CHAPTER 21

RADIOACTIVE WASTE MANAGEMENT IN SPAIN MAIN ACTIVITIES UP TO THE YEAR 2000

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21.1 INTRODUCTION

In 1995 there were nine nuclear power stations in operation in Spain with a total capacity of 7.4 GW, supplying about 36% of the Spanish electrical energy. At present, spent fuel from the nuclear power plants is stored on site in pools constructed for this purpose. As of the end of 1993, there were 1457 tU of spent fuel.

The estimate of the total volume of high level wastes, spent fuel, that will have to be managed in Spain is up to 11,700 m^3 (40 years of expected life). Total volume of LLW is expected to be about 200,000 m^3 of which about 137,000 m^3 will be from the dismantling of power plants.

The strategy and main activities for the definitive disposal of high level, long lived wastes are given in the General Radioactive Waste Plans (GRWPs). Following a period of intermediate storage of these wastes, their transport and encapsulation, they will be disposed of in a deep geological formation. Transport of the spent fuel will be carried out by ENRESA as the responsible authority, either using the company's own resources or through specialized firms.

Waste conditioning or encapsulation will be carried out at a plant that is planned to be constructed on the same site as the disposal facility. The technique to be used for disposal will be based on a programme of study, research and international co-operation.

Disposal of LLW, will continue in the "El Cabril" facility, which has been in operation since 1992.

The legal framework governing radioactive waste storage facilities and radioactive or nuclear installations in Spain is established by the Nuclear Energy Act 25 of 1964 and the Regulations on Nuclear and Radioactive Installations of 1972.
The "Consejo de Seguridad Nuclear" (CSN), the Spanish Nuclear Safety Council, was constituted in 1980 as an organization existing under Common Law, independent from the Central State Administration. CSN has its own legal standing and corporate assets independent from those of the State, and is the only body in Spain with responsibility in the fields of nuclear safety and radiological protection.

The management of radioactive wastes in Spain is undertaken by "Empresa Nacional de Residuos Radioactivos, S.A." (ENRESA), the Spanish national radioactive waste company, constituted in 1984. Eighty percent of the company is held by the Spanish Centre for Energy, Environmental and Technological Research (CIEMAT), previously known as the "Junta de Energia Nuclear" (Nuclear Energy Council).

21.2 LOW AND INTERMEDIATE LEVELWASTES

The strategy applied to low and intermediate level wastes continues to be based on a one-to-one relationship between the disposal facility and the wastes themselves. Two major courses of action have been established. The first includes the conditioning, transport and characterization of radioactive wastes and corresponding acceptance criteria, as well as the inspection criteria and procedures required to guarantee compliance. The second includes the design, construction and operation of the disposal facilities.

ENRESA was awarded a Provisional Operating Permit for the Extension to the Nuclear Installation for the Disposal of Solid Radioactive Wastes located in Sierra Albarrana by a Ministerial Order issued on 9th October 1992. As a result of this award, the installation in ques-

tion, known as El Cabril, will be used over some 20 years for many of the stages involved in managing the LILW generated in Spain, such as conditioning, characterization and disposal. This waste constitutes a new operating stage of special relevance in our country.

21.2.1 Waste Conditioning, Transport, Characterization and Acceptance.

Except in the case of the minor producers, the previous treatment and conditioning of low and intermediate level wastes is the responsibility of the producer, who is obliged to generate packages satisfying the acceptance criteria defined by ENRESA for subsequent conditioning and disposal at the El Cabril facility. In the case of the minor producers, waste treatment and conditioning is carried out at the aforementioned facility.

Transport of the wastes is carried out by ENRESAas the responsible operator, either using its own resources for the removal of wastes generated by the minor producers, or the services provided by specialist companies in the case of conditioned wastes.

The contracts signed between ENRESA and the waste producers include the criteria and technical specifications to be considered in relation to the characterization and acceptance of wastes for subsequent disposal at El Cabril.

