

Radioactive Waste Management in Central and Eastern European Countries (CEECs)

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1. INTRODUCTION

As we approach the end of this Millennium, we have many things to celebrate. Some of the most important things occurred ten years ago in Central and Eastern Europe. During the last decade we have learned a great deal about the nuclear programmes of our closest neighbours. We have watched with interest and, we believe, supported them as they have tried to come to terms with the legacy of their past. Now, these Countries have applied to join the European Union. Suddenly they seem geographically much closer. Soon their problems will be our problems. Our interest has, not surprisingly, increased.

The current level of safety in the nuclear sector in the majority of these applicant countries is not considered by many to be as high as that in the present EU Member States, and nuclear safety in general has therefore become one of the priority issues in the enlargement process.

During the period of Soviet influence in these countries there was little evolution in nuclear safety culture, and the practices in evidence in the 1960s were still being applied three decades later. In comparison, the nuclear sector in the West underwent radical changes during this period.

Over the last eight 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.

The radioactive waste problems in Eastern Europe were emphasised in the report produced for the Commission in 1998 by a panel of high-level advisers on nuclear safety. The panel was appointed to review the PHARE and TACIS nuclear safety programmes and to propose future priorities regarding EU assistance in this field. In its conclusions, the panel recommended a shift in focus from pure reactor safety improvements to other aspects of nuclear safety such as radioactive waste management and safe closure of research reactors. They also mentioned specifically the need for continued assistance concerning remediation of uranium mining sites in several applicant countries.

2. REPORT ON THE STATUS OF RADIOACTIVE WASTE MANAGEMENT IN THE APPLICANT COUNTRIES OF CENTRAL AND EASTERN EUROPE

In the light of the need to assess accurately the situation in the applicant countries, the Commission service for nuclear safety asked the responsible authorities in the applicant countries to nominate representatives to attend a meeting in Brussels at the end of 1998.

The group reconvened in September 1999 and it is intended to reconvene it at regular intervals. It should maintain the contact and encourage dialogue on all aspects of radioactive waste management. A small number of experts on radioactive waste from EU Member States also attend these meetings.

The first task of this group was to provide the Commission with reports on the radioactive waste situation in these countries. These reports were compiled and edited, including additional data from other sources where necessary, and published in the Commission report series "Nuclear Safety and the Environment" (EUR 19154).

2.1. Purpose of the report

The report summarises the situation concerning the management of radioactive waste in the applicant countries of Central and Eastern Europe.

The report also represents a first step in assessing the radioactive waste problems in these applicant countries. It will help formulate future Commission strategy in this field during the enlargement process, and provides a necessary benchmark by which to judge subsequent developments in these countries. These developments will be the subject of periodic updates to the present report.

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.

2.2. Structure and content of report

The main topics covered in the report are:

- *Facilities in the country:* This includes storage facilities for spent nuclear fuel from both nuclear power plants (NPPs) and research reactors, and all radioactive waste facilities, i.e. for storage, treatment, conditioning, and disposal. It should be noted that in most of the countries operating NPPs national policies regarding the management of spent nuclear fuel have yet to be defined.
- *Radioactive waste quantities:* The quantities of waste arising, treated, stored and disposed of at the different facilities are listed, if known. Both operational waste from the NPPs and institutional (i.e. non-fuel cycle) waste arisings are included.
- *Legislation and responsible authorities:* This includes a summary of the relevant legislation, regulations and responsible authorities in the field radioactive waste. A brief description of any radioactive waste management financing mechanism is also provided.

- *International assistance and co-operation:* Information is provided on the assistance or co-operative projects in the field of radioactive waste, especially those funded by the PHARE programme or other Commission co-operation programmes.
- *Objectives and priorities:* These include national priorities on the technical, institutional and regulatory levels.

Actual or predicted waste arisings from on-going or imminent decommissioning activities are indicated in the report. These decommissioning activities will be the subject of a soon to be published Commission report.

