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# LOW AND INTERMEDIATE WASTE MANAGEMENT IN SPAIN

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## ABSTRACT

The main objective of this facility is the final disposal of all L&ILW produced in Spain, mainly in the operating Nuclear Power Reactors, in the Nuclear Power Plant under decommissioning by ENRESA, a fuel fabrication plant and institutional producers, as well as those arising from incidents outside the nuclear industry. The disposal concept consists of so called disposal units, mainly durable concrete overpacks, placed in concrete vaults. A drain control system exists in inspection galleries constructed beneath the disposal vaults. These vaults are protected from the weather during their operation and sealing by a metallic shelter, which also supports the handling crane.
The facility also include:

- A treatment and conditioning shop, which includes incineration, institutional wastes segregation and conditioning, drum transfer into overpacks, supercompaction, liquid waste collection, and grout preparation and injection.
- A waste form characterisation laboratory with means for non-destructive radiological characterisation and for destructive test on the waste forms(specimens extractions, unskinning of the drums, mechanical strength, leaching test on specimens and full size packages) to supports the waste acceptance procedures and the verification of the overall quality of the packages.
- A fabrication shop for overpacks construction.
- Auxiliary systems and buildings in support of operation, maintenance and surveillance of the facility.

The paper deals with the design, the operating experience of the facility, the waste packages characterisation and acceptance practises and the reception of the wastes from the generating facilities.

Keywords: ENRESA, decommissioning, nuclear power plant

## 1. INTRODUCTION

ENRESA is the Spanish organisation in charge of radioactive waste management of spent fuel and high level waste. Its responsibilities include interim storage and final disposal, decommissioning of nuclear installations and management of Low and Intermediate Level Waste (L&ILW).

The main source of L&ILW in Spain is nuclear power generation. The main nuclear fuel cycle facilities in Spain are nine power reactors in operation, one nuclear power plant being decommissioned by ENRESA and a fuel assemblies fabrication plant. Other facilities generating radioactive waste are classed as radioactive installations and are intended for medical, research and industrial activities. A certain volume of radioactive waste has also been identified in conventional industries and transferred to ENRESA for its treatment and disposal.

A major difference exists in the scope of ENRESA's responsibilities depending on the origin of the waste. Nuclear power reactors and other fuel cycle facilities generally deliver their waste already conditioned, in accordance to the technical specification issued by ENRESA. Conversely, small producers' waste are collected in a raw form and treated at El Cabril Facility.

In addition to ENRESA and waste generators, the main actors in L&ILW management are the Nuclear Safety Council (CSN) and the Ministry of Industry and Energy. The Ministry establishes the radioactive waste management policy and grants the licenses (after report from CSN). CSN is an independent regulatory body, reporting to the Parliament. Among its responsibilities are: the evaluation of the licensing documentation on all the aspects related with nuclear safety and radiological protection and the inspection of nuclear and radioactive installations.

## II. EL CABRIL DISPOSAL FACILITY

L&ILW management is organised around EL Cabril facility (Fig. 1). The main purpose of this facility is the final

disposal of all L&ILW produced in Spain. Additionally, it provides the means for treatment of waste from small producers and for some streams from nuclear installations (e.g. compactible waste or contaminated oil). A waste characterisation laboratory has also been constructed as a part of the facility to support the waste acceptance and verification processes. Moreover, there is a fabrication plant for manufacturing the reinforced concrete over-packs, used to prepare the final packages. Interim storage buildings together with the ancillary systems and buildings, needed for operation and maintenance, complete the facility.

El Cabril is located in the province of Cordoba, some 400 km south of Madrid. Formerly, it was a waste storage facility consisting mainly of three storage buildings owned by CIEMAT. The site was turned over to ENRESA in January 1986. Since then, ENRESA extended the site characterisation works already in course and begun the engineering, safety assessment and environmental impact assessment works, in support of the licensing process to build the disposal facility. Its construction started in January 1990 and it was commissioned in October 1992.

