# DECOMMISSIONING OF NUCLEAR AND RADIOACTIVE FACILITIES IN EAST EUROPEAN COUNTRIES

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**This paper describes two decommissioning projects in which Empresarios Agrupados has participated, for the Jaslovské Bohunice A1 Nuclear Power Plant in Slovakia and for the Main Radioactive Waste Repository (CSOP) at Rozan, Poland. Both projects were funded by the European Commission's Phare Programme. The objectives, work methodology, results, and conclusions are indicated for each project. Finally, this paper highlights the main lessons learned as a result of executing these projects, both the technical as well as the organisational and methodological lessons.**

Empresarios Agrupados' experience in the decommissioning of nuclear and radioactive facilities funded by ENRESA has recently been enhanced by its participation in projects for decommissioning these kinds of facilities in Eastern European countries, funded under the European Commission's Phare Programme.

Phare Programme projects are being executed, in most cases, by consortia of companies from different European Union countries. Local sub-contractors from the beneficiary countries also participate in these projects.

These kinds of projects require companies in consortia to make great efforts to adapt. On the other hand, they offer them an excellent opportunity to exchange technical experience and know-how and expertise in organisation, procedures, criteria and methods. This knowledge can then be used on similar projects in the future.

This paper describes, separately, two Phare projects in which Empresarios Agrupados has taken part: for the Jaslovské Bohunice A1 NPP, in Slovakia, and for the Main Radioactive Waste Repository (CSOP) near the town of Rozan, Poland. Finally it sets forth the main technical, organisational and methodological conclusions drawn from the executing the projects.

In line with principle of international cooperation embodied in Phare projects, Empresarios Agrupados has worked with AEA Technology (United Kingdom) and SGN (France) on the first project, subcontracting the services of the Slovak engineering companies DECOM and VUJE. For the second project, currently underway with the participation of the Polish Institute of Atomic Energy (IAE), Empresarios Agrupados is working alongside BNFL (United Kingdom).

## PROJECT NO. 1: "A PLANNING TOOL AND SOME MEANS TO IMPROVE RADIOLOGICAL SAFETY IN DECOMMISSIONING THE BOHUNICE A1-REACTOR"

### BACKGROUND

The A1 reactor is at the Jaslovské Bohunice nuclear complex, located 60 km north-east of Bratislava (Slovakia). It is the first pre-commercial Czechoslovakian reactor. The A1 reactor, with a power of 150 MWe, is a Soviet-designed reactor, cooled with carbon dioxide and moderated with heavy water, was shut down in May 1979 by the authorities after an accident in which the fuel channel was damaged during re-fuelling operations. This caused the partial melting of a fuel assembly, thus releasing fission products into the primary coolant.

The Slovak authorities have decided to decommission the plant over an extended period of a maximum of 80 years. This process began in 1980 and, until now, has essentially consisted of eliminating the direct consequences of the accident, partially decommissioning the plant, constructing waste-treatment equipment, and estimating

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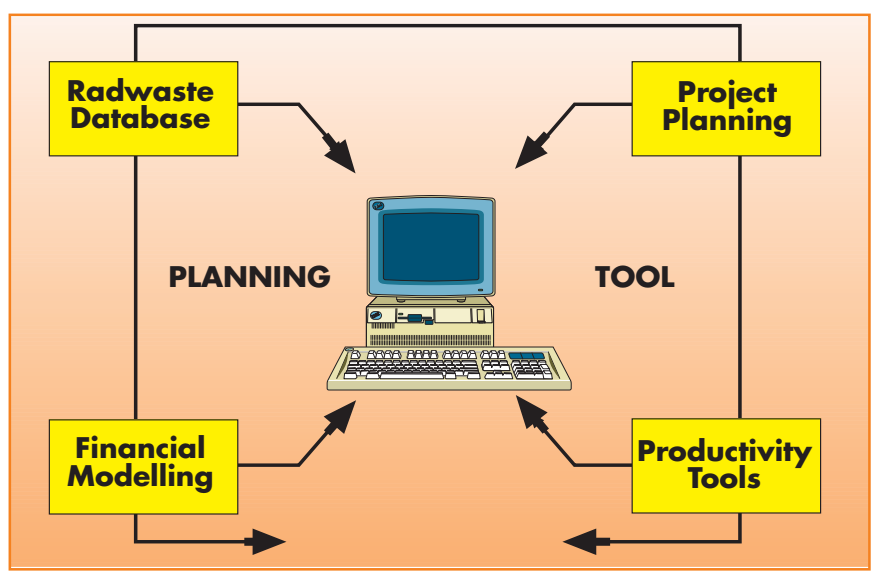


the plant's waste inventory. A long-term overall decommissioning plan has been prepared by the Bohunice decommissioning team.