2.3. Summary of problems highlighted in the report

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)

The above aspects are dealt with in more detail in the following sections.

3. THE MANAGEMENT OF SPENT NUCLEAR FUEL

Power reactors

The management of spent fuel from nuclear power plants (NPPs) became a critical issue in many applicant countries following the collapse of 'take-back' agreements with the USSR. Such agreements not only allowed for the return of the spent fuel, but also meant that reprocessing wastes would remain permanently in the Soviet Union. It is unlikely that future contracts can be arranged under the same terms.

As a consequence of the need to store spent fuel on-site, a number of reactor cooling ponds are reaching saturation, resulting in difficulties during reactor operations. However, steps have been or are being taken in all countries with NPPs to increase the interim storage capacity for spent fuel by constructing additional AFR ('away from reactor') wet or dry storage facilities, or increasing the capacity of existing AR ('at reactor') or AFR storage. These measures may need to be supplemented with additional storage capacity in the years to come, depending on the lifetime of the reactors concerned. All operating VVER and RBMK reactors are affected by these problems of spent fuel storage. (At Kozloduy NPP (Bulgaria), the AFR wet store is currently experiencing licensing problems, and a replacement AFR dry store is under consideration.)

Most if not all countries operating NPPs have still to decide on their long-term strategy regarding spent fuel, i.e. open versus closed fuel cycle (direct disposal versus reprocessing of spent fuel). Only Bulgaria does not currently consider the possibility of direct disposal of spent fuel, though this policy may be reviewed in the near future.

Research reactors

In the case of Soviet designed research reactors, some, but not all, countries made regular returns of spent fuel to the Soviet supplier, but these arrangements all broke down in the late 1980s. Consequently, there are accumulations of spent fuel at all sites (Bulgaria, Czech Rep., Hungary, Latvia, Poland, Romania), and where no fuel has ever been returned these accumulations can be considerable (e.g. > 5000 fuel assemblies at Swierk in Poland).

The vast majority of these accumulations are in wet storage, either in AR or AFR facilities. There is a possibility that a programme of fuel return to Russia could be implemented in the future, though this is far from certain and as yet no financial arrangements have been made.

In comparison, the TRIGA research reactors in Romania and Slovenia still benefit from agreements with the USA allowing the return, cost-free, of highly enriched spent fuel to the USA until May 2006.

The facilities at these sites were not designed for long-term storage of spent fuel. Nonetheless, some of this fuel has been in wet storage for almost 40 years, and there is evidence of cladding degradation. There is also the possibility, in some instances, that the fuel itself, not just the cladding, has suffered corrosion. This is particularly the case with metal fuels. Such problems, and high enrichment levels that could result in criticality issues in repositories, might make some fuel unsuitable for direct disposal

Where the research reactors are likely to remain in operation for several more years (e.g. Czech Rep. and Hungary), it is likely that safety levels can be maintained via the routine maintenance and monitoring of the storage facilities. At other sites, where the general run-down in activities could affect the continuing safe storage, there is a greater urgency to deal with the problem of what to do with this spent fuel. As none of these countries has any immediate plans for reprocessing or disposal of this fuel, the only feasible option would appear to be interim dry storage.

International assistance projects have studied or are studying the problems at most of the sites and recommendations have been or will be made concerning options for the management of spent fuel and decommissioning in general.

4. RADIOACTIVE WASTE MANAGEMENT FACILITIES

Treatment and conditioning

Before 1990, normal waste management practices at NPPs meant that operational waste was simply stored on-site with very little treatment, and all decisions relating to volume reduction, conditioning, long-term storage and disposal were postponed until the time of NPP decommissioning. Even now, waste treatment capabilities at some NPPs are still very rudimentary, relying at best on sorting and packaging of solid waste and ion exchange or evaporation of liquid waste. However, new treatment facilities are being commissioned or planned, which show a trend towards improved volume reduction and conditioning techniques such as compaction or supercompaction and incineration. These include a new waste treatment centre at Bohunice in Slovakia, treatment facilities under construction at Kozloduy NPP in Bulgaria, and additional facilities planned at Cernavoda NPP in Romania.