The general layout (Fig. 2) is adapted to the hilly landscape of the region. The facility is divided into two main areas: the disposal area, and the auxiliary building area. Both are separated by a brook, which surrounds the disposal area and controls the behaviour of the underground water flow.

**Disposal system**. The main design objectives for a near surface disposal facility can be summarised as follows:

- To protect man and the environment from present and future radiological risks,
- To allow for the clearance of the site after a surveillance period of reasonable length (a few hundred years).

To reach these objectives two main criteria are stressed:

- To isolate waste from the main vectors of radioactivity release (man and water), and to limit the activity being disposed of.

The disposal concept is shown in Fig. 3.

Primary waste packages containing immobilised waste, or pellets arising from the supercompaction process, are re-conditioned in concrete over-packs thus forming the final package to be disposed of. The concrete container in use has room for 18 0.22 m3 drums or up to 50 super-compacted drums. A back-filling grout is injected, filling the gaps among primary packages. Other types of final packages might be used upon approval of the safety authority.

These final packages are piled up inside reinforced concrete disposal vaults. Once completed the vault is back-filled with gravel to stiffen the assembly, and a reinforced concrete closing slab is constructed. The vault is then protected with a synthetic provisional cover.

The disposal vault in operation is protected from the weather by a metallic shelter, which also holds the overhead crane used for handling the final packages and the radiological monitoring equipment. The handling equipment is remotely controlled from the control room located at the waste conditioning building.

There are 28 vaults constructed above the water table and maximum probable flooding level. They are laid in two areas. Each area has two rows of vaults. Beneath each of these rows, there is an inspection gallery. Two different drainage systems exist inside the inspection galleries: one collecting the rainwater fallen inside the vaults waiting before operation; the other receiving any water potentially collected in the vaults in operation or already sealed.

After completion of a disposal area, a multi-layer-engineered cap will be constructed to divert the rainwater. Fig. 4 shows the North disposal area.

The disposal system is designed to withstand extreme site conditions, including the safety earthquake of 0.24 g, and the concrete materials were selected after a research program to optimise the durability of the barriers.

**Auxiliary buildings**

Conditioning buil. The waste conditioning building (Fig. 5) is divided into four areas.

The first area is intended for the treatment of institutional waste. Some waste streams from nuclear power plants can also be received in that area. The main piece of equipment is a 50-kg/h excess air incinerator, together with the pre-treatment equipment and the off gas treatment system.

The second area, called transfer area, contains a number of trucks unloading rooms with the handling equipment (automatic overhead cranes, etc). The drums are transferred from the transport trailers into the concrete over-packs. A 1200-ton supercompactor, working at negative pressure, is installed in this area to treat compactible waste in 0.22 m3 drums. Up to 50 pellets (average of 30) are placed in a single over-pack. The volume reduction factors obtained are lower than those usually foreseen by vendors, probably due to the fact that Spanish NPPs perform a pre-compaction at the reactor sites.

The third area is the containers handling area. There, the empty over-packs arrive. These are moved to and from the different unloading rooms of the above mentioned transfer area, using carts on tracks. Then, the completed over-packs are back-filled with grout. This area also contains two grout preparation and injection systems. One of the systems is designed to use clean water or contaminated liquid waste (after physic-chemical control to ensure the compliance with strict specifications), while the other can only use clean water.

The forth area consists of the conventional part of the building. It includes the Control room, the electric gear, the electronic rooms, and the conventional equipment of the grout preparation system.

Characterisation Laboratory The waste characterisation (checking) laboratory (Fig. 6) is the main tool to perform the waste acceptance process, described below, and to verify, on a random basis, the quality of the packages being actually delivered to ENRESA.

The laboratory has two buildings: the so-called "inactive laboratory", where tests on simulated waste samples are carried out; and the "active laboratory", equipped with capability for testing real packages and radioactive samples.