GENERAL DESCRIPTION OF THE PROJECT

The object of the project was two-fold: 1) to develop and implement a computer-based planning tool for all stages of decommissioning of the Bohunice A1 reactor; and 2) to support the selection of the best options for metal and non-metallic (excluding spent fuel) plant waste management.
The project was divided into four tasks, each approached independently by the different members of the consortium:

1. A planning tool for the decommissioning of the A1 reactor
2. Evaluation of the best options for metal waste treatment
3. Downgrading of waste exceeding limiting values of emitters critical for disposal
4. Storage option for special waste

*Task 1: "A Planning Tool for Decommissioning"*

The aim of this task was to produce a computer application capable of storing and managing data necessary for calculations and estimates, as well as for generating reports such as work schedules, resource allocation, project control, dose calculations, costs, etc.
The computer program, which runs under Microsoft Windows, consists of the four main modules shown in Figure I. The project also involved supplying the computer hardware to run the programme and the training and support required to use it.

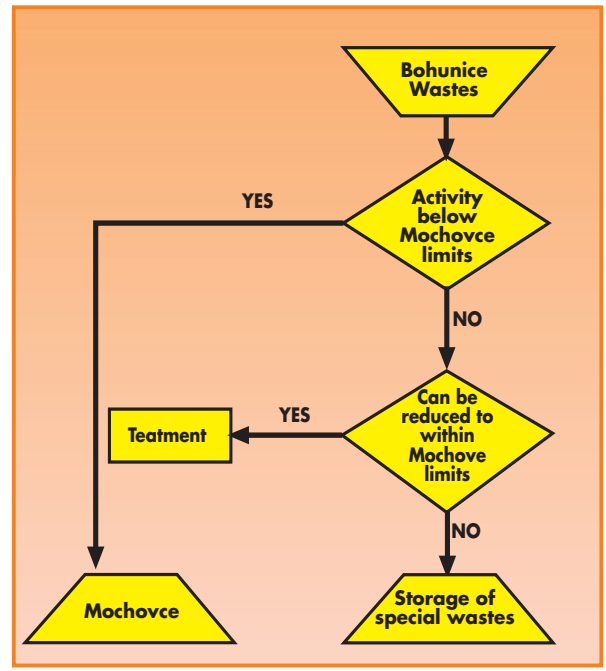
*Task 2: "Evaluation of the Best Options for Metal Waste Treatment"*

Three solutions were studied for managing the almost 2,000 tonnes of metal waste existing at the plant as a result of the first decommissioning operations:

- Cutting metal pieces into small enough pieces to be stored in 200 litre drums
- Purchasing a device for measuring levels of contamination in order to determine which pieces can be cleared, recycled and decontaminated to the levels required for storage at the Mochovce intermediate and low-level activity surface waste repository
- Construction of a furnace for melting pieces of a certain activity. The resulting ingots could be cleared or shipped to Mochovce

The following conclusions were reached:

- The recommended option consists of combining the decontamination of metals with their melting, to be able to recycle most of them later in the nuclear industry
- To do this, an approximately 4-tonne induction oven capable of treating 2 tonnes of metals per hour should be used. It would work in campaigns, and the maximum activity (beta-gamma) that may be melted will be set at 500 Bq/g

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*Task 3: "Downgrading Of Waste Exceeding Limiting Values Of Emitters Critical For Disposal"*

