



World Nuclear Association Annual Symposium  
8-10 September 2004 - London

## **The Dismantling of the Vandellos I Nuclear Power Plant**

Manuel Rodriguez

### **Introduction**

As we are all aware, dismantling a nuclear power plant is a complicated issue that requires much more time and costs a great deal more than what we would like or than might appear to be reasonable, compared to the costs and periods involved in the construction and operating phases.

When we ask ourselves why this should be, we all immediately think of the complexity and risk involved in working with contaminated and/or activated materials. It is not the same to build a plant with clean materials and without active systems as it is to dismantle or demolish it, when many active and potentially contaminated systems still remain.

If we think about the subject in greater detail, we also find socio-political reasons making the process more difficult, and varying considerably from one country to the next, such as the lack of facilities for the disposal of radioactive wastes, the lack of treatment or recycling plants for non-contaminated materials, the lack of companies equipped to do the job or simply the absence of a financing scheme allowing the work to be performed.

But the difficulty is also due – and to my way of thinking this is a third reason – to the fact that we are dealing with a relatively new activity of which there is little experience and that has not yet been sufficiently standardised. There is a limited margin of manoeuvre as regards the two first reasons but, in view of the large number of plants that will be entering the dismantling phase in the near future, we can and should act in relation to the third, consolidating this activity as soon as possible and making it as standard and efficient as possible in terms of cost, duration and the quality of the end product.

In the next few minutes I will very briefly describe the contribution made by Spain and by my company, Enresa, to this objective of standardising this new business, this new industrial process of nuclear facility dismantling, and to making it increasingly efficient.

## Plant Characteristics and Life Cycle

The Vandellos I Nuclear Power Plant was a 500 MWe gas-graphite reactor of the same type as the French St Laurent-des-Eaux plants. The nuclear steam supply system was integrated, with the core and the steam generators located inside a pre-stressed concrete pressure vessel. The reactor vessel housed the reactor along with the blowers and auxiliary equipment. The site included also other buildings such as the irradiated fuel building, spent fuel pools building, auxiliary heating plant and the graphite vaults.

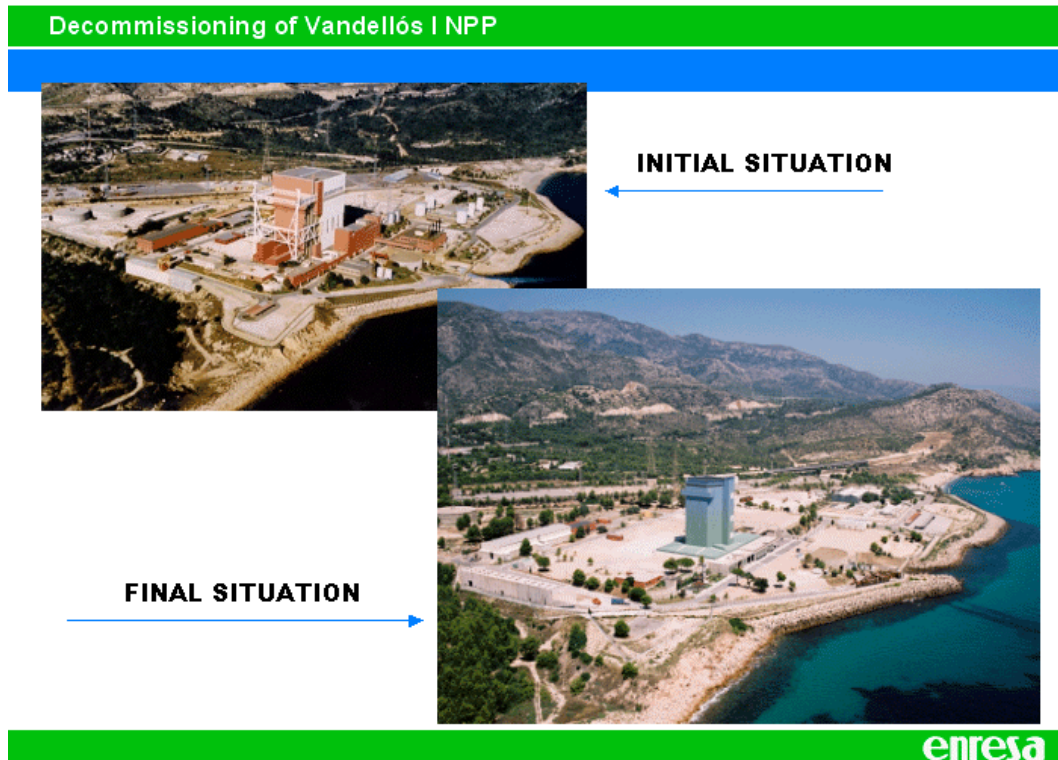
It was built between 1967 and 1972 and was operated, without any significant problems, until 1989, when it was shut down due to a fire in the turbines. The incident, which originated in a mechanical failure, did not produce any radioactive emissions or any damage to basic elements. Nevertheless, the recovery cost of the plant, including new requirements established by the regulatory body, led to the decision to definitively shut down the plant.