A key component in the process of waste quality verification, which to date has been mainly performed abroad, has been the construction in Spain of a Low and Intermediate Waste Quality Verification Laboratory for performance of the corresponding tests (destructive testing, verification, characterization, etc.). This laboratory is part of the El Cabril installations, along with the Disposal Structure Conditioning Plant and other Services.

21.2.2 Disposal of Low and Intermediate Level Wastes

With a view to ensuring the disposal of the low and intermediate wastes produced in Spain, ENRESA operates the El Cabril centre, located in the province of Córdoba; an extension of the works at this facility was completed in 1992.

El Cabril incorporates the most advanced technologies used for this type of installation. Technically, the facility is based on a system of shallow disposal with engineered barriers, similar to the French model. This system guarantees compliance with the necessary safety objectives and criteria, such that there will be no significant radiological impact during the period required for the activity of the wastes to decay to harmless levels.
The facility is made up of the following buildings and structures as shown on Figure 21.1:

1. Low and intermediate level waste Conditioning Building, which houses the necessary treatment and conditioning systems (compaction, incineration, manufacturing of hydraulic conglomerant, etc.) for the liquid and solid wastes arising from the application of radioisotopes in medicine, industry, agriculture and research; the solid wastes from CIEMAT, Juzbado Uranium Concentration Plant and the nuclear power plants, and the wastes generated at El Cabril itself as a result of operations.
2. Disposal Structures for the duly conditioned low and intermediate level wastes from the Spanish nuclear and radioactive installations. These structures consist of cells aligned in two rows along two esplanades; it is estimated that their capacity will cover Spain's needs until the end of the first decade of next century (see Fig. 21.2 for layout of disposal platforms).
3. Quality Verification Laboratory where the processes of characterization, testing and control of the characteristics of radioactive packages received or conditioned at the facility are carried out, and for research activities aimed at enhancing the processes of low and intermediate level waste conditioning and characterization.
4. Services and Control Building where industrial safety, reception, technical services, general services, maintenance workshop, concrete container manufacturing and administration are carried out.

The El Cabril facility has been operational since October 1992, when the buildings and structures described above were constructed and the necessary assembly operations and tests were performed.

Up to that date, ENRESA had stored the conditioned low and intermediate level wastes from CIEMAT and the minor producers in the surface modules of the old El Cabril installations. In recent years, these modules have also been used for packages from the José Cabrera, Santa María de Garoña and Ascó nuclear power plants. The other (conditioned) low and intermediate level wastes generated in Spain are temporarily stored at the producers' authorized on-site installations awaiting transfer to El Cabril.

