



## **The legacy of uranium mining in Central and Eastern Europe — a view from the European Union**

**S. Webster**

European Commission, Directorate-General Environment, Brussels, Belgium

**J. Vrijen**

KARUWEEG BV, Waste Management Consultants, Middelburg, Netherlands

**Abstract.** Throughout the countries of Central and Eastern Europe there was widespread mining and processing of uranium which has left a huge environmental and public health problem requiring urgent remedial action. The present paper outlines the situation from the perspective of the European Union by presenting a description of the assistance provided through Community funding and a summary of relevant European Union legislation in this field.

### **1. INTRODUCTION**

A number of Central and Eastern European Countries (CEEC) are currently in discussions with the European Commission over future membership of the European Union (EU). These countries have come under close scrutiny by the European Institutions in recent years in order to assess their progress in implementing the necessary reforms before accession. Within the EU, environmental and public health issues have gained in importance over recent years, and this is also being reflected in the accession process.

One area of particular concern is the legacy from the extensive uranium mining activities in the CEEC, which includes numerous tailings ponds, low-grade ore heaps and abandoned mines, all posing an actual or potential radiological threat to the local population. The majority of these activities were initiated over 50 years ago by the former USSR for military purposes. In later years, following the transfer of the former USSR military-owned and highly secret companies to national governments, an increasing part of the uranium was used in the manufacture of fuel elements for national nuclear power programmes. Few, if any, environmental remediation measures were undertaken at the affected sites during this period. Furthermore, since the industry was State-owned and managed during the later years of operation, responsibilities for remediation now lie with the respective governments, who are faced with the problem of developing and implementing their own cost-effective programmes to rehabilitate the sites. However, not only are the financial resources in the region limited, but there is also a lack of local expertise in the field of site remediation.

### **2. EU ASSISTANCE**

#### **2.1. PHARE Programme**

The PHARE programme [1, 2] administered by the European Commission is the main channel for the European Union's financial and technical co-operation with the CEEC. In the past, PHARE assistance has been provided to these countries to assess the situation at uranium mining and milling sites and identify the remediation priorities and objectives. More recently, PHARE funding has also been provided for actual implementation of remediation measures at a few individual sites. In line with general PHARE requirements, the projects have all been identified in proposals to the European Commission made by the beneficiary countries themselves.

### 2.1.1. Nuclear safety programme

One of the many multi-beneficiary programmes coming under the PHARE umbrella concerns nuclear safety in the CEEC [3]. Projects in this programme have concentrated mainly on safety aspects of nuclear power reactor operation in these countries. Nonetheless, between early 1997 and the second half of 1998, a project was financed entitled “Preparing remediation at Uranium milling and mining sites in the PHARE countries - provision of means to assess radiological risks”.

The project was aimed at providing beneficiary countries with both hardware and know-how in the field of radioactivity measurement and dispersion via water and atmospheric pathways. The countries involved were Bulgaria, the Czech Republic, Estonia, Hungary, Poland, Romania and Slovenia. The supply of equipment under this project was dependent upon prior approval from the Commission services. One of the principal aims was to harmonize the measuring devices in use throughout the PHARE countries, and to this end a standard package of equipment was offered to each beneficiary. In addition, specialist measuring devices were supplied where specific needs were identified. The contractor, Wismut GmbH / Uranerz GmbH, went on to produce measurement guidelines and provide training in the use of the equipment supplied under the project.

### 2.1.2. Multi-Country environment programme

Most of the PHARE assistance providing for preparatory measures and development of remediation methodologies has been channelled through a Multi-Country Environment (MCE) programme entitled “Remediation Concepts for the Uranium Mining Operations in CEEC” [4].

Though this PHARE MCE programme was under the responsibility of Directorate-General IA (DG-IA) of the European Commission, everyday co-ordination of activities was performed initially by a Programme Co-ordination Unit (PCU) set up in Pécs, Hungary. Terms of Reference were drawn up in collaboration between the Commission, the beneficiaries and the Commission's independent project co-ordinator (KARUWEEG BV) and the projects were contracted following a procedure involving a restricted Call for Tender to a shortlist of interested companies. All companies had to demonstrate the required specialist expertise, experience and ability in the particular field, thus ensuring application of latest technology and current best practice. Involvement of local partners constituted a key aspect of all these projects.

