NEW DEVELOPMENTS IN LOW LEVEL RADIOACTIVE WASTE MANAGEMENT IN SPAIN

P. ZULOAGA
ENRESA
Emilio Vargas, 7, 28043 Madrid - Spain

ABSTRACT
El Cabril disposal facility was commissioned in 1992 and is a key element in LILW Management in Spain. It is a vault-type surface disposal facility with a total internal volume of 100,000 m^3. The installation also has facilities for waste treatment and conditioning, verification and characterisation, interim storage and other ancillary equipment. This paper includes a brief description of the facility, the operational experience, the design improvements and new developments in waste acceptance procedures, safety assessment and the related research programme. The paper also refers to the new disposal facility intended for very low activity waste, under construction at the same site. This facility, a part of El Cabril nuclear installation, will have a maximum capacity for 130,000 m^3 of very low activity waste. Its construction started in February 2006, after the evaluation of the nuclear safety authority and the environmental impact statement procedure.

1. Introduction

The Ministry of Industry, Tourism and Commerce (MITC) is responsible for the radioactive waste management policies; the Nuclear Safety Council (CSN), an independent body reporting to the Parliament, is responsible for nuclear safety and radiological protection regulation and enforcement; and the Ministry of the Environment (ME) is responsible for the Environmental Impact Statements. The cabinet has recently approved, in June 2006, the sixth General Radioactive Waste Plan (GRWP) [1], a document where the national policy in this field is reported.

ENRESA is responsible for the long term management of all categories of radioactive waste and for nuclear installations decommissioning operations as well. ENRESA owns and operates El Cabril Low and Intermediate Level Radioactive Waste (LILW) disposal facility, which was commissioned in October 1992. Since then, it has been a key element in waste management in Spain.

The total internal volume of the existing disposal vaults is 100,000 m^3, corresponding to 35,000-50,000 m^3 of primary waste packages as delivered by the producers, depending on the waste types. The total expected volume of LILW arising from the Spanish nuclear programme is estimated in 176,300 m^3 [1], as shown in figure 1.

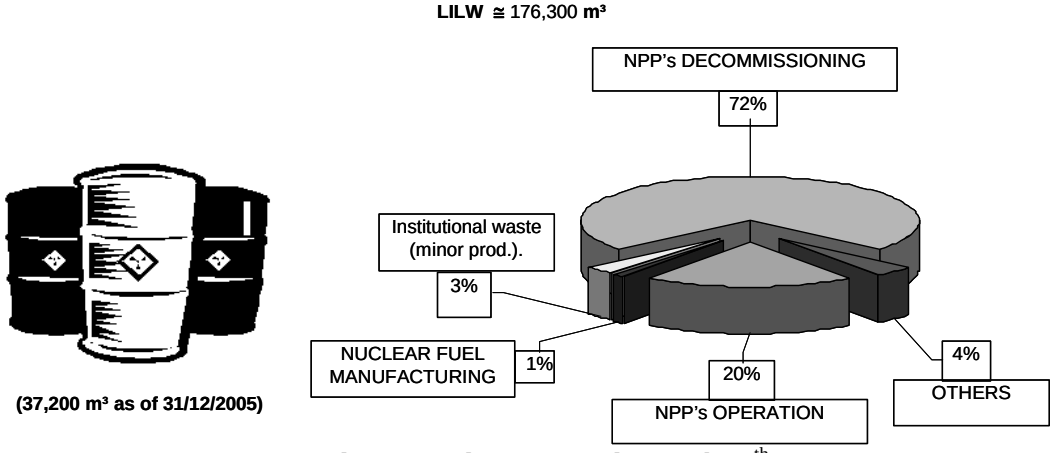

Fig. 1- Expected LILW volumes according to the 6th GRWP

An important part of this grand total would be very low activity waste, mainly arising from decommissioning operations. 53% of the existing capacity at El Cabril has already been filled-up by summer 2006, while still a good margin exists in terms of the maximum activity authorised. Together with operational safety and reliability, the main axis of development in LILW management are: A good administration of the remaining vaults' volume, through volume reduction in co-operation with the waste producers, and through optimisation of the occupancy rate supported by the revision of the waste acceptance criteria (WAC); The construction of a new disposal facility for very low level waste (VLLW); and the improvement of confidence

building, through updating and enhancing the safety assessment, the surveillance of the facility and the research to improve the knowledge of the site characteristics, the waste forms and the isolation barriers behaviour.