The main element in this building is the sample preparation cell. This hot cell houses:

- The drilling machine (to drill out cylindrical samples from the real packages); the saw (to cut the cylindrical samples to standard size specimens)
- The mechanical test equipment
- The cutting machine (to cut out the metallic skin of the drums, in order to get a naked waste form).

In addition, it has to be mentioned:

The operations room, from which the tele-manipulators are handled, and which has the control panel and the aliquot preparation cell.

The leaching tests room, with leaching tanks for samples and full-scale real packages.

The spectrometry assay room, providing means to carry out a complete beta-gamma spectrometry, through segmented gamma scanning devices, on homogeneous or heterogeneous 0,22 or 0,4 m3 drums, or on standard size specimens drilled out from the packages

Other buildings The facility has four storage buildings in operation (the three previously existing buildings and a reception building, which can be used as a buffer storage). The Conditioning building also has rooms for sealed sources storage and for liquid waste storage (both aqueous solutions and organic liquid waste).

The facility is completed with the ancillary systems and buildings needed for its operation and maintenance. The auxiliary buildings include security, maintenance workshop, administration, auxiliary systems, general services (medical service, radiological protection laboratory and laundry), concrete containers factory and laboratory, and information centre.

**Public information.** One of the ENRESA's objectives in the area is to keep the surrounding population well informed on the activities performed at the facility to improve the general public trust. This is especially important with the neighbours. Some 4000 people from the neighbouring towns visit the information centre and the facility every year.

## III. MANAGEMENT ASPECTS OUTSIDE EL CABRIL

**Inventory and following up of waste generation. Volume reduction** A fundamental activity to optimise the management is to get a good knowledge of the existing waste, situation at the NPP storage facilities and waste production. A good co-ordination with nuclear power plants has been achieved.

ENRESA has developed a tracking system to verify the compliance with the different activity limits (per package, vault and site) and to provide a tool for retrieval, transport and disposal facility operation planning. This tracking system includes all the relevant information (specific activity, location, classification, acceptance status) of all the waste packages at the NPPs stores, at the stores or different parts of the conditioning building at El Cabril and after disposal.

The NPPs and ENRESA have made a joint effort, developed through joint projects in the field of the waste volume minimisation. These projects range from easy improvements in materials or drains segregation to the modification of the existing conditioning systems. The waste generation has actually decreased from some 6000 drums per year in the period 1989-1992 (reference period after the start up of the Spanish newest NPPs) to 3000 drums per year in the period 1997-1999. Additional projects are being implemented and a standard production of 2000 drums per years is foreseen in two years.

The present delivery rate from NPPs is 8000 drums/year, thus absorbing the existing stock at NPPs stores. This rate would be reduced in the future to accommodate to the production rates.

**Waste acceptance and verification.** ENRESA has established a set of waste acceptance criteria (WAC) linked to the safety assessment for operational and post-closure phases. It has also set up characterisation, acceptance and verification procedures. Three steps can be identified in the acceptance process: approval of a package-type, verification of individual packages data, and inspection of the packages prior to retrieval (contractual acceptance).

The producers (each NPP for each waste stream) apply for the approval of a package-type, sending a Waste Package Description, which gives information on the fabrication of the package and its control and the activity measurement methodology. After review by ENRESA, ENRESA issues a characterisation programme and performs the tests to check the compliance with the WAC. Finally, ENRESA issues the approval of the package type. A problem to deal with is the existence of packages produced before the establishment of the acceptance system. This requires additional studies to demonstrate the respect to the safety limits under the disposal conditions, taking into account the characteristics of the final package.

Some of the activity assignment actions are directly carried out by ENRESA, in order to optimise the overall system, reducing costs. Alpha content measurement and establishment of scaling factors for difficult to measure

radionuclides are in the scope of ENRESA's responsibilities.

Two conditioning levels, namely levels I and II, have been considered, in order to focus the effort, time and money in those waste packages with a higher activity.