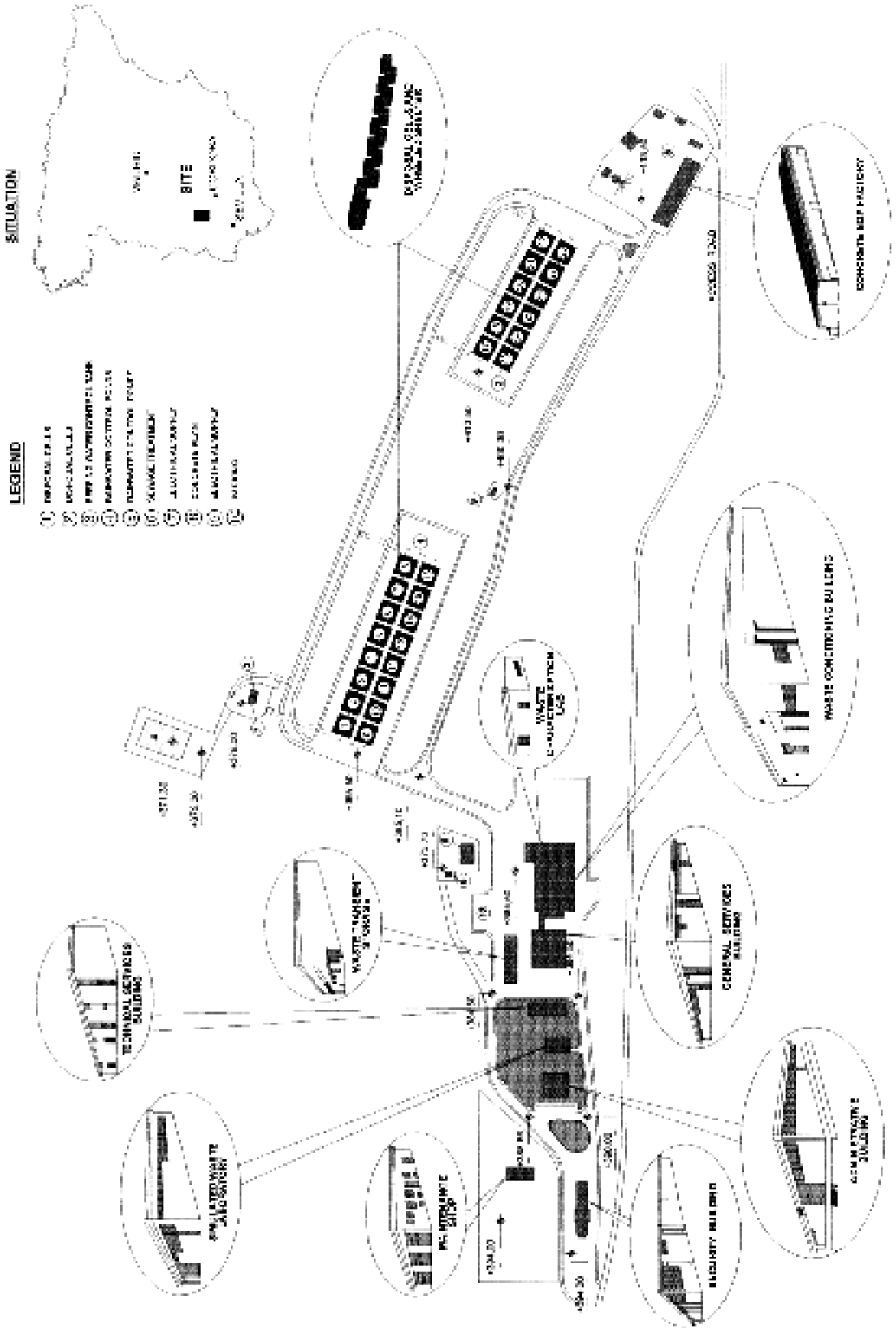

Figure 21.1. General layout of the "El Cabril" LLW disposal facility.