2. General Description of the facility

El Cabril is located in Southern Spain. The site was an exhausted Uranium mining reserve and was used for radioactive waste storage since 1961. The main objective of the facility is the final disposal of all LILW from the country. Other additional aims of the facility include waste treatment and conditioning; waste characterisation and verification, interim storage, and auxiliary installations to support operation and maintenance.

Fig. 2 - El Cabril LILW Disposal Facility General View

The disposal concept is a multibarrier surface disposal system. Waste packages (mainly 0.22 m^3 drums and 1,3 m^3 metal boxes) delivered by the producers, respecting the WAC, usually are reconditioned in concrete containers to form an 11 m^3 final package or disposal unit, which constitutes the first barrier. The internal volume of the concrete container may be back-filled with mortar grout, or may be used to condition institutional liquid waste or contaminated ashes. These packages are place inside 24x20x10 m concrete vaults. Once the vault is completed with 320 11-m^3 concrete containers, it is backfilled with gravel and a closing slab is constructed and coated with an impervious painting. After completion of, at least, one of the two areas in which the disposal zone is divided, an engineered multi-layer cap will be built. Beneath each row of disposal vaults there is an inspection drift, where two drainage systems are installed, one for rain water collection from the vaults not yet in operation, one for the vaults containing waste packages. Each row of vaults is served by a metallic shelter on wheels, for weathering protection and supporting the 32 tonnes overhead lifting crane.

The installation is laid out in two main zones: The disposal zone, containing the 28 existing vaults, and the rain water collection pond and a factory to prefabricate the concrete containers as well; And the auxiliary buildings zone, including security, administration, workshops, storehouses, and the treatment and conditioning building (where the main systems are incineration, super-compaction, grout preparation and injection, and ashes treatment), and characterisation laboratories (with waste core extraction and specimen preparation cell, gamma spectrometry scanning room, leaching test room, and sample preparation and measurements radiochemical laboratories).

3. Operational experience

The number of primary packages actually disposed of at El Cabril by the end of June 2006 is 98,548. Most of them (95,800) are 220-litre drums (63% are solidified waste in cementitious matrix; 37% are compactable waste drums). There are 1920 480-litre drums and 828 1.3-m^3 metal boxes as well. In addition we have some 7000 packages at El Cabril in interim storage, most of them pre-classified as VLLW, waiting for the commissioning of the new VLLW disposal vaults under construction at the site.

No major operational incidents have occurred, although some minor ones can be reported as the drop of a drum because of the rupture of the lifting cable with local dissemination of material inside a building or the drop of a concrete container at the mortar injection post due to a wrong positioning of a trolley, which required special means for handling.

An interesting finding was the appearance of some liquid in the water collection system of the vaults. After a sound investigation of potential in-flow from the upper slab and construction joints, which included water tightness tests of flooding such roof and joints, capillary rise from the water table, together with evaporation and condensation due to thermal differences was analysed as the origin of such water collection. The air gap among containers and vaults walls produced a seasonal difference of temperature of a few degrees, which provokes water vapour diffusion from the walls to the concrete containers in summertime or from the concrete containers to the walls in winter. There are changes in the liquid saturation in the concrete and finally some condensation at the cold surface, with a maximum volume of a few litres per day in the vault with more water collected.

A surveillance programme including more than 1000 samples in 118 sampling points has shown no abnormal values and average collective dose since 1992 has been 12.2 mSvxperson with no internal contamination recorded in the annual internal dosimetry checkings.

4. Major design changes

Main design changes since the facility start-up were:

In relation to disposal some changes were:

- The slopes of the closing slab (from four directions to one direction to the external side) and some adaptations to the changes in structural concrete and cement regulations;
- The possibility to use the gap among drums, inside the concrete container to condition some type of cemented solid wastes (smelting ashes).
- The possibility to accept in some conditions 480-littre drums where 220-littre drums had been reconditioned

In relation to treatment and conditioning equipment it may be stressed:

- New grout injection system, because it was identified as the bottle neck in the facility operation.
- Grinding, Leaching and Electrolysis equipment for pre-treatment of contaminated ashes and cemented hazardous waste, to fulfil the requirements to be part of the injection grout.
- Decontamination room for treating some waste.
- Tests for incineration of NPP'S waste
- Improvements in the compactor system drain collection, due to presence of liquid in amounts larger than expected.