Additionally ENRESA performs inspections (production controls) at the NPPs to check that the real waste condioning is made in accordance with the documentation and a revision of the paperwork supporting it. At random some real packages being received at El Cabril are selected and sent to the characterisation laboratory to make verification tests (destructive or not destructive – i.e. activity measurement).

**Reengineering and improvements** Design changes are always necessary, for instance to adapt the specifications to changes in materials and construction regulation or to modify the treatment systems to new waste streams considered. An example of that is the preparation to burn liquid waste from NPPs. A major change is being developed to treat a large amount of contaminated dust from a caesium source melted in a smelter, actually stored at El Cabril. This dust will be mixed with the injection grout, inside the concrete over-packs, taking advantage of a useless volume.

The engineering team is also in charge of a continuous improvement of the safety assessment including new scenarios development, better knowledge of waste and materials characteristics and improvements in the models. The aim of this activity is to have the tools to treat specific problems arising as well as building a higher confidence from the regulatory and social point of view.

**Transport.** The responsibility of the waste packages is transferred to ENRESA at the NPP fence. In general terms, ENRESA owns the special equipment (shielded trailers, transport casks) and subcontracts the transport services to a specialised company. In the case of minor producers' waste, ENRESA performs directly the collection and transport.

Most of the packages have been qualified as industrial package type II, but it may be required additional shielding to meet the transport requirements. Some package types require the use of ISO containers or specially designed casks. This is the case of packages with a contact dose rate of 1-10 rad/h (Fig. 7). All the transport containers are compatible with the handling equipment at El Cabril and allow for a remote opening from the Control Room.

**Institutional waste.** The general rules apply to the waste coming from minor producers (use of radioisotopes in medicine, industry and research), but have been adapted to the features of these waste generators:

- The way they deliver the waste (untreated)
- The large number of facilities.
- The small amounts of waste
- The fewer technical means in comparison to NPPs.
-

A specific organisational unit deals with this kind of producers. In addition to the technical work, a training and enquiry effort has been needed.

**Research.** ENRESA has approved its fifth Research programme, which includes limited research projects in the L&ILW field. The main objectives in this area are:

Development of new treatment systems, focussed on volume reduction.

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 barrier materials under disposal conditions

**Quality and environmental management.** ENRESA has set up a quality system, which includes a company quality manual, specific quality assurance programmes for engineering and construction; El Cabril exploitation; and Connected management activities, in accordance to IAEA 50 CQA and Safety Authority guidance documents. Moreover, it has the ISO 9001 Quality Assurance certificate.

Additionally, ENRESA has established a general and El Cabril specific environmental management systems. El Cabril has obtained the ISO 14001 environmental management certification.