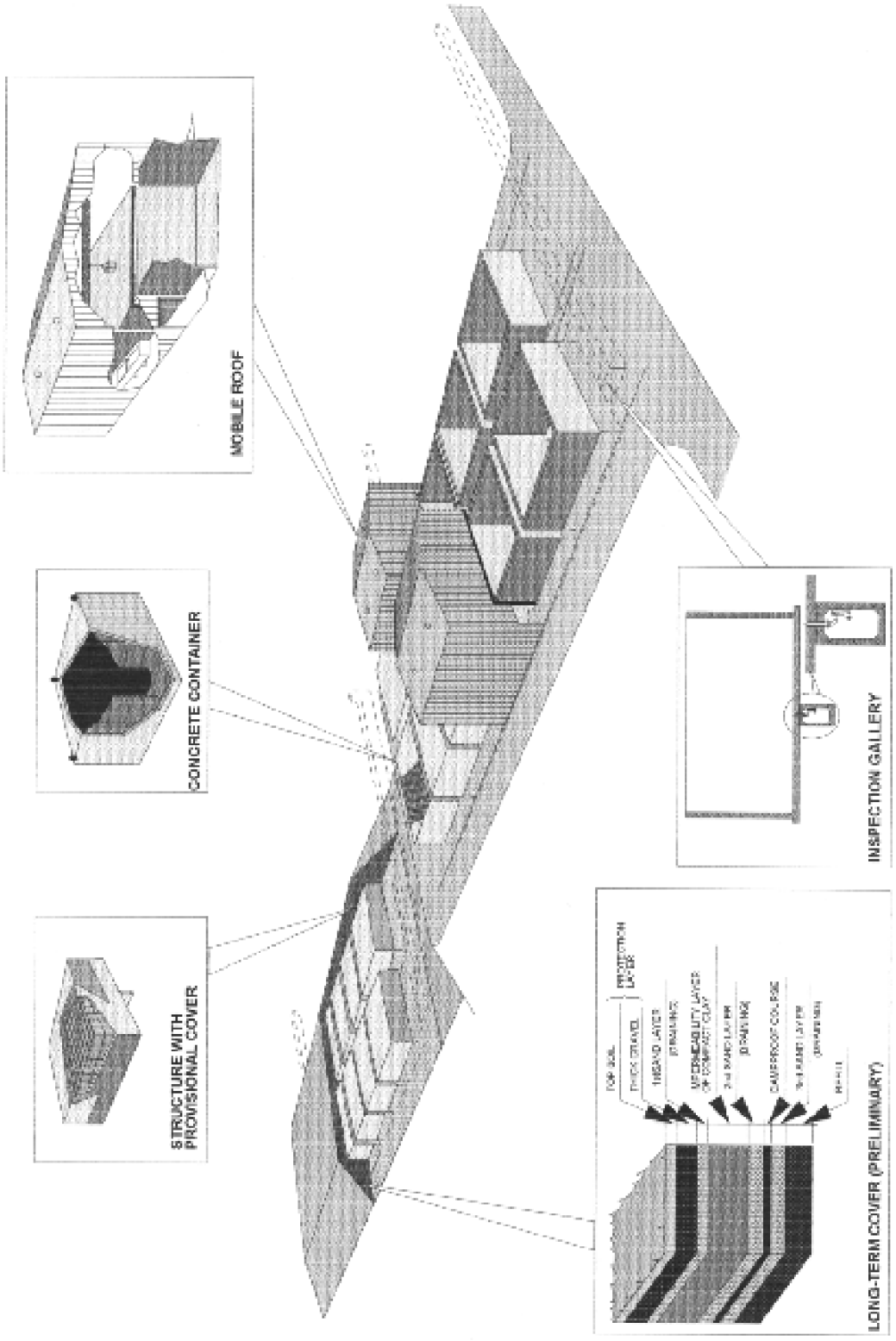

Figure 21.2. Layout of the disposal platforms.