The other waste treatment facilities in the region are situated in nuclear research institutes, usually in close proximity to research reactors. Though their main role is to treat the site's own waste arisings, they often also treat institutional (i.e. non-fuel cycle) radioactive waste. However, owing to ageing of the plant and lack of reinvestment in the plant infrastructure, the efficiency of some of these facilities is questionable.

Storage and disposal facilities

Only the Czech Republic has a licensed and operating disposal facility for NPP operational waste, though a new facility in Slovakia is currently in the licensing phase. In all 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.

Most 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 on-going 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. Only the Czech Republic, Hungary and Slovakia have begun siting investigations for a deep repository, though these are 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.

International assistance

There has been international assistance in the field of site selection and in topics such as safety assessments of existing repositories. Past or on-going regional PHARE projects have also provided assistance in such aspects as derivation of waste package acceptance criteria, QA and QC procedures and LILW storage methodologies. Training of local staff in various waste management techniques will also be provided by a planned PHARE regional project.

5. LACK OF FINANCIAL PROVISIONS FOR RADIOACTIVE WASTE MANAGEMENT AND DECOMMISSIONING OF NUCLEAR INSTALLATIONS

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 managing the wastes and decommissioning the plants. Therefore no separate funding systems were set up.

However, funding will be necessary for conditioning and disposal of existing wastes, for wastes being generated now and wastes generated in the future. In addition, funding will be necessary for decommissioning of the installations and for restoration of contaminated sites. Spent nuclear fuel from both power reactors and research reactors will also be a liability that must be covered. Finally, the remediation of the large areas suffering environmental damage as a result of mine and mill tailings will be extremely costly (see Section 7 for more discussion of this).

The costs of all the above are so high that, even in the countries operating power reactors and 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 future costs, it is clear that, in most instances, the State will have to assume responsibility for the costs associated with earlier operations.

International assistance can help initiate or support some of the work but cannot be expected to cover the costs of all the activities.

As a complement to the modernisation or upgrading of waste treatment, conditioning and storage facilities, efforts will also be needed to reduce waste arisings at source through improved NPP 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 the long-term management of radioactive waste is guaranteed through a variety of financing schemes.

In the applicant countries with operating NPPs, such schemes are only now being introduced. They are usually based on Government controlled segregated funds. Though these countries are in general adopting the principle that the "polluter pays", there is a question mark over the adequacy and availability of the new funds.

In several countries there are power reactors that will enter the decommissioning phase during the next decade. Detailed decommissioning plans often do not exist, and the countries concerned have, until recently, made little or no financial provisions for the decommissioning or to cover the costs of managing the resulting radioactive waste. . The adequacy of the funding that can be supplied by the radioactive waste and decommissioning financing schemes will be determined, to a large extent, by the length of time the NPPs remain in operation.

Current and planned PHARE projects are concerned with decommissioning studies at Ignalina NPP and Kozloduy NPP, and Commission-funded regional studies have assessed the situation at nuclear installations in other countries.

Concerning decommissioning projects currently in progress, international assistance programmes have addressed some of the problems at sites such as the Bohunice A1 reactor in Slovakia and the Paldiski nuclear naval training centre in Estonia.

6. MANAGEMENT OF SPENT SEALED RADIOACTIVE SOURCES

Spent sealed radioactive sources pose a potentially serious threat to public health. During the Soviet era, a large number of radioactive sources, containing a range of different nuclides including radium, were used widely in the applicant countries. In many of the Soviet style repositories of the region, spent sources were disposed of in borehole facilities, often without any conditioning. More recently, use of radioactive sources in these countries has declined, presumably for economic reasons, and it is becoming more routine to return spent sources to the foreign suppliers.

