



EUROPEAN
COMMISSION

Community Research



Engineering Studies and Demonstration of Repository Designs

6th EURATOM FRAMEWORK PROGRAMME for NUCLEAR RESEARCH
and TRAINING (2002-2006) of the EUROPEAN UNION
Management of Radioactive Waste

THE PARTNERS

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 GIE, Belgium
GRS, Germany
NRG, The Netherlands

The ESDRED Project has three main objectives:

- ▶ To promote a common European vision in terms of radioactive waste disposal technology applicable to various repository designs.
- ▶ To fabricate and construct full scale technological demonstrators for waste emplacement, for backfilling and for sealing of disposal drifts or boreholes.
- ▶ To disseminate the knowledge acquired by way of technical papers, presentations, training courses, workshops, etc.

Key Numbers & Data:

- ▶ Start date: February 2004
- ▶ Project duration: 5 years
- ▶ Total budget: EUR 18.7 million of which EUR 7.3 million provided by the 6th Euratom Framework Programme for Nuclear Research and Training (2002-2006) of the European Union.

ESDRED Integrated Project

Coordinated by



Agence nationale pour la gestion des déchets radioactifs

(DP/TE Engineering Department – Project Division)

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Module 1

Buffer Construction Technology for Horizontal Disposal Concepts

The challenge: design and construction of buffers for horizontal disposal drifts

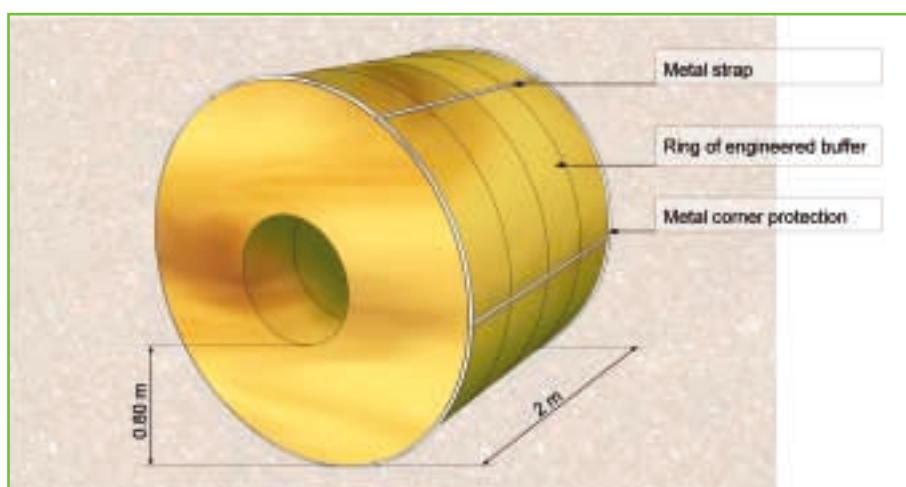
The buffer is the engineered barrier, usually made of material such as cement or bentonite (possibly mixed with sand), which is placed between the radioactive waste container and the geological formation surrounding the disposal drift.

Within ESDRED, 3 engineering options for waste emplacement are considered leading to 3 designs and therefore 3 demonstrations:

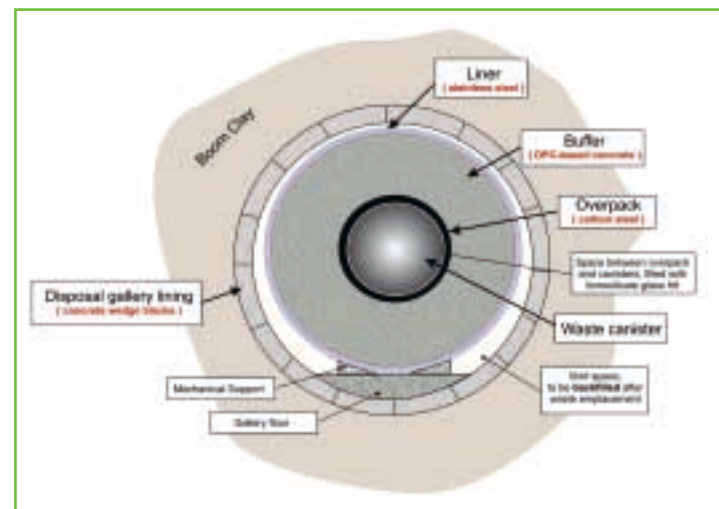
1. the buffer is prefabricated in a surface facility, then transported to the underground repository and positioned in the disposal drift ; then the waste canister can be emplaced
2. the waste canister is inserted into a large container, (so-called "super-container") which includes part of the buffer ; once the super-container is emplaced in the disposal drift, the annular space between the super-container and the drift is then filled with a granular buffer
3. the waste canister is placed on a prefabricated solid buffer cradle and then a granular buffer material is used to fill the disposal drift

The 2 last options look rather similar, but the volume of granular buffer material required and the emplacement technology used, (including the possible compaction), are different.