The are non-metallic wastes at the plant with alpha emitting contents that make their storage at the Mochovce intermediate and low-activity surface storage repository inadvisable. This task involved evaluating treatment techniques for reducing the activity levels of as much waste as possible to levels suitable for Mochovce, the costs associated with this and the secondary waste generated.
Slovak legislation was compiled and studied along with international recommendations and those of Eastern European countries and the United States regarding acceptable activity levels at surface repositories. These were compared in order to detect information gaps or significant differences. See Table I.
The non-metallic wastes were classified into 18 streams according to their physical, chemical and radiological characteristics. It was then determined which, from a radiological point of view, were suitable for Mochovce without prior treatment and which, even after treatment, could not be stored at Mochovce. The radiological evaluation procedure followed was that shown in the flow chart in Figure II.
The possible ways of treating the 18 waste streams chosen were studied, estimating their quantities, physical and radiological characteristics and the destination of the final products, the resources necessary and costs. Work schedules for their execution were also established. As a result of this study, it was recommended that one of the streams be filtered and demineralised, discharging the liquid effluent and immobilising the resins and resulting active filters in cement, and that the remaining streams be directly immobilised in cement.

*Task 4: "Storage Option for Special Waste"*

This task arises from the need to manage the special waste generated by the selected non-metallic waste treatment processes described in Task 3. The best option is believed to be the conditioning and long-term storage of waste (50 years) in such a way that they can be moved to a deep storage facility in the future.
Therefore, a solid-matrix cement or bitumen storage facility for drums of waste was

Table I
**OVERVIEW OF ALPHA ACTIVITY LIMITS IN WASTE FOR DISPOSAL**

| COUNTRY | STATUS | ALPHA ACTIVITY LIMIT | REMARKS |
|---|---|---|---|
| France | In operation at La Manche and La Aube | 3.7 GBq/t | Based on average of 0.37 GBq/t |
| UK | In operation at Drigg | 0.74 GBq/$m^3$ | Average in one day's burial |
| USA | Eight sites | 3.7 GBq/t | Special acceptance procedure for type D packages |
| Spain | In operation at El Cabril | 0.185 GBq/t | Based on average of 0.37 GBq/t for disposal site. Special acceptance procedure for packages < 3.7 GBq/t |
| Slovakia | Proposal to Mochovce | 0.079 GBq/$m^3$ of Pu-239GBq/$m^3$ | Based on average of 8.8 x $10^3$ GBq/$m^3$ of Pu-239 for the bunker |

designed. In designing this storage facility, care was taken to take into account the international codes and standards regarding radiological protection, both under normal operating conditions and in the event of accidents (ventilation loss, handling accidents, fire, explosions) at the installations, as well as those regarding possible external events (earthquakes, tornadoes, aircraft crash, etc.).

**PROJECT NO. 2: CLOSING OF THE ROZAN REPOSITORY IN POLAND**

BACKGROUND

CSOP's main radioactive waste repository is a surface repository located in the village of Rozan, 90 km from Warsaw, Poland, which makes use of a former military fortification built in 1910. In 1961, the facility's licence was turned over to the Nuclear Research Institute, which used the repository to dispose of radioactive waste. Currently, the Polish Institute of Atomic Energy (IAE) is in charge of the facility.

The repository, which occupies 4.2 hectares, is located 800 metres from the River Narew and 500 metres from the first homes of the town. Most of the repository is a concrete Military bunker with a 1.2-metre-thick roof, walls of 1.5 m and a 30-cm-thick floor, approximately.

There are seven facilities inside the controlled area of the repository. Five of these are used for waste storage, one for services and offices and another for decontamination. Figure III shows a schematic map of the controlled area of the repository and its facilities.

Solid and solidified intermediate and low-activity waste is stored at the CSOP repository. In all, there are four groups of waste:

- Low-activity wastes, with dose rates ranging from 2 mSv/h
- Intermediate-activity wastes, with dose rates of from 2-6 mSv/h
- Alfa wastes, with dose rates below 2 mSv/h
- Sealed sources, below 74 GBq

Due to strong opposition to the repository from the townspeople of Rozan, the possibility of definitively closing it is being studied. For the time being, those in charge of the facility (the IAE), with the consent of the local community, intend to continue operating it until the year 2000.