However, the management of spent sources remains a serious problem in these countries, and two Commission regional study contracts are being organised to assess the situation in the region. Of particular concern are the sources that have become "lost" and are no longer under any regulatory control and those containing radium or other long-lived radionuclides.

7. URANIUM MINING AND MILLING OPERATIONS

Uranium mining and milling operations were widespread in many of the applicant countries, though most have now ended for economic reasons. Since all activities were carried out by nationalised mining companies, the resulting liabilities in each country rest with the State. The only countries not affected are Latvia and Lithuania. The legacy of the uranium mining and milling industry is one of disused mine workings, tailing ponds and low-grade ore or waste heaps, all constituting a very real health or environmental hazard, either through radon emanation or contamination of water supplies. Perhaps the worst affected countries are Bulgaria, the Czech Republic and Romania. Most countries concerned are taking at least some active remediation measures paid for out of public funds. However, in both Bulgaria and Romania there is general lack of internal financial resources for remedial action at affected sites. In Bulgaria, 100% PHARE funding has been arranged to cover urgent remedial work on two tailing ponds.

Projects carried out under the PHARE Multi-Country Environmental (MCE) Sector Programme have studied most aspects of the required remediation in the various countries, with pilot projects at a number of key representative sites. Most of these projects have now been completed, and the results disseminated to the beneficiary and co-beneficiary countries. However, to date there has been very little actual implementation of long-term remedial measures. The scale of the problem is such that full implementation will undoubtedly be very costly, possibly running to several tens of millions of euro for one major site alone. It is important, therefore, that international funding should also be available to assist in the actual remediation work at the worst affected sites. Two co-funding mechanisms are co-ordinated by the Commission. These are the Large-Scale Infrastructure Facility (LSIF) within the PHARE programme, and the Instrument for Structural Policies for Pre-Accession (ISPA). The latter instrument is particularly adapted to such environmental remediation projects, especially when they can lead to early compliance with one of the key Directives in the environmental 'acquis' (e.g. water quality).

8. INSTITUTIONAL, LEGISLATIVE AND REGULATORY ISSUES

Reform of national institutions and regulatory structure

In the centrally planned economies of the region during the period of Soviet domination, all aspects of nuclear power were the responsibility of the State, with no clear separation between regulating and implementing functions. The laws and regulatory systems were found to be inadequate with the emergence of the new socio-political systems, and the countries concerned have therefore entered a period of reform. It is clear that in this process, the goal of earlier accession to the EU has proved a powerful incentive to harmonise legal and institutional systems.

Most countries have now passed new or revised basic legislation in the form of atomic laws or similar. Under this new legislation it is normal for the established nuclear regulatory authority to have responsibility for licensing of nuclear activities, including those involving radioactive waste management and spent fuel. However, to be effective, this new basic legislation must be strengthened by the drafting of robust secondary legislation, e.g. revised and updated radioactive waste regulations, and the formulation of management policies and programmes. This strengthening of the legal framework and

establishing of coherent strategies will take more time and has yet to be achieved in many countries.

The legislative and associated organisational reforms involve a trend to the western-style "classical triangle" of independent waste producer, regulator and waste management organisation (WMO). In this regard, an independent and competent regulator is essential if acceptable standards of safety are to be achieved. However, the regulatory bodies in these countries often had little previous experience in the field of licensing of radioactive waste activities, and were faced with acquiring additional skills and competencies in order to fulfil their new role. For several years, PHARE regulatory assistance projects in all countries of the region have played an important part in transferring Western regulatory methods, including those in the radioactive waste field, and it is important that this and other international regulatory co-operation and assistance should continue.

Regarding the establishing of an independent WMO, those countries demonstrating the most progress include the Czech Republic, Hungary and Slovenia, in which WMO have been created and are expected to assume most if not all responsibilities for the activities in the field of radioactive waste management in the next few years. The WMO in the Czech Republic was set up with direct assistance from a PHARE project and will be described in a later paper.