After cancelling the exploitation licence, the Ministry of Industry made the following assignments:

- a) To the operator of the plant, the following post-operational activities: removal of the spent fuel from the site and conditioning of the graphite and other operational wastes.
- b) To Enresa, the Spanish public company responsible for radioactive waste management and the decommissioning of nuclear power plants: preparation of an analysis of alternatives and, following the selection of one such alternative, performance of the technical design of the project.

Each company carried out its assignments during the period 1990-1997 and, in February 1998, the handing over to Enresa of the responsibility of the former operator, who continues to be the owner of the site, took place.

With the help of the former plant operator, which became a services provider, Enresa undertook the level 2 dismantling of the plant between February 1998 and June 2003. This basically consisted of dismantling, decontaminating and demolishing most of the buildings, leaving the inside of the reactor and part of the basement of the building as the only regulated zone (*Figure 1*).



*Figure 1: Station before and after decommissioning*

These buildings will be dismantled and demolished in approximately 30 years when, thanks to the fact that the activity inside the reactor will have decreased to 5% of the current levels, it will be technically easier and more economic to intervene inside the reactor.

### **Key aspects of the decommissioning of Vandellos I**

Having a good technical project might not be enough to successfully undertake a dismantling project since certain internal and external agents (society, the regulatory authority, local institutions) may have concerns and expectations that might affect the activities planned and that should be considered in order to make dismantling feasible and acceptable for all the stakeholders.

In our case, the internal concerns of Enresa before the decommissioning began were, on the one hand, that we had to face a completely new activity (at least for us, who were previously skilled in radioactive waste management) and, on the other, the fact that we had to lead the project at somebody else's site. Furthermore, we had to inherit the equipment and the personnel from the former operator, incorporating them into the organisation.

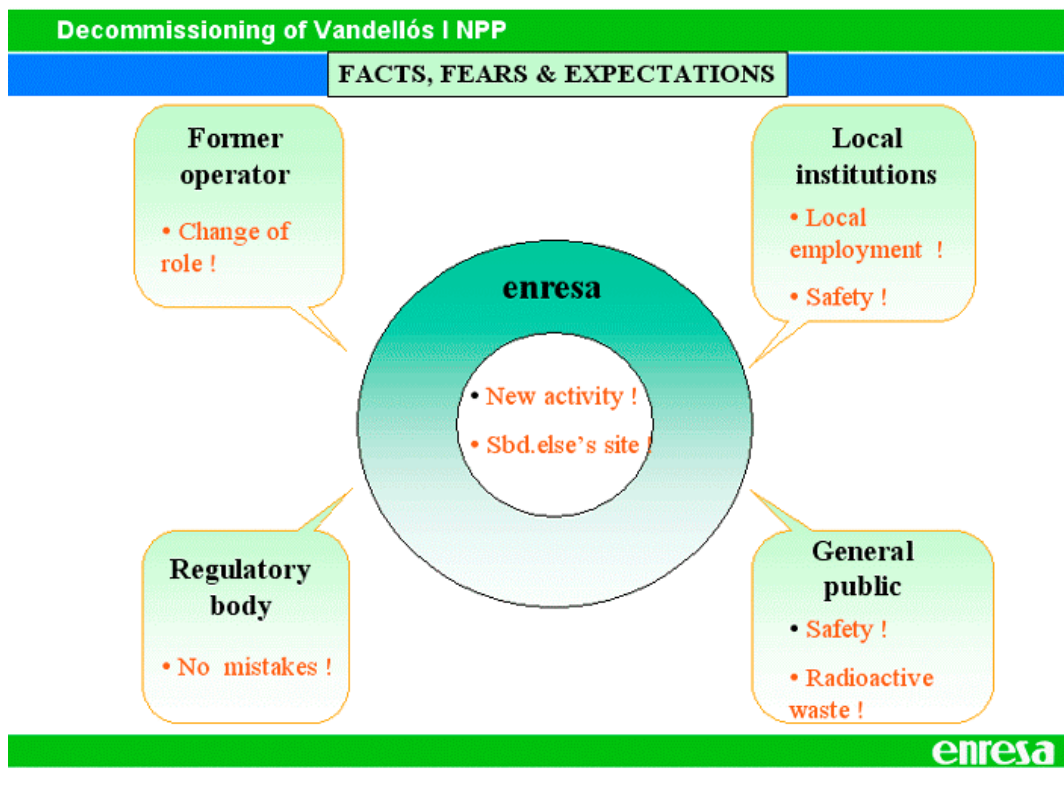
In the same way, some external agents had some concerns that we had to tackle and, if possible, neutralise.