Case 1: This project will focus on the prefabrication and pre-assembly technology of bentonite buffer rings. Emplacement of the ring assembly will be studied in Module 3.



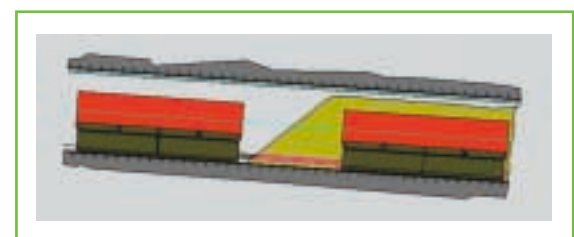
Case 2: This project will focus on backfilling the annular space between the super-container and the drift liner with granular buffer material, after the super-container has been placed in the disposal drift.



Case 3: This project will focus on the backfilling technology to be used after waste canister emplacement.



1) The waste canister is emplaced on a solid buffer cradle.



2) Granular buffer material is used to backfill the disposal drift, which may have a slight dip.

Module 2

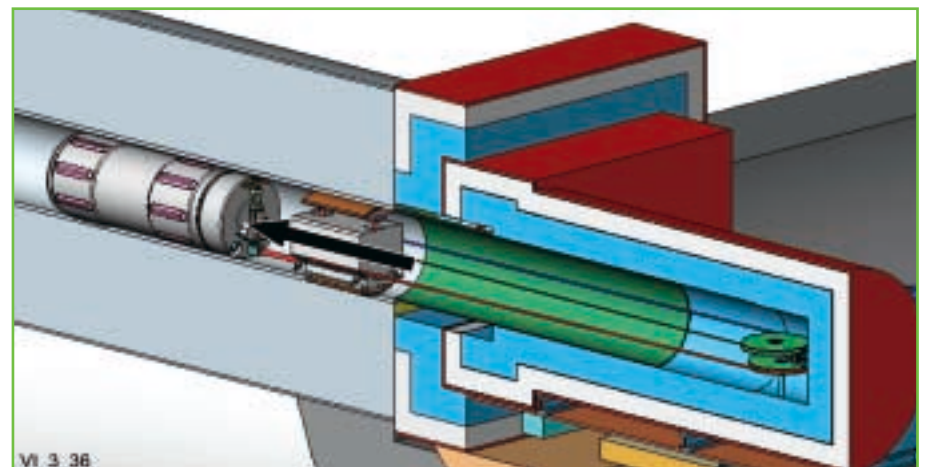
Waste Canister Transfer and Emplacement Technology for Horizontal and Vertical Disposal Concepts

The challenge: design and construction of demonstrator prototype equipment for the remote controlled emplacement of irradiating waste canisters

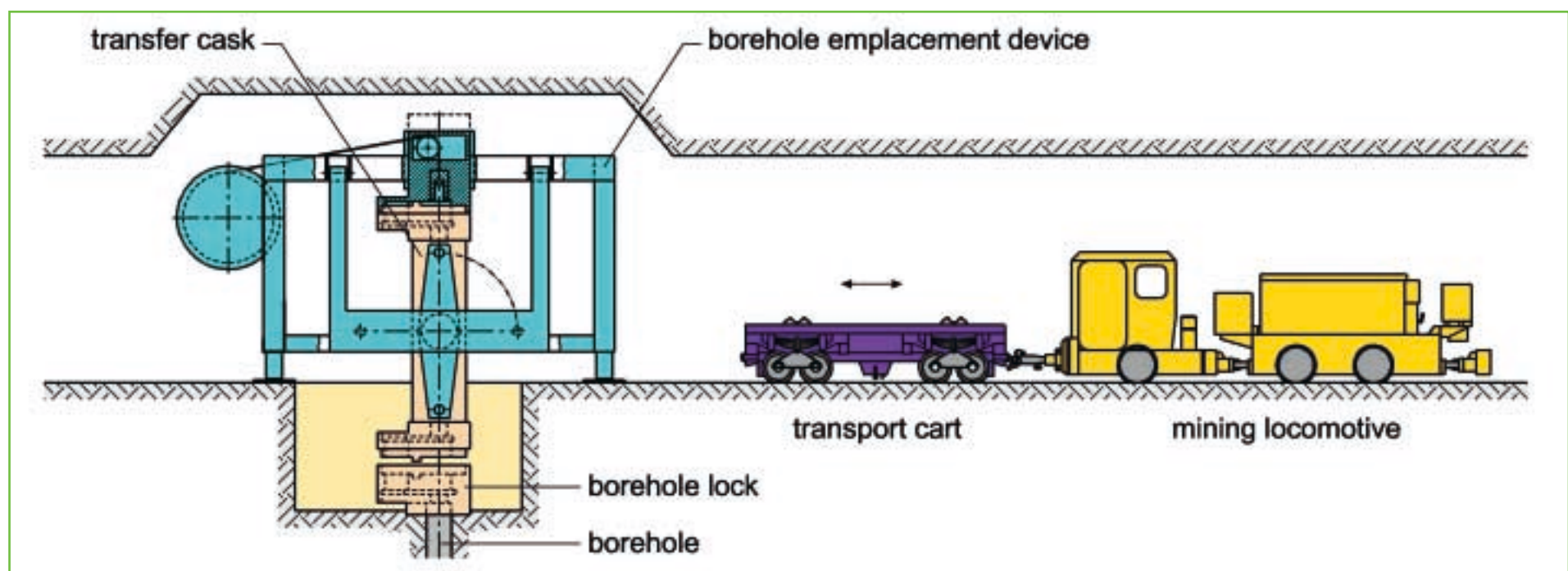
Although surface transportation of radioactive waste is a routine activity, transport and emplacement in an underground environment presents unique challenges:

- ▶ spaces are more confined and a shielding cask is required for transportation in order to ensure the radiological protection of workers
- ▶ in addition to the shielding cask, remote control operating techniques must be used :
 - while docking at the disposal location
 - during the transfer operations into the disposal location (drifts or boreholes)
 - and finally during closure of the disposal drift or borehole

Case 1: A remote-controlled pushing robot (black arrow) is emplacing a waste canister while a shielding cask (in red) is insuring the radiological protection of workers present in the access drift.



Case 2: General lay-out for a vertical emplacement of waste canisters





Module 3

Heavy Load (15 to 50 metric tons) Emplacement Technology for Horizontal Disposal Concepts

The challenge: design and construction of various prototype demonstrators for the horizontal emplacement of heavy loads including prefabricated buffers, waste canisters and super-containers

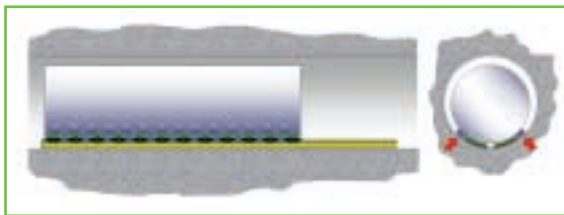
Horizontal emplacement of a super-container (including buffer material and the waste canister) or of a large assembly of prefabricated bentonite buffer rings (see Module 1) is required in some disposal concepts.

In order to limit friction forces which are a consequence of such heavy cargoes, the option of using air or water cushion technology is considered. This technology is widely used in civil engineering with pressurised air or water injected between two flat horizontal surfaces.

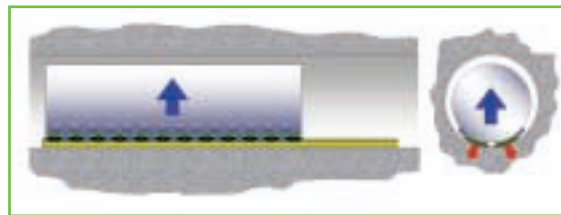
The challenge is to demonstrate the feasibility of this technology, for heavy cargo emplacement, when pressurised air or water is injected between two cylindrical surfaces. It is known that the cylindrical shape of the surfaces does reduce the uplift force which could otherwise be obtained between two horizontal surfaces.

The type and flow-rate of the fluid must also be compatible with the repository environment.

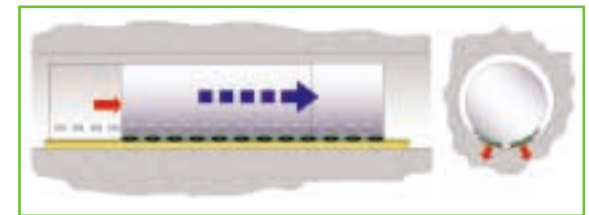
Case 1: Application of air or water cushion technology for cylindrical container emplacement



1) The cargo rests on the lifting device.



2) Pressurised fluid is expelled through the lifting device and the cargo is raised.



3) Once the cargo is raised by the fluid cushion, the friction is reduced and a small force can move the cargo horizontally.

Module 4

Low pH Cement for Shotcrete and Sealing Plug Construction Technology

The challenge: development and validation of specific "low pH" cement and subsequent demonstration of its application by constructing a sealing plug using shotcrete techniques

Cementitious materials are widely used in underground engineering. For radioactive waste disposal, specific consideration is given to the applicable geochemical phenomena in the long term safety analysis, including for instance the possible interaction with the vitrified waste matrix or with the surrounding geological medium through a so-called plume effect.

In order to reduce these interactions, new cement formulations are considered, which are more neutral with respect to the waste matrix and underground environment, while keeping the necessary mechanical and sealing properties.

Moreover, this development must also include the placement of the cement, at an industrial scale, using the shotcrete technique for the construction of a disposal drift sealing plug and for rock-wall lining.

A full-scale demonstration test is planned at the Äspö underground research laboratory (Sweden).

Case 1: Demonstration plug lay-out