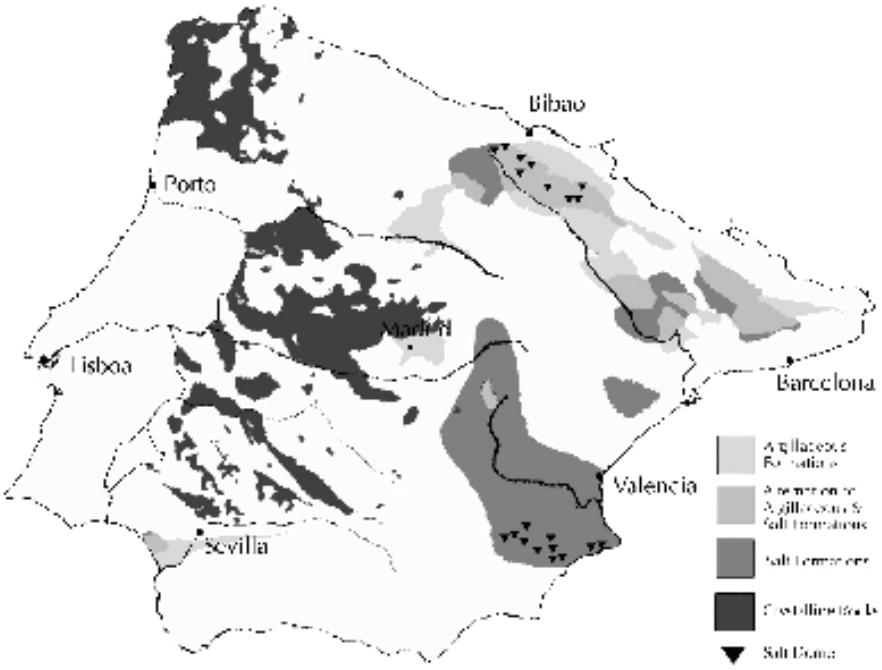

Figure 21.3. European catalogue of geological formations in Spain having favourable characteristics for disposal of HLW.

All this makes Spain one of the few countries, along with France, United States, Sweden, United Kingdom and Japan, to possess an overall capacity for management of low and intermediate level wastes produced by the country's nuclear power plants and some one thousand smaller installations (hospitals, industry, etc.) from a modern environmental point of view.

21.3 HIGH LEVELWASTES

In Spain, high level wastes are understood to be the non-reprocessed spent fuel from nuclear reactors, the exception being the fuel from Vandellós I NPP, which has been sent to France for reprocessing.

In view of the overall open cycle strategy applied to this fuel in Spain, there are basically two types of high level wastes which will have to be managed: (a) the spent fuel generated by the country's light water reactor nuclear power plants, by far the larger volume, and (b) the vitrified wastes arising from the reprocessing in France of the Vandellós I spent fuel.

Before the definitive disposal of these wastes is accomplished, it is necessary for them to be kept for a period of interim storage in order for prolonged cool down and decay of their isotopic activity to occur.

According to the economic studies carried out, the most reasonable solution for interim storage of the spent fuel, while the nuclear power plants are in operation and taking into account the plant lifetime considered, will be for them to be stored on site at the plants where such spent fuel is generated. This storage will be accomplished either in the plant fuel pool or using dry storage techniques on site. Consequently, the date by which a centralized temporary storage facility for this fuel should be available will depend, fundamentally for the time being, on the time at which the first nuclear power plant dismantling process is undertaken, in other words, on the service lifetime considered for these installations.

The date on which the deep geological disposal facility enters operation will not, however, undergo any variation, regardless of whatever hypothesis is adopted regarding service lifetime.

21.3.1 Search for a Site for Construction of Facilities.

The process of designating a site for disposal of HLW started in 1986 and continues today. The geological media contemplated are granites, salts and clays. A National Inventory of Favourable Formations (IFA Project), has been developed during 1986-7 which confirms the Spanish contribution to the European Catalogue (Fig. 21.3), and a selection process known as the "High Level Regional Studies" (ERA Project) has

been drawn up. The site screening in the ERA project has been based on geological, hydrogeological, seismic, environmental and societal data.

The second phase of the process known as the "Study of Favourable High Level Areas" (AFA Project), which covered the period 1990-1995, identifies more than one thousand municipalities with potential capabilities to construct a HLW repository.

In the 4th General Radioactive Waste Plan (December 94) a project of law to arbitrate the procedures to designate the site of surface and underground installations is under consideration by the government. The bill will dictate the means of participation in the ultimate decision of State and other concerned institutions, as well as the general public.

21.3.2 Development of Basic Design for Deep Geological Disposal Facility.

Progress is being made in defining the conceptual design for future surface and underground installations. The aim of this project, which was initiated in July 1990 and is being performed by Spanish engineering firms, in collaboration with Swedish and German organizations, is to perform systems analyses, and to evaluate various detailed disposal concepts and alternatives.

This entire process serves as an important central activity of the R&D programme and is needed to design and construct the disposal facility, regardless of whatever geological medium is chosen.