Firstly, the former operator was going to lose its position of privilege, handing it over to Enresa. The consequence of this is that the personnel and even the management team were quite anxious, awaiting our first decisions.

Secondly, the local institutions were afraid of the possibility of job losses and of the safety of the new operations, both for the personnel and for the environment.

Thirdly, the general public, across the entire country, were concerned about safety and the risks of handling and transporting what they thought was highly contaminated waste.

Finally the regulatory body demanded that Enresa made no mistakes when handling and dispatching materials (no clearance and dispatching of contaminated materials).



*Figure 2: concerns and expectations*

To tackle these facts, fears and expectations, Enresa moved from the very beginning in three different directions:

- Firstly, developing a detailed engineering project.
- Secondly, designing a sound waste management methodology that minimised the risks of making errors and causing damage to people and to the environment.
- Finally, developing different policies dealing with training, employment, communication and safety.

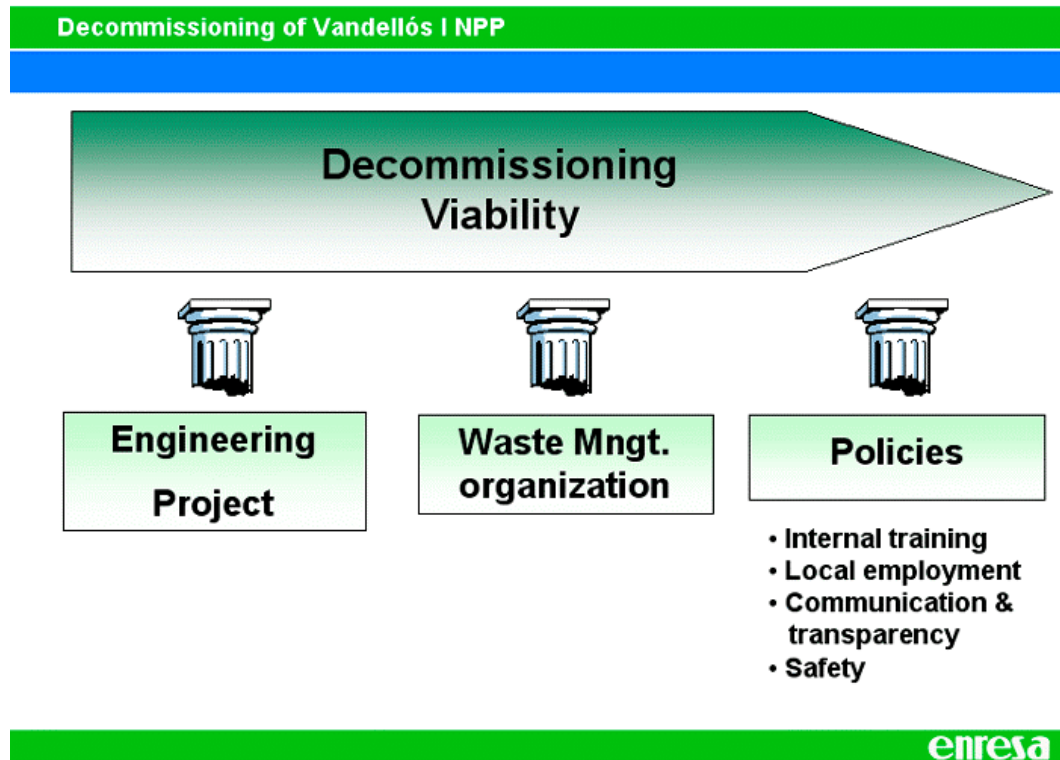


Figure 3: Feasibility of dismantling

### Activities performed

The project was divided into three main phases:

- Preliminary activities, needed to build up or to adapt certain facilities and auxiliary systems of the plant to the decommissioning activities. Large-scale cutting, decontamination and material management activities had to be carried out in appropriate spaces and workshops and controlled and supplied with adequate ventilation, fire-fighting and electrical systems.
- Dismantling and demolition activities, that constituted the essence of decommissioning, consisting of the decontamination and dismantling of the systems and the demolishing of the structures.

During this phase the following active buildings were emptied, cleaned, declassified and demolished or dismantled:

- Reactor building
- Fuel treatment building
- Spent fuel pools building
- Graphite vaults
- Effluent treatment building
- Other minor active infrastructures

The following conventional buildings were also emptied and demolished:

- Auxiliary heating plant
- Pumping station
- Electrical building
- Others

The materials arising from these areas were properly segregated, classified, decontaminated (when possible), declassified (when possible) and dispatched to appropriate destinations.

- Final activities, consisting of rehabilitation and preparation for dormancy (care and maintenance).

During this phase the reactor vessel was isolated and a graphite interim store was built. In parallel with the above, the installation and its systems were adapted to the care and maintenance situation (new small offices, new security control system).

### Waste management methodology

Enresa has conceived the dismantling of Vandellos I not as a simple demolition but as an industrial process in which large volumes of materials of different types have to be handled, as a result of which the logistical aspects are fundamentally important.

As in any industrial process, permanent attention must be given to the elements described in the following graph:

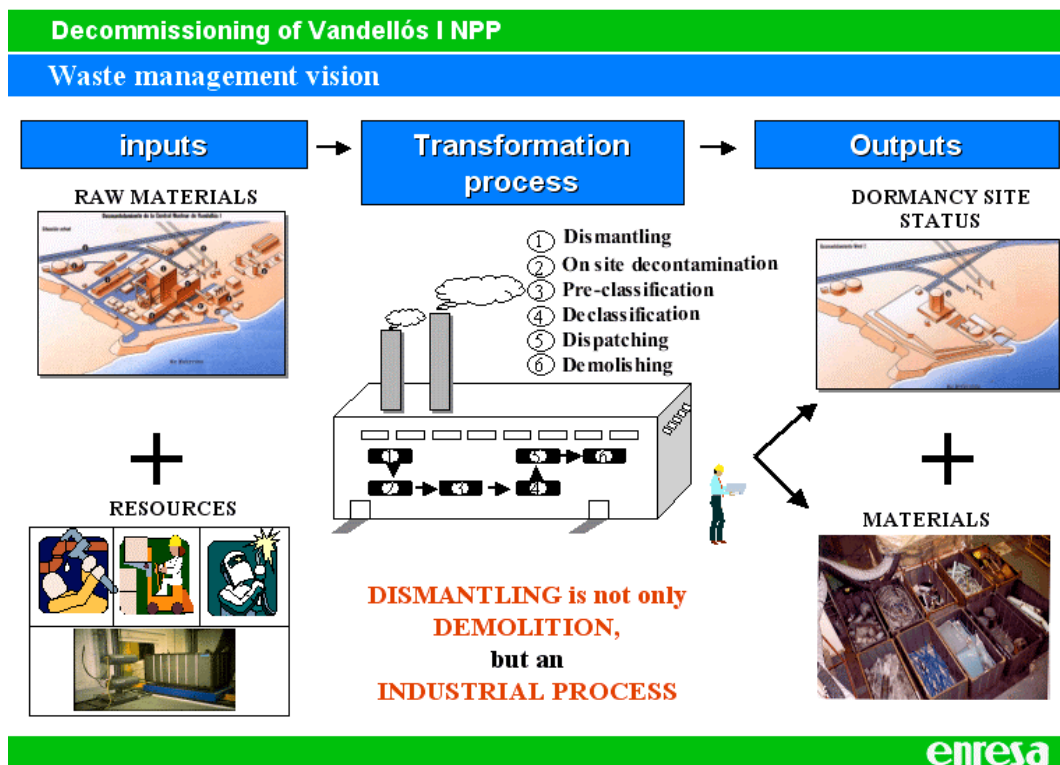


Figure 4: The industrial process

The logic applied to the management and declassification of the materials is described in the following graph:

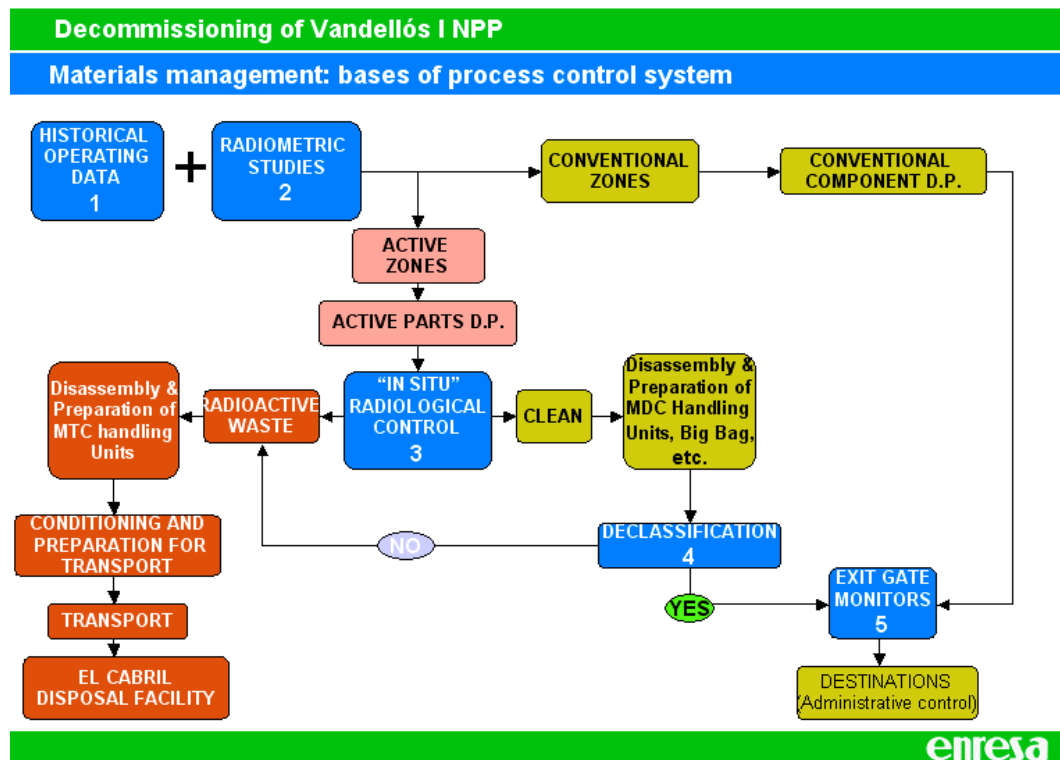


Figure 5: The controls

Once developed in the form of procedures, these concepts gave rise to a materials management methodology that is an essential part of dismantling and that could be used in future projects of this nature.

## Policies

The third line of action required for dismantling to be feasible is the adoption of active policies making it possible to overcome the fears or concerns of the stakeholders.

The main lines of work adopted have been as follows:

- Policy for training and motivation of the former plant owner, in order to achieve the best from the workers.
- Policy of promoting local employment, allowing this to be maintained at acceptable levels and qualified workers to be attracted from the surrounding area, this including the involvement of the local institutions and business community.
- Communications and transparency policy making it possible to correct erroneous perceptions and provide truthful information to the authorities, the media and the general public.

## Some figures on the project

The most significant parameters of the level 2 dismantling have been a cost of €4m, as against the €90m budgeted, and a duration of 63 months compared to the 60 initially foreseen.

63 different companies and 2700 workers have collaborated in the project, with a peak figure of 30 companies and 420 workers involved simultaneously. Thanks to the policy of local employment applied, 65% came from the local area.

As regards training, more than 1500 courses have been delivered, most relating to conventional safety and radiation protection, these having contributed to the absence of any serious accidents.

The following figure shows the volumes of materials handled during the dismantling, along with their main destinations. Particularly significant is the large volume of ferrous materials recycled in conventional industry and the small amount of radioactive wastes generated, compared to the total materials managed.