Initially some €12 million was to be spent on this programme over a five-year period. However, owing to restructuring of the whole PHARE programme the funding was discontinued in 1998, leading to the closure of the PCU and the transfer of the remaining co-ordination activities to KARUWEEG BV.

TABLE I. OFFICIAL BENEFICIARY ORGANIZATIONS IN THE MCE URANIUM MINE REMEDIATION PROGRAMME

Country	Beneficiary
Albania	GJEOALBA, Rruga Sami Frasheri 33, Tirana
Bulgaria	Committee of Energy, 8 Triadiza Str., 1040 Sofia
Czech Republic	DIAMO s.p., 47127 Straz pod Ralskem
Estonia	AS SILMET, Kesk st. 2, Sillamae EE2010
Hungary	Mecseki Ércbányászati Vállalat, Esztergár Lajos út 19, 7633 Pécs
Poland	Wrocław University of Technology, Wybrzeze Wyspianskiego 27, 50-370 Wrocław
Romania	Compania Nationala a Uraniului s.a., 68 Dionisie Lupu Street, Sector 1 - Bucharest – 70184
Slovakia	Uranpres s.r.o., Frana Krala 2, 05280 Spisska Nova Ves
Slovenia	Rudnik Zirovski Vrh, Todraz 1, 4224 Gorenja Vas

This premature end to the MCE programme meant that only the first two phases, totalling some €4.64 million, have been completed. Nonetheless, these represent a very successful and worthwhile series of projects.

Access to the results and reports, including the database of liabilities, is subject to the normal rules applying to PHARE projects, requiring the prior approval of the beneficiary and the European Commission. In the case of the latter, there can be no objection to dissemination of the information to as wide an audience as possible. Within the CEEC, requests for information should be therefore, directed to the respective beneficiary organizations listed in Table 1.

#### 2.1.2.1. Part A: Common activities in all CEEC

The first phase (Part A, duration two years), completed in August 1998, involved two regional projects to compile an inventory of and to categorize and prioritize all the uranium liabilities in the countries concerned.

Beneficiary countries: Albania<sup>1</sup>, Bulgaria, Czech Rep., Estonia, Hungary, Poland, Romania, Slovakia, Slovenia

##### **Project no. 1**                      Inventory of all uranium liabilities in nine CEEC.

Contractor	Uranerz, C&E Consult, IWACO
Budget	€1 million
Contracted	July 1996
Completed	July 1997

##### *Main activities:*

- to create a computerized inventory of all uranium liabilities in nine CEEC;
- to collect all essential data in order to ensure that the resulting database remains useful and relevant to the needs of remediation efforts in these countries.

Some 5779 individual or grouped uranium liabilities were identified in the countries concerned, covering some 90 districts and 210 fields. In total, there are 7161 separate objects including 3631 shafts and adits, 1487 dumps (covering a total area of 46 km<sup>2</sup> and with a total volume of 85 million m<sup>3</sup>), 29 tailing ponds (total area 12 km<sup>2</sup>, total volume 104 million m<sup>3</sup>), 11 processing plants, 76 in-situ leaching fields (total area 21 km<sup>2</sup>), 6 heap leach piles and approximately 2000 exploration objects (mainly boreholes).

##### **Project no. 2**                      Data verification, categorization of liabilities.

Contractor	Uranerz, IWACO
Budget	€450 000
Contracted	August 1997
Completed	August 1998

##### *Main activities:*

- to verify the quality of the inventory database;
- to categorize the uranium liabilities;

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<sup>1</sup> Although qualifying for assistance under the PHARE Programme, Albania is not an EU applicant country.

- to assess and categorize the environmental and health impacts of these liabilities;
- to make a compilation of relevant legislation / guidelines in the CEEC, and compare with those in EU, USA, Canada and Australia;
- to rank and prioritize the liabilities;
- to identify suitable pilot projects for inclusion in Part B of programme and to draft the Terms of Reference for three of these projects.

Of the 5779 liabilities, some 831 had sufficient data to warrant inclusion in the subsequent categorization and risk ranking exercise. These constitute the bulk of the major liabilities, for which about 90% of the required data are present in the database; this was considered sufficient to enable a meaningful comparative analysis to be performed. The screening was via statistical methods and expert opinion.