## REFERENCES

www.enresa.es


Figure 1. El Cabril disposal facility. General view

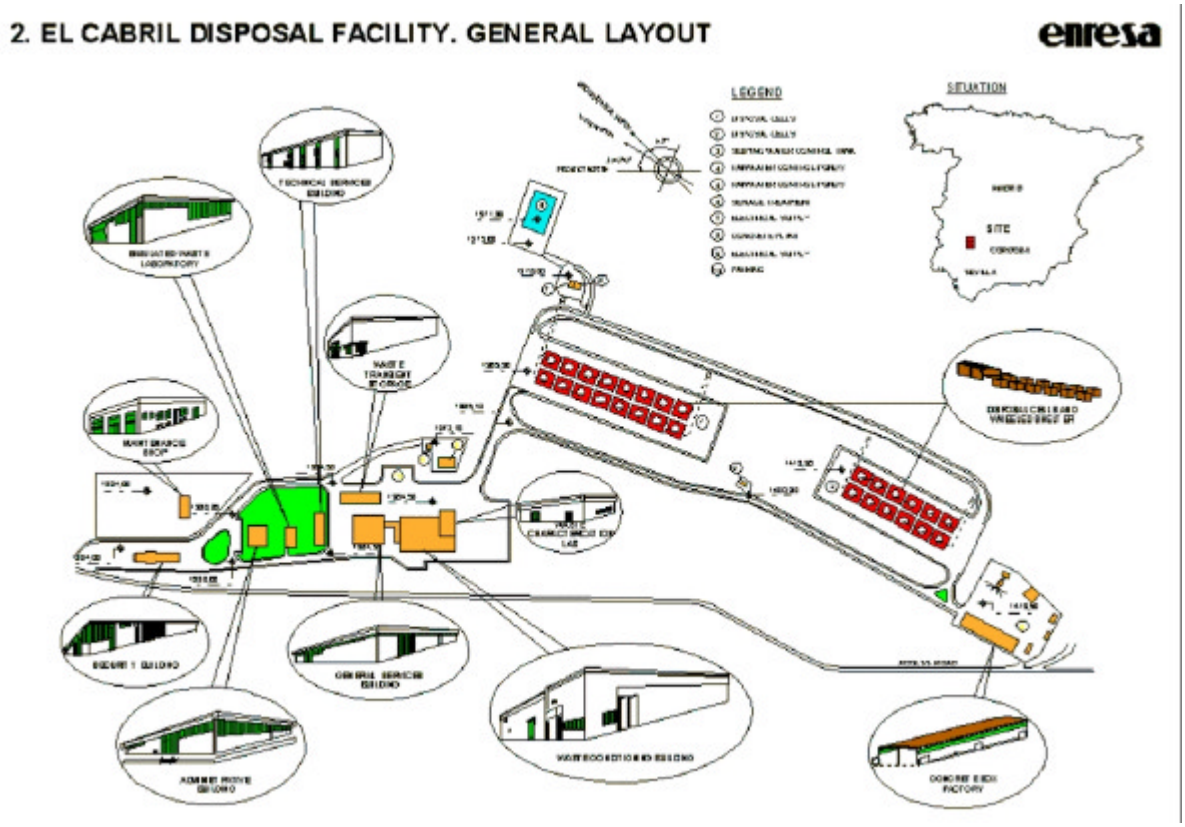


Figure 2. El Cabril disposal facility. General layout