GENERAL DESCRIPTION OF THE PROJECT

The object of the project, currently under way, is to carry out the studies required to decommission facilities 2 and 3 of the repository and prepare a Pre-decommissioning Safety Report on them, to be approved by the authorities, as a first step towards decommissioning the entire repository and thus clearing it from the scope of the Polish Atomic Energy Law.

The project has been divided into four phases, listed below. They are being undertaken jointly by the members of the consortium, each with differing scopes of responsibility for the tasks and activities comprising the project.

- Research Phase
- Evaluation Phase
- Decommissioning Plan
- Pre-Decommissioning Safety Report

*Task 1: "Research Phase"*

This first stage involved compiling all information necessary to evaluate the recommended decommissioning method for facilities 2 and 3 of the Rozan repository. The data, supplied by the IAE and compiled into a report after being studied by BNFL and Empresarios Agrupados, refer to:

- The waste stored in both facilities
- The type and characteristics of the containers used for shipping and storing the waste
- The state of the concrete in structures and barriers
- The geology, hydro-geology and geochemistry of the site
- The weather and climate of the area
- The radiological monitoring programme carried out in the zone and its results
- The occupational doses received by installation workers and the estimated doses

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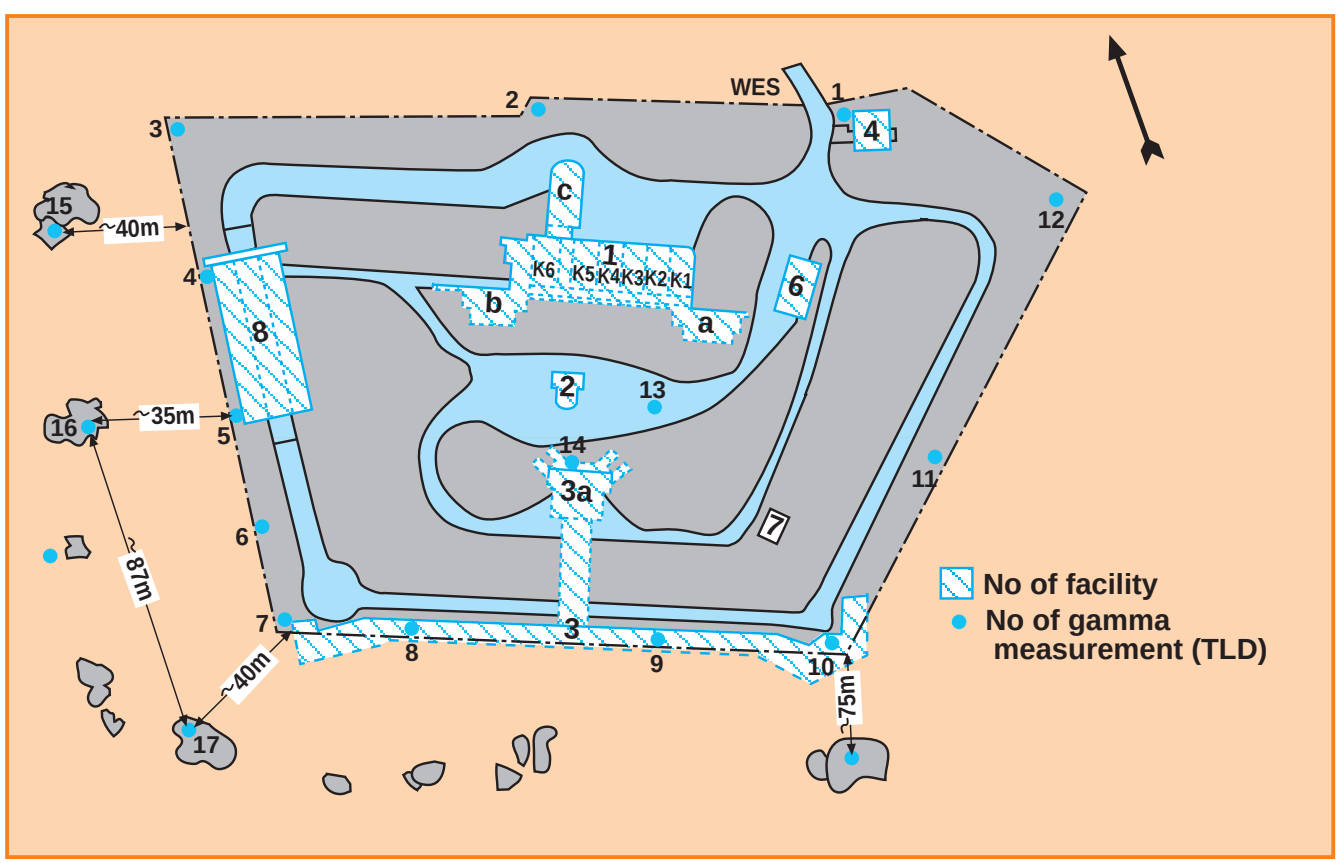