Adoption of EU legislation

The applicant countries are currently amending national legislation in line with the formal legislative "acquis" from the EU. In the field of radioactive waste, the relevant EU legislation covers basic safety standards for the protection of workers and the public against ionising radiation, transboundary shipments of radioactive waste and environmental impact assessment (EIA) for radioactive waste storage and disposal sites. The present degree of harmonising with this legislation varies and is continuously monitored by the relevant Commission services.

The EIA Directive in particular was the subject of a recent Commission study. This showed that there is already good compliance with this legislation in most applicant countries.

International aspects

The applicant countries should be encouraged to become contracting parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and in general to implement the technical recommendations of the International Atomic Energy Agency and International Commission on Radiological Protection. The ensemble of these international instruments represents a framework for safe nuclear practice, and their adoption by all applicant countries constitutes an essential prerequisite to accepted safe and environmentally sound management of radioactive waste.

At the beginning of May 1999, eight of the ten countries covered in the report had become signatories of the Joint Convention.

9. CONCLUSIONS

In the countries of Central and Eastern Europe the radioactive waste problems are wide-ranging and pose potentially significant threats to man and the environment. The measures that are necessary to alleviate these threats require not only allocation of financial resources, but also fundamental changes in the institutions themselves, in the system of regulation and control and in the underlying safety culture. Though these changes have already begun, it could be several years before the new political and economic systems of the region have matured sufficiently to allow this process of change to be completed.

There is still a lack of local expertise in certain of the current internationally acceptable waste management techniques. A key part of the necessary safety culture is the need for a strong and independent nuclear regulator. Until this is achieved, assistance to regulatory and technical safety organisations will continue to form an important part of the strategy followed by the West.

The scale of the problem at the majority of the radioactive waste facilities has now been established with the help of Western funding and expertise. However, there has been less progress made in the next, more costly, phase of actual remedial action. The countries must realise that assistance programmes will not continue indefinitely, and can only make a small contribution to the total cost. Even though co-operation and partnership with the West will remain a crucial element of the West's strategy during the enlargement process, eventually there must be a return to self-help.

Internationally accepted principles assuring the protection of man and the environment, both now and in the future, form a basis for the modern system of waste management. These fundamental principles are largely being respected in EU Member States despite delays in advancing to geological disposal of high-level and long-lived waste. In the applicant countries, more progress is still required before the region as a whole can make the same claim. However, with the right co-operation, advice and cross-fertilisation from the West, there is every chance that this progress can be achieved by the time of their planned accession to the EU.

10. RECOMMENDATIONS

Over the next few years, during the enlargement process, Community activities in the field of radioactive waste management in the applicant countries of Central and Eastern Europe should be guided by a clearly defined strategy.

The aims of such a strategy should be not only to provide essential Western help to the countries concerned but also to ensure that the Commission services have the information necessary to assess the situation. The strategy should seek

- to continue efforts aimed at strengthening the regulatory, institutional or safety culture infrastructure in these countries, for example through existing PHARE and other Commission funding programmes;
- to continue the funding of studies aimed at evaluating the situation at specific sites, especially in those fields in which local expertise is still lacking, such as long-term

safety assessments of existing repositories, risk assessments of contaminated uranium mining sites etc.;

- to maintain and improve the dialogue and contacts between the countries, the Commission services and experts in EU Member States;
- to establish, through the above contacts, a system of regular reporting of the radioactive waste management situation in the applicant countries, running in parallel with the reporting requirements by EU Member States under the Plan of Action;
- to assist in the arranging of co-funding or loans for implementation of actual remedial measures;
- to encourage the transfer of waste management and decommissioning technology from the west;
- to assist in the siting of new disposal facilities, especially for high-level and long-lived waste or spent fuel and to identify future research needs in these areas, especially where these are shared with present Member States
- to maintain the momentum generated by the PHARE Programme concerning remediation of uranium mining sites, specifically by encouraging progression to the implementation phase and assistance to the countries concerned in formulation of ISPA co-funding requests.