The first important milestone was the development in 1992, of a preliminary conceptual design for salt and granite formations.

Once ENRESA analyzed the results obtained, a second three-year phase was addressed. Its aim was to get the disposal concept for the three formations ready by the end of 1995, supported by a preliminary safety assessment. Successive later phases are to be undertaken until the selection of the final disposal system project is made.

21.3.3 Acquisition of Technology and Training of teams Required for Characterization of Chosen Site and Construction of Disposal Facility.

Site characterization and disposal system design and verification require a scientific technological support system provided by associated R&D activities. Once human and technical equipment have been selected by previous R&D investigations, a further verification of different methodologies using field studies on different scales will be needed. These studies will provide the necessary information for a long-term performance assessment of the disposal system.

After the final candidate site is selected, the three above mentioned areas of work will be directed towards the same objective which can be summarized as follows:

1. Detailed site characterization by R&D developed and perfected techniques. These will include surface workings, drilling and an underground research laboratory.
2. The previous disposal system design will be adapted by preparing a detailed project to assist in its final construction.
3. The R&D Plan will be aimed at completing the remaining activities, particularly the safety assessment of the chosen site, including specific works to be performed on the site.

All the planned works are to be completed by year 2015 and the final disposal system construction is foreseen to start and finish during the decade of 2020.

21.4 DECOMMISSIONING OF INSTALLATIONS

From the technological and waste production point of view, the most significant aspect of this important management issue in Spain is decommissioning the country's nuclear power plants. In this respect the Vandellós I NPP is of particular importance at this moment in time, with decommissioning of other plants currently in operation constituting a longer term activity.

In spite of the importance of these plants, there are other installations, such as uranium mines, the Andújar uranium mill and the La Haba concentrates manufacturing facility in Badajoz, whose decommissioning will have to be addressed and which are currently in different phases of performance, as described below.
The spent fuel from the Argos and Arbi experimental reactors was transported to the United Kingdom in 1992 for storage and reprocessing; it is foreseen that the waste generated in the process will be returned to Spain. As regards the JEN-1 reactor, dismantling is currently being addressed by CIEMAT; this organization is carrying out a research and development programme in rela-

tion to this issue, with participation by Spanish and overseas institutions and financing by the EU. There is also an agreement with the UKAEA for storage and eventual reprocessing of the fuel from this reactor, which was transported to the United Kingdom in 1992.

With regard to the issue of dismantling, special mention should be made of the particularly important question of the declassification of materials as radioactive wastes, since this implies total or partial exemption from the control systems applied to such materials, thus allowing them to be managed by means of methods similar to those used for conventional wastes. Work is currently advancing rapidly at national and international levels with a view to completing detailed development of specific criteria and methodologies for the application of such exemption practices in Spain.

21.4.1 Closed Uranium Mines

As was pointed out in the Third GRWP, ENRESA has carried out a study of the conditions at closed-down mining facilities belonging to the then Nuclear Energy Board, now CIEMAT.As a result of this study, the decision was taken to perform projects at certain of these facilities with a view to restoring the terrain altered by the operations, eliminating rubble tips, refilling quarries, shafts, etc. and in general carrying out whatever corrective measures might be required for the sites to be integrated into their natural surroundings.

The so-called Action Plan for the restoration of closed uranium mines was finalized at the beginning of 1994. Following the corresponding evaluations, work will begin on detailed development of the project at the mines considered to be of interest, as a preliminary step to performance of the field work. According to current forecasts, these tasks will imply specific actions at 2-3 mines; such actions are to be initiated in the last quarter of 1994 and completed during 1995, including the corresponding control procedures.