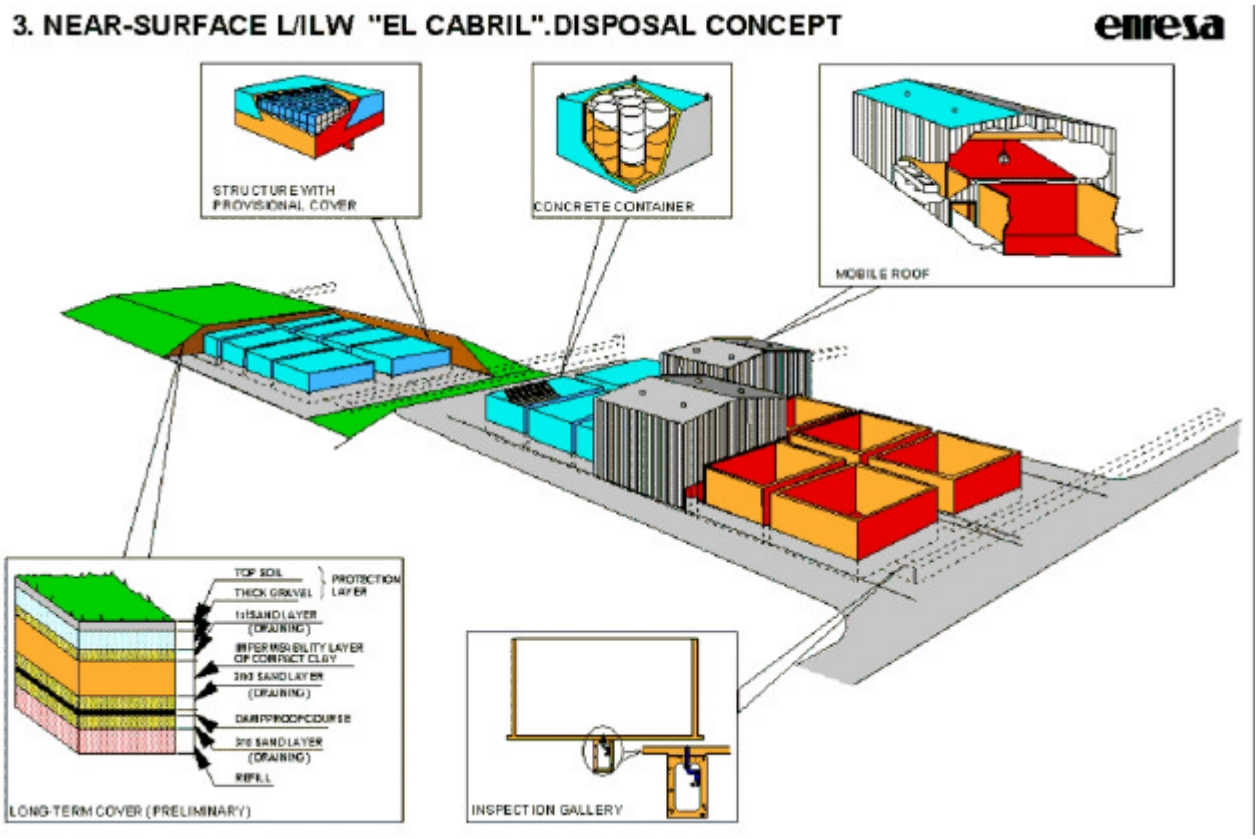


Figure 3. Near-surface L/ILW “El Cabril”. Disposal


Figure 4. North disposal area

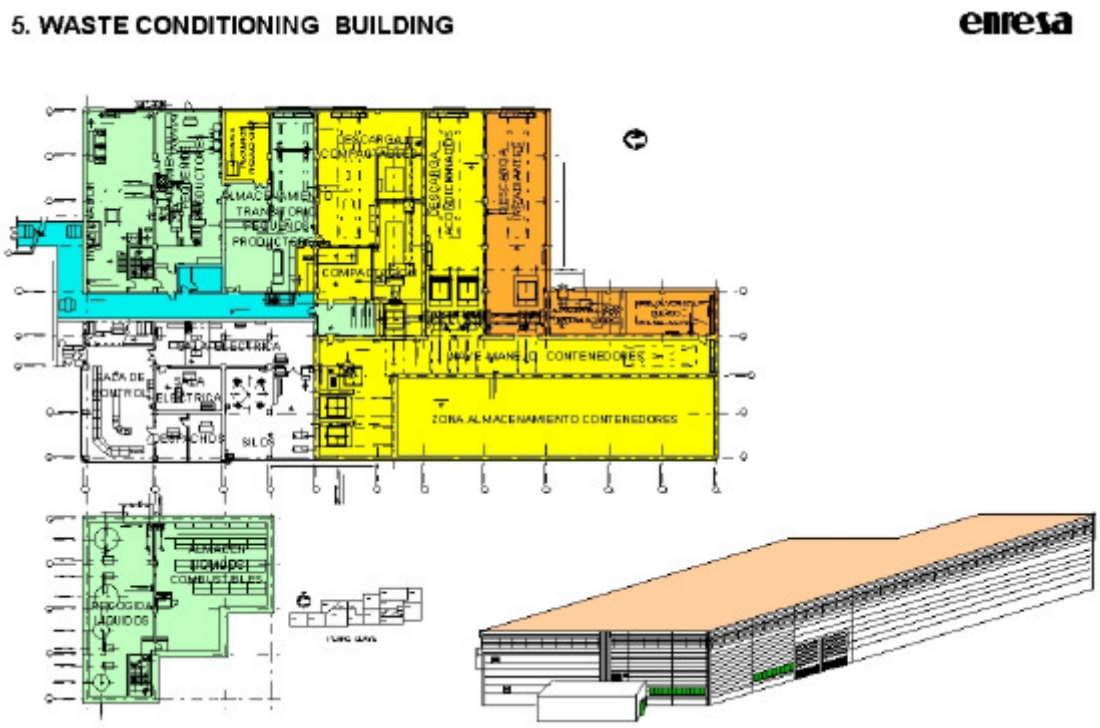


