer materials being considered have been formulated and characterized at a sufficient level of detail. The preliminary tests and modelling, implemented to check the relevancy of material performance or emplacement technology, have delivered conclusive results, paving the way for undertaking the “Demonstrations at an industrial scale” phase. All of the design and most of the fabrication related to the industrial scale demonstrations is either complete or is ongoing. Also the Partners have agreed on the nature of the non-intrusive monitoring test programme to be run and on the location of this experiment (Mont Terri URL). Currently, the test equipment has been installed and a first measurement campaign has been undertaken (end of 2005).

### Module 2: (Waste Canister Transfer and Emplacement Technology)

The Conceptual Design is complete for both the vertical and the horizontal emplacement concept while the Basic Design is ongoing for the horizontal emplacement concept. In the meantime the “Prototype Testing” of a Pushing Robot for the emplacement of type C waste canisters in a horizontal disposal cell was carried out during Q4 2005 and can be considered as a technical success. The Detailed Design for the emplacement device within the vertical emplacement concept was launched in November 2005.



**Figure 2:** Prototype Pushing Robot for the emplacement of type C waste canisters in a horizontal disposal cell



**Figure 3:** Demonstration of Prototype Pushing Robot to EC Officers and ESDRED partners

### Module 3: (Heavy Load Emplacement Technology)

The Detailed Design of the 3 Industrial Demonstrators has been completed. The fabrication of the KBS-3H Demonstrator (water cushion technology) and the Factory Acceptance Test of this equipment have been successfully completed with CNIM (at La Seyne-sur-Mer, France). The Sets of Bentonite Rings Emplacement Demonstrator and the Spent Fuel (CU1) Emplacement Demonstrator (both use air cushion technology) are in the reception of long lead items and assembly stage with MECACHIMIE (at Beaumont-Hague, France).

#### Module 4: (Temporary Sealing Technology)

The feasibility of constructing, under realistic repository conditions, a low-pH shotcrete plug in an underground disposal drift has been demonstrated. A one meter long shotcrete plug was constructed by AITEMIN last November 2005 on the -220 m level of the Äspö HRL, in a 1.85 meter diameter drift which had been previously excavated by SKB using the horizontal pilot hole and full face reaming technique. The concrete formula used for the shotcrete plug was designed by CSIC in compliance with the Functional Requirements established in the project Deliverable D1. Although this short plug was not initially foreseen in the project scope of work, the plug has been constructed and instrumented in such a way that it can be progressively loaded to study its mechanical behaviour and so gain very valuable information for the design of the much longer full scale plug.

In parallel, work aimed at developing formulations for low-pH shotcrete which can be used for rock support is progressing according to expectations. The results of the laboratory work are very encouraging and the recipes selected will be subject to pilot and field testing in the coming year.



**Figure 4:** Underground shotcrete test panels at Leon July 2005



**Figure 5:** Low pH shotcrete plug constructed at Äspö Sweden November 2005

## **COMMUNICATION, TRAINING, AND INTEGRATION PROGRESS DURING YEAR 2:**

The second year of the project has been busy, has been quite successful and has taken on a truly international dimension. Some of the work, such as planning for an international event and planning for an international conference, will not actually bear fruit until Year 4 and Year 5, as in the case of the international event. In addition to planning for the future there has also been a lot of activity with positive results during the year just completed, notably:

### **Module 5: (Training & Communication)**

ESDRED representatives participated in three international conferences. They presented technical papers at the Clay Conference in Tours France and at the Waste Management Conference in Tucson USA and they participated in a Poster Session (5 posters were produced during the year) at the ENC 2005 Conference in Versailles France. A workshop related to Low pH Cements was run in Madrid Spain during June with participation from 8 countries. Preparatory work is significantly advanced for presenting, in Q4-2006, a 12.5 hour course on radioactive waste technologies at the University Politecnica in Bucharest Romania. Likewise some progress has been made towards organising an international conference / workshop at the Czech Technical University in Prague in 2007. The ESDRED project was presented via talks, power points, photos and posters to at least five other groups in addition to the events noted above.

### **Module 6: (Integration)**

This challenging Module is the responsibility of the ESDRED Project Coordinator, also known as the IPC or Integrated Project Coordinator. Among other things the work in this Module involves managing a committee of independent Experts who are given certain documents to review and who report directly to the Board of Governors, with copy to the EC. During the past year these Experts reviewed and commented favourably on comprehensive Deliverables dealing with "Input Data and Functional Requirements". During this second year of the Project a full meeting was dedicated to evaluating the meaning and the objectives of integration as they relate to the work being undertaken by the different national waste management agencies and R & D organisations. The positive results of this exercise are being felt as the ESDRED participants continue to work together more efficiently and more in harmony.

## **CONCLUSIONS:**

There have not been any significant problems during this second year of the project and none are foreseen going forward. During the year two more prototype demonstrators have been designed and built without any technological difficulties. This in itself is a major achievement and augers well for the remainder of the project. In the course of this work several small firms, who do not normally operate in the nuclear field, were awarded work and performed satisfactorily. Thus ESDRED can be seen as a catalyst, not only for encouraging technological developments, but also for enhancing the experience and capabilities of a few small European firms.

### **Project Coordination by**

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