#### 2.1.2.2. Part B: Pilot projects

The second phase (Part B, duration 2.5 years) consisted of seven pilot projects to provide technical assistance and specific training in the development of remediation strategies for the types of environmental remediation problems occurring frequently in the CEEC, with the emphasis on particular cases at specific sites. Another important objective was to stimulate the development of the national remediation programmes and support co-operation between the countries involved. For each project, at a specific site most of the other countries in the programme had co-beneficiary status, thus ensuring the maximum dissemination of information and sharing of expertise throughout the region. To this end, all pilot projects involved workshops attended by the co-beneficiaries.

The project proposals coming from the beneficiary countries were, in the first instance, evaluated and ranked by the PCU before passing to the programme's Steering Committee for approval. This led to the acceptance of four pilot projects, and Terms of Reference for three of these were drafted by the contractor in Part A of the programme. Later, three further pilot projects were approved by the Steering Committee. For each project the final Terms of Reference had to be approved by the respective beneficiary and a Pilot Project Guidance Group (PPGG) was established by the Steering Committee. The resulting seven pilot projects are described below.

#### **Pilot project no. 1**                      Technical planning of long-term stabilization of tailing ponds.

Host country	Hungary (Pécs)
Contractor	Wismut, C&E Consult
Budget	€450 000
Contracted	May 1998
Completed	May 1999

#### *Main activities:*

- to develop criteria and identify key parameters for a systematic approach to the stabilization of the sludge interior of uranium tailing ponds in the CEEC;
- to apply this approach to the planning of the necessary measures for the long term stabilization of the tailing pond No.1 in Pécs.

#### **Pilot project no. 2**                      Prediction of the development in time of the water balance of a tailing pond.

Host country	Czech Republic (Dolni Rozinka)
Contractor	Wismut, C&E Consult
Budget	€390 000
Contracted	May 1998
Completed	April 1999

*Main activities:*

- to define specific criteria for long term control of the water balance of tailing ponds, key parameters for a systematic approach to the development of a water balance and requirements for monitoring systems that can be applied to the remediation of all tailing ponds in the CEEC;
- to develop a suitable water management model;
- to list appropriate technologies for the treatment of contaminated water from uranium processing plants;
- to apply the above-mentioned approach to the planning of the measures for water management at the Rozna K1 tailing pond in preparation for further remediation activities.

**Pilot project no. 3**

Technical planning of underground mine rehabilitation.

Host country	Romania (Banat Region)
Contractor	Dames & Moore (Manchester, UK and Paris offices)
Budget	€450 000
Contracted	August 1998
Completed	October 1999

*Main activities:*

- to define all relevant physical, chemical, hydrogeological and hydrological key parameters characterising the conditions and the consequences of uranium mine flooding;
- to define specific criteria to be met over the long term and applicable in the remediation of uranium mines in the CEEC;
- to develop a systematic methodology for the planning of the flooding of underground uranium mines in the CEEC;
- to apply the methodology to the technical preparation of the remediation of the Ciudanovita mine in the Banat Region (SW Romania) and to provide a technical plan for the close-out of the mine, outlining the technical measures required to reduce the impact of mine flooding on the environment.

**Pilot project no. 4**

Concept and design of reshaping and covering the Sillamae radioactive tailing pond, particularly in relation to dam stability problems.

Host country	Estonia (Sillamae)
Contractor	Wismut
Budget	€448 000
Contracted	November 1998
Completed	September 2000

*Main activities:*

- to set up a systematic approach for reshaping and covering tailing ponds including the consequences regarding long term geotechnical dam stability;
- to perform a detailed design of both tailing pond covering and reinforcement, in particular applied to the complicated Estonian tailing pond at Sillamae.

**Pilot project no. 5** Efficiency of former revitalization after uranium mining.

Host country	Slovakia (Spisska Nova Ves)
Contractor	AEA-Technology
Budget	€118 000
Contracted	December 1998
Completed	December 1999

*Main activities:*

- to develop a systematic methodology for the evaluation of the efficiency of historic remediation of uranium liabilities;
- to demonstrate the applicability of this methodology to a selected group of historically (partly) remediated uranium liabilities near Novoveska Huta.

**Pilot project no. 6** Development of a comprehensive method for the impact assessment of smaller uranium liabilities and its application on the radiological effects created during uranium exploration in Albania.