Figure 5. Waste conditioning building

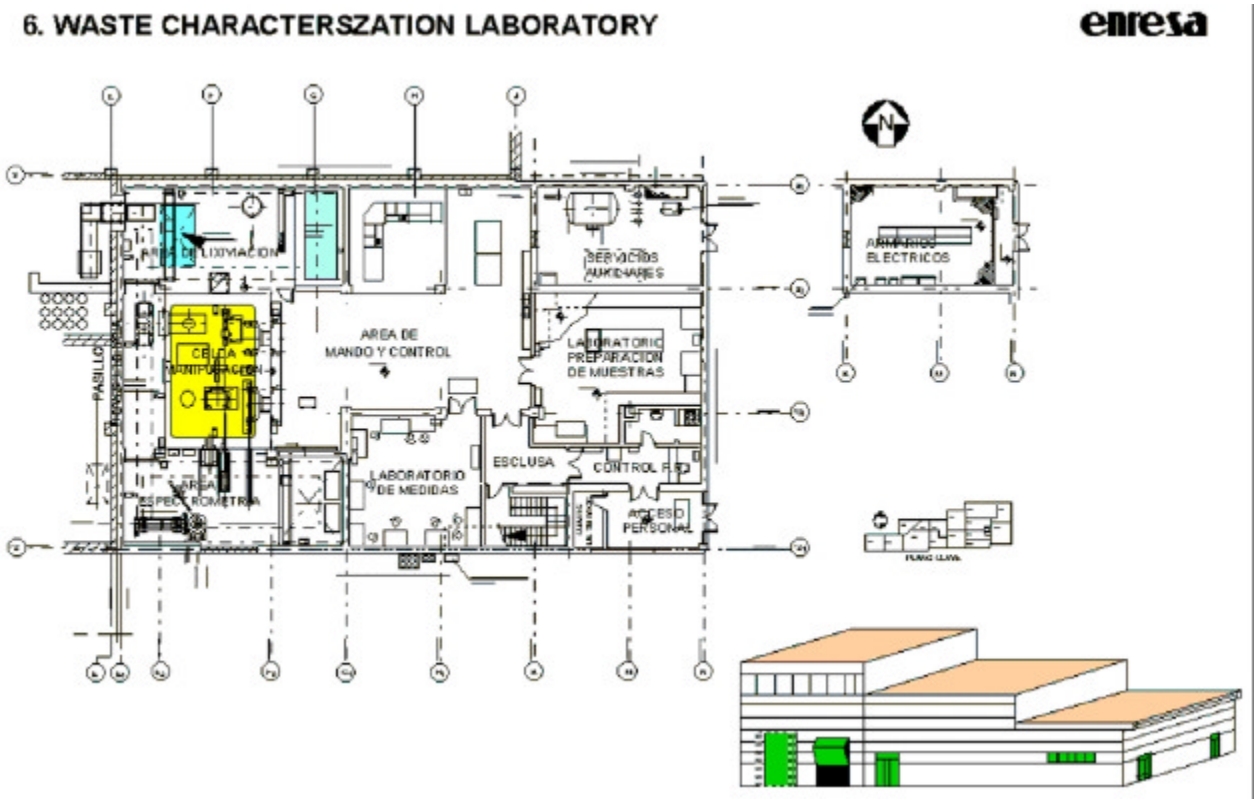


Figure 6. Waste characterization laboratory


Figure 7. Transport of 1-10 rad/h dose rate packages