received by the public
- The main Polish legislation and ordinances regarding radiological protection and management of radioactive waste

*Task 2: "Evaluation Phase"*

The result of this task will be a report containing, on the one hand, conclusions on:
- The current state of the structures of the facilities and forecasts of their behaviour in the long term.
- The results of environmental radiological measurements taken and their comparison with acceptable reference levels.
- The characteristics of the packages stored in the installation, their degree of integrity and total volume, and their volume by categories (long-lived, short-lived and exempt waste). The waste will be classified and quantified according to the categories indicated in document IAEA Safety Series No. 111-G-1.1. This classification will be done by comparing the characteristics of the Rozan waste with the reference levels set by the International Atomic Energy Agency (IAEA) in the aforementioned document.

And on the other, the following recommendations:
- Possible short and long-life waste disposal routes, inside and outside the Rozan repository, including the option of storing it in a projected long-term storage facility

Licensing criteria to apply to the decommissioning. Licensing criteria will be defined after a review of applicable Polish legislation, international recommendations and recommendations from relevant Western countries.
- The decommissioning method selected

*Task 3: "Decommissioning Plan"*

Once the most appropriate methods of decommissioning facilities Nos. 2 and 3 have been chosen, the next step was to prepare a decommissioning plan comprising:
- A schedule of the work to be done
- An environmental radiological monitoring programme
- The quality assurance programme to be used

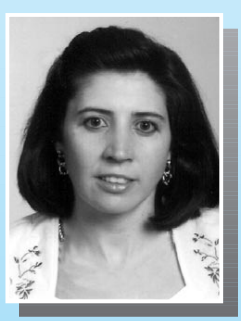
*Task 4: "Pre-decommissioning Safety Report*

The goal of this task is to prepare a pre-decommissioning safety report for facilities No. 2 and 3 of the Rozan repository. This document will be fundamental in obtaining the decommissioning licence from the pertinent regulatory authorities.
This safety report will be drafted on the basis of the studies performed in the previous tasks of the project and, in particular, the decommissioning plan prepared in Task 3. It will comprise, among other factors: a safety assessment of the proposed decommissioning plan, the safety criteria set, the radiological impact on workers and the public, etc.

## FINAL CONCLUSIONS

The following are the main conclusions that can be drawn following this brief description of the two projects:

1. Spanish experience, in particular that of Empresarios Agrupados, has enabled EA to successfully undertake international projects for decommissioning specific nuclear/radioactive facilities.
2. Technical and inter-personal collaboration with companies from other countries specialised in subjects related to waste and decommissioning has been effective, technically advanced and carried out in accordance with methodologies recognised by specialists in this field.
3. The execution of these types of projects has placed Empresarios Agrupados in a very good position internationally when it comes to undertaking projects of this kind, since the company has strengthened its links with leading European specialists and major Eastern European institutions.
4. Although both projects described herein are decommissioning projects funded under the Phare programme and executed by consortia made up of several companies, there are differences between them that should be highlighted, including:
   - The type of installation to be decommissioned
   - The policies of the beneficiary country
   - The make-up of the consortia and those responsible for local support
   - The degree of independence of the main tasks established in the project
5. The existence in a given country of the appropriate legal framework for practices involving radioactive material is a basic starting point and term of reference to be considered in the projects. Therefore, the analysis of the existing legislation of each beneficiary country and its comparison with international recommendations and those of Western countries have been important aspects of both



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*From 1984 to 1990, he also worked in Refueling Outage Support. Since 1987 he has been Project Director, and as of 1992 has taken part in several Eastern European assistance projects.*