Host country	Albania (various sites throughout country)
Contractor	AEA-Technology, UK
Budget	€185 000
Contracted	December 1998
Completed	September 2000

*Main activities:*

- the development of a systematic method for the assessment of the impact of smaller uranium liabilities in the CEEC on public health and the environment;
- the field application of this comprehensive method to assess the impact of the uranium liabilities in Albania.

**Pilot project no. 7** Management and clean-up of ground and surface water polluted with radionuclides as a result of uranium mining and processing activities in Buhovo area.

Host country	Bulgaria (Buhovo)
Contractor	Harress Pickel Consult (German office, Köln)
Budget	€414 000
Contracted	December 1998
Completed	December 1999

*Main activities:*

- to develop a methodology for effective management of both the contaminated and non-contaminated waters in the area, either already affected or liable to be affected by uranium mining and milling activities, leading to a computer-aided system of decision-making enabling improved management support;
- to implement this methodology as a pilot trial in the Buhovo area;
- to develop, using the results of this pilot trial, a detailed plan of action for environmentally sound water management around Buhovo and to prepare the Terms of Reference for the necessary detailed engineering of the required technical work.

### *2.1.3. Funding of implementation projects*

With the completion of these pilot projects, the MCE programme has now come to an end. It is expected that the momentum afforded by the acknowledged success of this programme will enable a more rapid transition to the next, and more costly, implementation stage. Estimates of remediation costs vary, but will probably amount to some tens of millions of euro per major site. Though this is often beyond the means of State budgets, other possibilities of funding and co-funding from EU financing mechanisms do exist.

The PHARE Large-Scale Infrastructure Facility (LSIF) [5] is currently co-funding remediation measures at the tailings pond at Sillamae, Estonia. The overall project, managed by the Nordic Environment Finance Corporation (NEFCO), is costing a total of €20 million of which €5 million is from PHARE/LSIF and €8 million from Estonian State funds, with the remaining funding from NEFCO and other international donors. The remediation measures to be applied are based on the results of the corresponding PHARE MCE pilot project (no. 4).

PHARE is also funding urgent environmental remediation of the tailing pond at Buhovo, Bulgaria. This investment project, for a total of €3.8 million, is one component of a wider programme managed by the Ministry of Environment and Waters as part of the National PHARE Programme for Bulgaria. Again, the work is based on the results of previous PHARE MCE studies (pilot project no. 7), and is to eliminate the risk of contamination of downstream waters with radionuclides seeping through the tailing pond dam and to take measures to prevent dam failure.

In a separate project at another site in Bulgaria, the complex tailing pond at Eleshnitsa located in the mountains upstream from the Greek border is the object of remediation funding as part of the PHARE Cross-Border Programme with Greece. The complete package of funding, approved in May 1999, totals some €25 million covering several sectors and involving various beneficiary institutions. The uranium mining sector comes under the responsibility of the Bulgarian Committee of Energy, for which PHARE will provide co-financing totalling €12 million for activities related to the closure of the uranium mines at Eleshnitsa and Dospat. The project will ensure full compliance with relevant European Union water and waste directives.

## **2.2. Instrument for Structural Policies for Pre-Accession (ISPA)**

The Instrument for Structural Policies for pre-Accession (ISPA) [6, 7] is the European Commission's principle co-funding mechanism to assist the ten CEEC in adapting their environmental and transport sectors in view of accession. Applications for co-funding under this programme need to identify clearly the connection with fundamental EU legislation in the field of environment or transport; in the case of environmental projects this usually means demonstrating a link with EU legislation in the area of water or air quality or waste management. For example, uranium mining remediation proposals would normally make reference to the criteria in the new Drinking Water Directive (see Section 3).

However, there is considerable demand for funding in this sector and it remains to be seen exactly what priority is placed on uranium mining remediation projects by the countries themselves. At the present time there are applications either planned by or already submitted from the Czech Republic, Hungary and Romania.

In the case of both PHARE/LSIF and ISPA, the success of the PHARE MCE Programme is evidenced by the willingness of the competent authorities in the countries concerned to structure their applications around the results and recommendations of the respective pilot projects.

## **2.3. DG-Environment's co-operation programme**

Through its general concern for issues of nuclear safety and radioactive waste management in the CEEC [8], the DG-Environment is also becoming increasingly involved in the problems of uranium

mining waste. As a result, a small number of projects in this field have been and are being funded within DG-Environment's current Co-operation Programme in the field of radioactive waste, decommissioning and nuclear safety.