In relation to waste characterisation and verification, an extension of the radiochemical laboratory has been built and new gamma scanning equipment has been set-up in order to increase the number of verification tests to ensure the limitation of activity determination uncertainties. In relation to interim storage a new building was needed as well as the adaptation of three final disposal vaults to be used s interim storage while waiting for treatment previously to disposal.

5. Very Low Activity Radioactive Waste disposal

Significant amounts of radioactive waste with very low activity (VLLW) have already been produced, especially in some incidents in the steel industry, and larger amounts are foreseen from nuclear power plants decommissioning. The total volume to be managed is estimated in 80,000-120,000 m^3 depending on the clearance and enhanced decontamination policies. A Parliamentary Committee recommended to the Government the development of a facility specifically intended for this type of waste not to misuse the existing disposal capacity at El Cabril, considered strategic and designed to dispose of waste with higher specific activity. The application for this facility was presented in May 2003. MITC granted the execution licence for the disposal cells, after binding report from the CSN and environmental Impact Statement by ME on February 2006. Civil works are now under way; the project schedule foresees a construction delay of 18 months

Although the disposal principles for VLLW remain the same that for the rest of LILW, a different barriers' lay-out has been adopted (figure 3). The Spanish regulation applicable to hazardous waste disposal [4], based on the corresponding European Directive [5], was taken as a major reference for the design criteria. Each cell presents a one-meter artificial geological barrier of compacted clay, complemented with geo-bentonite to provide a five-meter equivalent clay barrier. The isolation barrier has also a High Density Polyethylene (HDPE) film above which there is a leachate collection system.

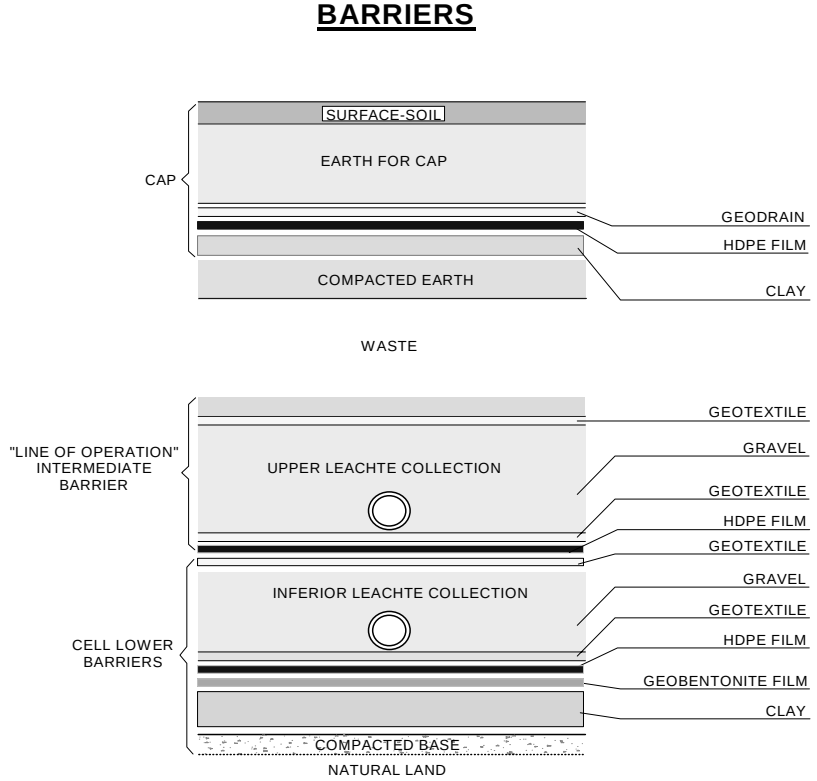

Fig. 3 - VLLW disposal cell: barriers scheme

The VLLW disposal zone is organized in four large disposal cells with 35,000- 45,000 m^3 capacity each. Each cell is divided into so-called "lines of operation", which are protected by a light roof structure (to minimise the volume of leachate to treat) (Figure 4). Each single "line of operation" has an additional HDPE film and leachate collection to help identifying where the collected liquids come from.

