

Radioactive waste management and early decommissioning of nuclear facilities in the candidate countries

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1. INTRODUCTION

Over the past ten years, the EU has allocated significant sums of money to finance studies and safety improvements in the field of nuclear safety in these applicant countries. Much of this money has been devoted to safety improvements on nuclear power reactors of older Soviet design. Other studies and assistance projects have helped evaluate the current situation in the field of radioactive waste management. These have produced a clearer picture of what needs to be done in this field to attain an acceptable level of safety and environmental protection, both now and in the future.

With the help of a group of experts from the candidate countries and a small number of experts from EU Member States, the Commission prepared a report on the radioactive waste situation in the Central and Eastern Europe. This report (EUR 19154) was published in 1999 and formed the basis for the radioactive waste management part of the European Union's evaluation of nuclear safety in the context of enlargement. This paper highlights some of the more important issues raised in the report and more recent work.

In the context of the discussions with candidate countries for enlargement, there have been a number of negotiations on early closure of some nuclear power plants.

¹ The views expressed in this paper are those of the author and do not necessarily reflect those of the European Commission

These will soon enter the decommissioning stage. The objective of this paper is not to discuss the background to these closures, nor to limit itself to discussing the issues related to early closure. It will mainly cover the issue of financing decommissioning of nuclear installations – early or not – but with some reference to the problems posed by early closure.

This is set in the context of an evolving Community infrastructure for nuclear safety – including for waste management and decommissioning.

Adoption of EU legislation by candidate countries

In this context it is worth noting that candidate countries are already amending national legislation to bring it into line with the formal legislation of the Union – also known as the Community "acquis". For example, in the field of radioactive waste, the relevant EU legislation under the EURATOM Treaty covers basic safety standards for the protection of workers and the public against ionising radiation and the transboundary shipments of radioactive waste. Under the EC Treaty, Directives require environmental impact assessments (EIAs) for radioactive waste storage and disposal sites and for decommissioning of nuclear power plants. The present degree of harmonising with this legislation varies and is continuously monitored by the relevant Commission services.

2. RADIOACTIVE WASTE MANAGEMENT

The report compiled by the Commission represented a first step in assessing the radioactive waste problems in the candidate countries. The report can be seen as a complement to the information on EU Member States contained in the Communication and Fourth Report from the Commission on the Present Situation and Prospects for Radioactive Waste Management in the European Union.

The radioactive waste management problems described in the report vary considerably in type and severity from country to country, depending on the individual circumstances. There are also differences resulting from the varying

degrees of progress towards institutional and legislative reform. In general, however, the problems can be categorised under the following headings:

- deficiencies in the management of spent nuclear fuel, including that from research reactors;
- insufficient or inadequate treatment and conditioning facilities;
- storage and disposal facilities of unacceptable design and construction, with unknown contents or with insufficient capacity;
- lack of identified disposal sites;
- lack of plans or financial provisions for radioactive waste management and decommissioning of ageing and unsafe facilities, including for the management of the resulting waste;
- uncertainties over the management of spent sealed radioactive sources;
- environmental contamination from past uranium mining and milling activities;
- inadequacies within the institutional, legislative and regulatory infrastructure (generally affecting all of the above)

Time is too short to go into details on these issues, but I would like to highlight one of them now – and a second one a little later as it also concerns decommissioning.

Lack of identified disposal sites

Only the Czech and Slovak Republics have licensed and operating disposal facilities for NPP operational waste. In other countries with operating NPPs, operational waste is being stored on-site at the power plant. Concerning institutional waste, there are operating repositories in several, but not all, of the applicant countries. Some of these sites have accepted NPP operational waste in the past.

Many of these existing disposal facilities were constructed in the 1960s or 70s without a recognised site-selection procedure and have been operated in the past without applying strict waste acceptance criteria or using accepted waste

conditioning techniques. In some instances, facilities were also used for disposal of military waste. As a result, many of these repositories are now considered to be of unsuitable construction and contain inappropriate waste packages with unknown radionuclide inventories.

Some of these disposal facilities have now been closed with the intention of retrieving and repackaging the waste. Others have been closed pending upgrading. Some repositories are still operating as storage facilities, at least for certain waste types, pending further safety assessments or the availability of alternative disposal sites. Other disposal facilities are operational but very close to full capacity. Finally, some facilities are in operation but upgrading is acknowledged to be necessary.

Siting programmes for low and intermediate level waste (LILW) disposal are ongoing in countries currently lacking adequate facilities for NPP or institutional waste, though often these programmes are not far advanced. They suffer from the same problems of public acceptance experienced in the West.