The most significant project to date involves co-funding of remediation measures at the last remaining tailing pond in Poland situated at Kowary in Lower Silesia. The contract was signed in March 2000 and the EC contribution will be €300 000, which is estimated to be one third of the final overall cost for complete rehabilitation of the site. Though the tailing pond is of small dimensions there are nonetheless fears regarding the dam stability owing to the steep-sided nature of the valley in which it is situated and the possible erosion by the adjacent mountain stream during times of heavy rainfall. Important input for the design stage of this project has also come from the Estonian MCE pilot project (no. 4). The EC contractor, responsible mainly for the design and construction of the pond cover, is G.E.O.S. Freiburg mbH, Germany. Work is due to be completed towards the end of 2001.

DG-Environment has also recently funded an important assessment of the numerous surface liabilities in Banat region of Romania using methodologies developed in the PHARE MCE programme (pilot projects nos. 5 and 6). The contractor in this case was the Romanian mining institute ICPMRR (Institutul de Cercetare si Proiectare Pentru Metale Rare si Radiocative SA), and the work complemented that performed in the corresponding MCE pilot project (no. 3). The results constitute invaluable basic data for the planned remediation work, and are considered essential input in any subsequent application for ISPA funding. In a follow-up to this work, another contract has now been signed with ICPMRR to perform a similar assessment of the surface liabilities near Barzava village in Arad County, Romania. The waste rock piles in question are in very close proximity to neighbouring dwellings and have undergone no remediation since they were deposited there more than 30 years ago.

Following the recent incident in Romania involving the collapse of the dam at the "Baia Mare" goldmine, DG-Environment is also becoming increasingly concerned by the environmental threat posed by all old mining sites and tailing ponds in general. This is likely to result shortly in new legislative initiatives in this area, though it remains to be seen to what extent uranium mining is also covered.

### 3. EU LEGISLATION

The principle items of EU legislation relevant to remediation of uranium mining sites include:

- *Basic Safety Standards Directive* - Council Directive 96/29/Euratom [9] of 13 May 1996 lays down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. The origin of these measures lies in the provisions of Chapter 3 of the Euratom Treaty [10]. The Directive presents the most recent set of basic safety standards, and effectively transposes into law the recommendations of ICRP 60. Member States had to comply with the provisions of this Directive by 13 May 2000. Ongoing uranium mining is included in the scope (Title II) of the Directive, and the legislation therefore provides protection to the workforce and public against the radiological threat from related activities. Past mining practices are also covered by the Directive (Art. 48), but not to the same extent as current mining activities. Article 53 of the Directive, concerning past practices, regulates only intervention measures (like demarcation of the site, monitoring of exposure, etc.). Remediation measures themselves are not regulated, and the Directive does not contain any specific binding target values in this respect. However, the Commission has recently published a report [11] giving guidance for remediation projects from the radiation protection perspective.
- *Drinking Water Directive* - Council Directive 98/83/EC [12] of 3 November 1998 on the quality of water intended for human consumption prescribes a total indicative dose of 0.1 mSv/year (excluding tritium, potassium-40, radon and radon decay products) for drinking water. This

Directive entered into force on 25 December 1998, and Member States have two years from this date to transpose it into national legislation and a further three years to ensure that drinking water standards comply with those set by the Directive (i.e. until 25 December 2003). The Directive has specific provisions for monitoring and remedial action in the event that the prescribed limits are surpassed. The provision of this Directive will have direct relevance to remediation at affected sites.

- *Landfill Directive* - Council Directive 99/31/EC [13] of 26 April 1999 on the landfill of waste entered into force on 16 July 1999 and EU Member States have two years from this date to transpose it into national law. The Directive does not cover landfills that have already been closed before this date. Also, it is not clear yet whether or how the Directive will apply to waste at uranium mining sites (mill tailings, low-grade ore heaps etc.), and the applicability to these mostly historic mining and milling deposits may need to be established on a case by case basis. However, assuming the Directive will also apply in these cases, there are minimum requirements that must be respected concerning protection of soil and water (e.g. maximum permissible permeability and minimum thickness of covering mineral layers). No matter what the applicability, the Directive does appear to provide good guidelines for planning, licensing and implementing of remedial measures.

These legislative items form just a part of the body of radiation protection and environmental legislation to be adopted by the applicant countries before accession to the EU. Further reading on all these aspects can be accessed via the DG-Environment Internet site [14].

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