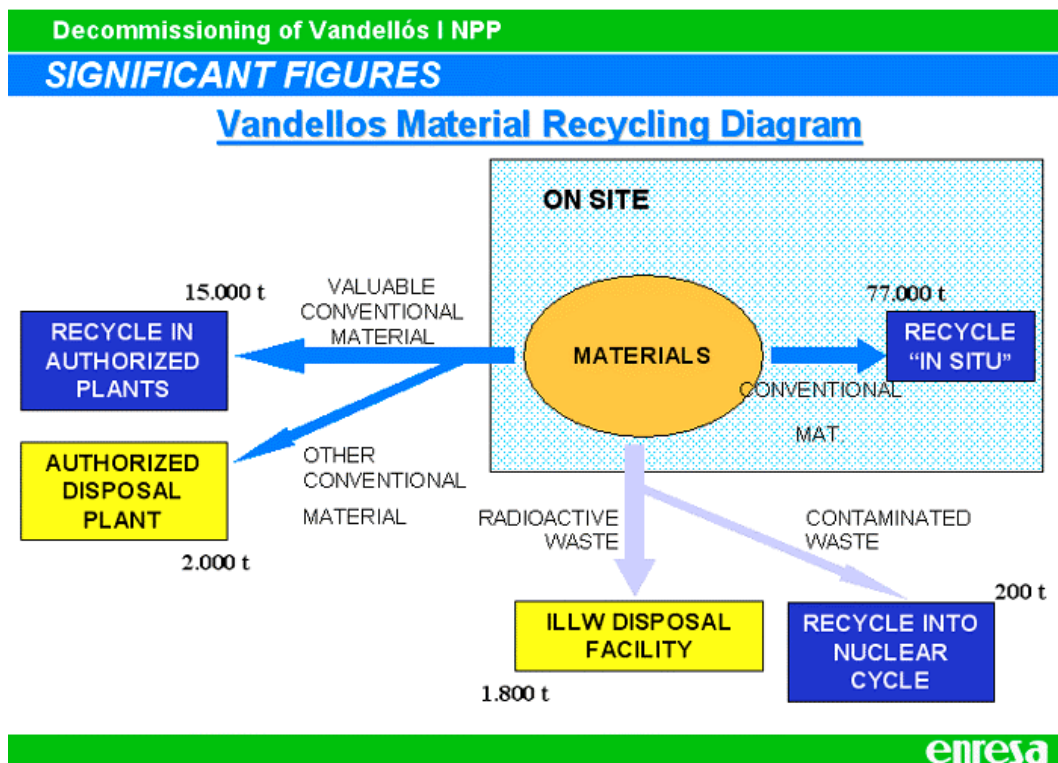


Fig. 6: Recycling of materials

The declassification policy applied has contributed to the optimisation of the volume of radioactive waste generated, with 9250t of materials having been declassified from the total 10 500t of material characterised. Likewise, 136 000m<sup>2</sup> of material have been measured, of which 15 000m<sup>2</sup> were decontaminated, this avoiding the effect of dilution and significantly minimising the amount of wastes generated.

As regards collective dose, the actual dose has been far lower than that estimated (433.13mSv/p compared to 603.39mSv/p), and quite a lot lower than the average dose experienced in the refuelling of a type plant.

Finally, in relation to transparency, it should be said that more than 25 000 people have visited the site and witnessed the progress of the works first hand. Likewise, more than 100 presentations and conversations have been held with the media, the works tracking commissions and other institutions of various types (town councils, universities, business associations), this having contributed significantly to the acceptance of a project of this type.

### **CONCLUSION: WHAT NEXT?**

In relation to Vandellos I, dismantling to level 3 remains to be carried out in order to close the life cycle of the plant and return the land to a situation similar to the one existing in 1967.

For this to be achieved, it is necessary to wait until the activity inside the reactor decays to easily assumable levels (time is on our side), for technology suitable for intervention in the interior of the reactor to be developed (full confidence in the industry) and for a series of socio-political conditions allowing for the construction of repositories in which to dispose of the wastes that cannot currently be sent to the Spanish ILLW disposal facility (El Cabril).

Meanwhile, our most immediate objective is to consolidate this new line of activity for Enresa with the dismantling of the “Jose Cabrera” Nuclear Power Plant, taking advantage of the experience acquired, learning from our errors and taking note of what is done by others, with the final objective of becoming increasingly efficient, that is to say quicker, cheaper and with an end product increasingly in keeping with what is demanded by society and the owners of the plants.