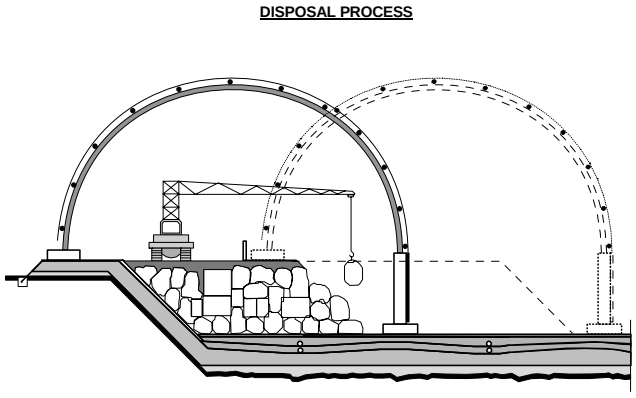

Fig. 4 - VLLW disposal cell: operation scheme

6. Current safety assessment and associated research

The developments on assessment on post-closure safety have been mainly centred on: The adaptation and the updating of the assessment methodology to the current international practices; The review and the

enhancement of scenario development approach; The review of the conceptual model, the mathematical formulation and data use to represent each scenario; The extension and the improvement of uncertainties and sensitivity analyses; and providing a coherent link between waste acceptance criteria, engineered barriers design requirements and criteria, and site additional data with the assumptions and the parameters used in the safety assessment. Taking into account the most recent approaches to safety assessment, the efforts have been centred on reorganization of the information included on the safety report.

The performance of the disposal system under both present and future anticipated conditions, including events associated with the normal evolution of the facility and less probable events, was review. The approach adopted relay on a systematic identification and consideration of Features, Events and Processes (FEPs). The set of scenarios developed, although are basically the same as those defined previously, enhance their justification and a defensible presentation of the system.

A critical review has been carried out in order to assure that the models representing the scenarios are adequate and appropriate. The computer codes used are adapted to the specific characteristic of the system. A special care have been put on providing coherent link between design requirement and criteria regarding waste packages/disposal units, engineered barriers and site. The improvements in each of the aspect mentioned above have contributed to identify, document and quantify (when it is possible) the system uncertainties.

An important effort is carried out to link in a comprehensive way the design requirements and the design criteria of the component of the disposal system with the assumptions and the parameters used to describe the component behaviour. The effort has been focused on the following aspects: activity confinement, permeability and durability.

ENRESA research programme includes a limited number of research projects in the LILW field. The main objectives in this area are:

- Development of new treatment systems, focussed on volume reduction, and including a plasma torch furnace for LILW treatment.
- Development of characterisation techniques for different matrices
- Activity measurement methodology for radionuclides difficult to be measured.
- Graphite waste management.
- Clearance of materials with an extremely low activity.
- Behaviour of concrete barrier materials under disposal conditions
- Construction of a pilot earthen cap.
- Instrumentation of pilot containers, disposal vaults, etc
- Model development to integrate migration model in hydro-geo-chemical models

7. Conclusions

An overall LILW management system exists in Spain, which allows the waste generators to get rid of their waste in a safe an efficient manner. Nonetheless, to have a system running in an appropriate way do not permit any relaxation and we have to be prepared to answer the growing social and regulatory requirements. A careful administration of the existing disposal capacity and the new disposal facility for very low activity radioactive waste under construction are crucial elements for being able to manage the expected volumes of waste to be generated.

References

[1] Ministerio de Industria, Turismo y Comercio. Sexto plan general de residuos radiactivos. Rev. Mayo 2006.

[2] Ministerio de Economía. Orden Ministerial de 8 de Octubre de 2001 por la que se concede a ENRESA autorización de explotación de la instalación nuclear de almacenamiento de residuos radiactivos sólidos de Sierra Albarrana (El Cabril).

[3] Real Decreto 1481/2001, de 27 de diciembre, por el que se regula la eliminación de residuos mediante depósito en vertedero (BOE de 29 de enero de 2002

[4] Directiva del Consejo de la Unión Europea relativa al vertido de residuos. (1999/31 CE, de 26 de abril de 1999).