Geological disposal

Expert consensus identifies deep geological disposal as the only acceptable long-term management solution for high-level waste (HLW) or long-lived LILW. The associated costs will be very high and adequate long-term financial planning is essential. The Czech Republic, Hungary and Slovakia have begun siting investigations for a deep repository, but these are still at a very preliminary stage.

Small but significant quantities of long-lived LILW or HLW also arise from decommissioning activities at nuclear facilities and research reactors, including in countries with no operating power reactors (Estonia, Latvia and Poland). In the case of these countries, it is inconceivable that national disposal sites would be constructed for such small amounts of waste, and some form of regional solution, possibly involving exchanges of waste in other categories, would appear to be the only economically viable long-term solution.

3. EARLY DECOMMISSIONING OF NUCLEAR FACILITIES

Decommissioning covers a series of activities, of a technological and regulatory nature, necessary to remove the radiological restrictions that apply to a nuclear installation, once its operational life is declared as terminated.

Normally the life of a nuclear plant is ended on the basis of objective reasons like technological obsolescence, the economical viability of safety requirements, or the enveloping fuel cycle structural limitations.

Nevertheless, there are cases in which the decision to shutdown a plant results from considerations of a purely political or strategic nature. This is the case in countries that have decided on a more or less progressive abandoning of the nuclear option, which will result in the early closure of plants that might otherwise continue operation in compliance with the current regulations. In other cases the decisions taken have involved the abandoning during the construction of plants (i.e. Austria, Spain), well in advance to the delivery of any fuel or radioactive material to the site. In these cases the eventual demolition works cannot be considered as decommissioning, since the radiological implications do not exist.

There is a growing number of nuclear plants (and also other type of fuel cycle installations of the) across Europe are already, or will soon be the object of decommissioning projects. Most of these have reached or are reaching the normal end of their economic life – and some have already exceeded it.

However, some of the candidate countries have nuclear power plants that have been considered as non-upgradable, at reasonable cost, to the level of safety currently practised in the EU countries. The negotiations for accession, on a country by country basis, has specifically addressed the need for the early closure of these reactors – Ignalina (RBMK - 2 units), Bohunice (VVER-440/230 - 2 units) and Kozluduy (VVER-440/230 - 4 units). This early closure will give rise to costs that have not been programmed into the planning of the units.

Costs of early closure

The immediate major impact of early closure is a financial one, due to the loss of electricity production. It is in all cases a relevant share of the country's total (above 40% in Slovakia and Bulgaria, higher than 80% in Lithuania) production capacity.

It is necessary to make clear the difference between what is generally referred to as "decommissioning costs" and the marginal costs resulting of the shutting down of the plant in advance to the expected lifetime, i.e. "early closure costs".

For consistency reasons, it is assumed that a nuclear power plant that is to be closed "early" should be decommissioned to the same level of radiological impact (safety of the activities, volume/activity of waste produced, total dose of workers and public etc) as one that is to be decommissioned at the end of its economical and safe operational life (technological closure).

The difference between the "early closure" and the "technological" closure costs are referred to here as "marginal costs". They would be partially compensated by some marginal cost savings.

The ***marginal costs*** might include:

- higher cost of the substituting electricity (e.g. from fossil fuelled plants).
- financing of new generation capacity (nuclear or conventional).
- financial implications of the early interruption of the decommissioning fund
- modifications to the electrical network, due to changes in topology
- modifications/new infrastructure for energy supply investments
- social impact: reallocation of workers and related industries
- local costs: compensating actions at local/regional level.
- eventual losses due to breach of contracts

Savings, on the other hand, might include:

- less waste to dispose of

- smaller investment/expenses for safety upgrading
- reduced nuclear regulator effort

There are also **other consequences** that might have a real impact in the economy:

- the benefit of the increased diversity of supply
- the need of investing in better energy efficiency
- the loss of nuclear technology capabilities (in particular in Lithuania)
- the "cost" of the "green-house" emissions due to increased fossil fuels burn.

Although the economic impact of the early closure of nuclear power plants varies from one country to another, is in all cases very significant and it has been assumed that it would be hard to bear by these countries on their own. There is wide consensus inside the European Union and with other international actors about the necessity to help the three candidate countries to overcome the negative impact that the shutdown of some of the nuclear power plants will have on their economies. In order to compensate the effects of the closure of the plants, the Commission has allocated specific funds for the financing or co-financing of concrete measures.

The situation of the agreements and contributions, typically through the PHARE Programme, is summarised in the following table.