21.4.2 Andújar Uranium Mill

Authorization for the decommissioning of the Andújar Uranium facility was awarded by Ministerial Order on 1st February 1991, and performance of planned activities began immediately. For performance of the Decommissioning Plan, ENRESAanalyzed the technology used in other countries for this type of project and defined the activities to be performed using the USA UMTRAP (Uranium Mill Tailing Remedial Actions Project) programme, which covers 24 installations of this type, as a point of reference.

The proposal includes dismantling of the installations, demolition of buildings and incorporation of the resulting rubble into the mass of tailings, and stabilization of the whole through reduction of banks and construction of a cover providing protection against erosion, diffusion of radon, and infiltration of water.

The design criteria and objectives contemplated relate to the control of dispersion, long-term radiological protection, durability, the cleaning of contaminated soils, the control of radon diffusion, protection for groundwaters and the minimization of long-term maintenance.

The works were completed in May 1994, in accordance with the existing schedule; what now remains to be accomplished is establishment of the corresponding monitoring programme, to be performed over the next 10 years and prior to declaration of the decommissioning of the facility.

21.4.3 Decommissioning of La Haba

The main activities to be accomplished at LaHaba include restoration of the terrain affected by the mining works, by transferring the rubble tips to the mine openings and subsequent replanting, and closure of the Lobo-G plant and the associated tailings dike. This task consists of dismantling the installations and the stabilization and covering of the dike.

21.4.4 Decommissioning of Nuclear Power Plants

Following the final removal from service of the Vandellós I NPP, it was necessary to adjust development of the strategies and technical activities contemplated for this area of management in the first waste plans. These emphasized the fact that this particular problem was a long-term issue and contemplated initiation of total decommissioning (Level 3) of all the Spanish nuclear power plants five years after final shutdown of the reactor.
Based on experience acquired in other countries, especially in France where the technology originated, ENRESA has performed studies aimed at defining the most feasible strategy from a technical and economic point of view, taking into account the specific circumstances of Vandellós I NPP.

The following three possible alternatives were consid-

ered:

1. Maintenance of the plant in the final definitive shutdown for an indefinite period of time. (Level 1 dismantling).

2. Dismantling the conventional parts of the plant and active parts other than the reactor and its internals (Level 2 dismantling).

3. Total dismantling, leaving the site in conditions allowing it to be used without any type of restriction (Level 3 dismantling).

To date, no Level 3 dismantling process has been carried out at any commercial plant. Consequently, this alternative may be ruled out for Vandellós I in the short term, owing to the technological, methodological and licensing risks involved. After following a process of study and assessment of various parameters (technological, radiological impact, regulatory, economic, logistics and the volume of wastes to be managed), it was considered that the most feasible strategy for decommissioning the Vandellós I NPP would be immediate dismantling in accordance with alternative 2, followed by a period of waiting, estimated to last 25 years, for completion of total dismantling the remaining parts of the plant in accordance with alternative 3.

The alternative chosen not only represents the most feasible approach from the point of view of both performance and impact on general waste management, but is also backed by French experience in relation to the dismantling of the two units of the Saint Laurent des Eaux plant (SLA 1 and 2). This led to the decision to undertake a Level 2 dismantling followed by total dismantling (Level 3) following a suitable waiting period, estimated at between 25 and 30 years.

At Vandellós I NPP, the programme of activities to be performed prior to dismantling is being coordinated with the fuel removal activities carried out by HIFRENSA, such that during 1995, the detailed engineering project and licensing process will have been completed. In this respect, ENRESA submitted a dismantling and decommissioning project to the Ministry of Industry and Energy in May 1994, for its approval. This project contemplates partial dismantling of the facility (Level 2), which will make it possible to determine the most suitable period of waiting prior to initiation of the total dismantling process. It is estimated that four years will be required for completion of the partial dismantling process contemplated in this project, as from the date of initiation.

As regards the other light water reactor nuclear plants currently in operation, consideration is currently still being given, from the point of view of calculation and planning, to the alternative of undertaking complete dismantling (Level 3). This process is to be initiated between four and eight years after final shutdown of the plant.

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