Country	NPP	Final closure date	EC Financing (2001)
Bulgaria	Kozloduy 1	End 2002	PHARE Contribution to EBRD Fund ² to €200M (2000-2006)
	Kozloduy 2	End 2002	
	Kozloduy 3	2006 ¹	
	Kozloduy 4	2006 ¹	
Slovakia	Bohunice 1	2006	PHARE Contribution to EBRD Fund up to €150M (2000-2006)
	Bohunice 2	2008	
Lithuania	Ignalina 1	Before 2005	PHARE Contribution to EBRD Fund up to €165M (2000-2006) (possibly plus a share of €210M)
	Ignalina 2	2009	

¹ Estimated dates. Final decision to be taken in 2002 in agreement with the EC: The EC understands that closure cannot be later than 2006.

² The European Bank for Reconstruction and Development manages the 3 decommissioning funds for financing of the decommissioning related costs of Kozloduy, Bohunice and Ignalina. The EC is donor to the Fund together with a number of EU member and non-member states.

Lack of financial provisions for decommissioning of nuclear installations and management of the spent fuel and wastes

In the past all the nuclear facilities in the countries of Central and Eastern Europe belonged to the State. It was assumed that the State would, therefore, cover all the costs of decommissioning the nuclear power plants and of managing their wastes. Therefore no separate funding systems were set up.

However, funding will be necessary for decommissioning of the installations and for restoration of contaminated sites. In addition, it will be necessary for conditioning and disposal of existing wastes, for wastes being generated now and wastes generated in the future. Furthermore, spent nuclear fuel from both power reactors and research reactors will also be a liability that must be covered.

The costs of all the above are so high that, even in those candidate countries that have a history of collecting revenue from the electricity production, it is unlikely that many of the historical costs can be more than partially covered. In some countries, it is even unlikely that future costs will be fully covered. While it is vital that financing schemes are set up to cover “new” wastes and decommissioning costs, it is clear that, in most instances, the State will still have to assume responsibility for at least some of the costs. This does not just concern the costs resulting from earlier operations but also some decommissioning costs. International assistance can help initiate or support some of the work but cannot be expected to cover the costs of all the activities.

Already, even for those nuclear plants that will close soon, efforts are needed to reduce waste arisings at source through improved operational practices. This is one of the basic principles upon which modern waste management practices are founded. In Western Europe, the incentive for making such reductions in waste

arisings has largely been driven by the high cost per unit volume of waste management and the general application of the "polluter pays" principle. Funding for decommissioning and the long-term management of radioactive waste should be guaranteed through financing schemes.

In the candidate countries, such schemes have only recently been introduced. They are usually based on Government controlled segregated funds. Though these countries are in general adopting the principle that the "polluter pays", there may be a question mark over the adequacy of some of the new funds. Of course, the adequacy of the funding will be determined, to a large extent, by the length of time the power plants remain in operation.

4. CONCLUSIONS

If not adequately managed, radioactive waste can pose potentially significant threats to man and the environment. The measures necessary to alleviate these threats require not only allocation of financial resources, but also strong systems of regulation and control and a well developed safety culture. In recent years, very significant progress has been made in these areas in the candidate countries. However, in a number of instances, there is still some way to go.

Internationally accepted principles assuring the protection of man and the environment, both now and in the future, form a basis for nuclear practices. This is true for both management of spent fuel and radioactive waste and for decommissioning of nuclear installations. These fundamental principles are largely being respected in EU Member States – though even here there are important delays in advancing to geological disposal of high-level and long-lived waste. In the candidate countries, more progress is still required in some areas before the region as a whole can make the same claim. However, we feel that there is every chance that, in most instances, this progress can be achieved by the time of their planned accession to the EU. Where these do not already exist, the candidate countries need to develop their long-term management programmes and make real progress towards disposal. They should not forget that their programme should include an important research element.

Concerning decommissioning, in some ways the candidate countries may already be more advanced than our current Member States. This is certainly the case in those countries that have already established segregated, government controlled decommissioning funds. However, in a number of instances, these funds will be far from sufficient to meet all future costs – especially where reactors are closing earlier than originally expected. While some international support may be available, it is clear that this will not be sufficient to cover all future costs so alternative arrangements will need to be foreseen by the national governments.

If I am called upon to summarise our views on radioactive waste management and decommissioning issues in the candidate countries I would put the emphasis on two points: the need for financial resources for radioactive waste management and decommissioning and the need for progress towards establishing disposal facilities. These issues clearly need to be addressed quickly.