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The Long-Term Safety of Uranium Mine and Mill Tailing Legacies in an Enlarged EU

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EXECUTIVE SUMMARY

Six decades of uranium ore exploration, mining milling in Europe has resulted in a considerable legacy of waste rock piles, below-grade ore heaps, and milling residues disposal sites – Uranium Mine and Mill Tailings (UMMT). Following the fall of the 'Iron Curtain' and the drop in demand for uranium from both, the military and civilian side, most European countries stopped their uranium mining and milling activities. Since the late 1980s considerable effort and resources have been invested by the European Union Member States in dealing with the legacies and liabilities from their former uranium mining activities.

The progress made in remediating UMMT sites around Europe up to the end of 2005 was assessed under contract TREN/04/NUCL/S07.39881. At that time many projects were coming to conclusion and since then Romania and Bulgaria have become full members of the EU. Therefore, it was considered timely to update on the results and also to discuss the conclusions and recommendations. Also, the long-term fate of sites remediated, but not fit for free release had not been discussed conclusively in this report.

Broadly speaking the remediation of UMMT sites has two objectives:

1) to interrupt pathways to radiological and to non-radiological exposures
2) to mechanically stabilise the sites against environmental processes, such as erosion by water and wind, earthquakes, intrusion by plants and burrowing animals.

Given that UMMT contain very long-lived radionuclides, the technical solution must remain stable for very long periods of time. The collection of measures that may be put into place to maintain institutional control are commonly dubbed 'long-term stewardship'. Recognizing the managerial, societal, economic and technical challenges for a stewardship programme, a number of statements describing a likely successful programme can be derived:

- it is adaptive;
- it keeps stakeholders involved;
- it builds on engineering with nature;
- and monitoring provides feedback
- it focuses on realistic time frames;
- it allows for economic changes;
- it strives to keeping records 'alive';

A continuing concern is that stewardship programmes may break down, for instance due to disinterest and negligence by the responsible administrative organisations or in the wake of economic disorder or war. Supposing that international organisation may have a higher resilience against such changes, one may consider to entrust a suitable organisation with the safekeeping of information on UMMT sites so that institutional control and stewardship can be rebuilt. Currently there are two candidate organisations in Europe: the IAEA and the European Commission. The IAEA does have the advantage to have already in place a legal and organisational framework for maintaining the relevant information, namely the 'Joint Convention', while the EC is in principle endowed with suitable executive powers.

The history of national and international rules and regulations applicable to uranium mining is complex and reflects its development over the past six decades. Several rather different regulatory regimes have their bearing on uranium mining and milling activities. The close interrelations with the defence sector, where usually a different set of rules and

regulations applies, adds an additional dimension to the problem. Uranium milling facilities are normally 'regulated practices' under the respective national nuclear or atomic energy laws.

The field with one of the longest histories of international harmonisation efforts is radiation protection, culminating in the issuing of the Basic Safety Standards (BSS) of both UN-related organisations plus OECD-NEA, and of Euratom. In more recent years environmental impact assessment (EIA) emerged as a tool to control and license complex activities and facilities that may impact the environment (Directive 97/11/EC). It was not until very recently, however, that international regulations have addressed mining related issues (Directive EC/2006/21). In addition a range of UN conventions, such as the Aarhus convention and the Espoo convention, describe the governance regime for the planning and operation of facilities that my have environmental impacts.

Report TREN/04/NUCL/S07.39881 formulated a number of recommendations that have been reviewed in the light of developments since 2005:

Ad Recommendation 1: Portugal has made good progress in tackling the UMMT legacies, while the UMMT facilities in Romania appear to be still part of an ongoing production concern, rather than being a legacy.

Ad Recommendation 2: The recommendation to provide financial aid in order to trigger remediation can be qualified by suggesting targeted support based on risk assessment.

Ad Recommendation32: It is likely that the participation of key personnel from the institutions in charge of UMMT in international activities such as UMREG is more effective in assuring quality through peer review than formal QM procedures. Formal QC procedures on the other hand are now standard engineering practice in virtually all EU Member States.

Ad Recommendation 4: In order to provide a back-up in case of failure of national institutions in long-term stewardship programmes, the Commission might consider to act as a clearinghouse or repository for information on UMMT sites.

Ad Recommendation 5: This recommendation concerning harmonisation of standards and the application of the EIA Directive 97/11/EC was somewhat confused. The present report deconvolutes the issues and makes some more qualified recommendations.

Ad Recommendation 6: This recommendation concerned the effect of the 'Mining' Directive EC/2006/21, but this Directive explicitly excludes UMMT from its scope. The Commission might want to look into drafting a complimentary tool for UMMT, but needs to consider the current activities to establish a 'code of best practices' for the uranium mining industries world-wide, supported by WNA, the OECD-NEA and the IAEA.

It should also be considered that report TREN/04/NUCL/S07.39881 was still drafted under the implicit paradigm that uranium mining might cease with dwindling demand due to nuclear power generation being phased out in many countries. The likely 'nuclear renaissance', however, will shift the interest from a mere managing legacies from the past to preventing the creation of future liabilities.

Introduction

Six decades of uranium ore exploration, mining milling in Europe has resulted in a considerable legacy of waste rock piles, below-grade ore heaps, and milling residues disposal sites – Uranium Mine and Mill Tailings (UMMT). While these legacies are much smaller in extent and volume than those resulting from other types of metal or coal mining, the considerable levels of radioactivity that may be associated with them can be of concern. Nevertheless, it should be noted that not only UMMT contain radioactivity, but not infrequently comparable residues from other mining and milling processes too. These are commonly dubbed with the term Naturally Occurring Radioactive Materials (NORM).

The management of UMMT differed in general from the management of comparable materials from other extractive industries due to the fact that uranium was considered a commodity of strategic importance and closely linked to (national) defence interests. This strong link to the military complex and the resulting priority of production has in some of the Member States removed these mining activities from the control of civilian environmental and other authorities. Thus the inevitable legacies of a mining industry have became liabilities that have to be addressed.

Growing environmental concern as well as national and international legislation being developed in Western Member States from the early 1970s onward has led to some of these liabilities from extractive industries being addressed. The scope and extent of such liabilities in the Eastern European Member States has only become apparent after the fall of the Iron Curtain at the end of the 1980s. Traditionally very little was done to decommission and make safe the legacies from any kind of extractive industries. A practice that was promoted by the fact that mines often are removed from populated areas and in the consequence there was little pressure on making the land fit for re-use or to undertake cosmetic remediation; within a few years nature would 'take over' the sites again anyway.

To date considerable effort and resources have been spent by the European Union itself (e.g. under the PHARE programme) and its Member States on dealing with the legacies and liabilities from their uranium mining activities.

Rationale

The progress made by the end of 2005 in remediating UMMT sites around the European Union Under was assessed by VRIJEN *et al.* (2006) under contract to the European Commission. At that time of data collection several major projects were coming to conclusion and since then Romania and Bulgaria have become full members of the EU. Therefore, it was considered time to update on the results from the study and also to discuss their conclusions and recommendations in the light of Directive 2006/21/EC coming into force. Finally, the long-term fate of remediated sites that are not fit for free release had not been discussed conclusively in the report by VRIJEN *et al.*

This report now offers some thoughts on long-term stewardship based on current international thinking and recommendations.

In order to provide a common basis for discussion, in the following some general thoughts on remediation objectives and long-term stewardship are developed. It was also

considered helpful to discuss the current system of EC Directives and UN Conventions in their applicability to legacy UMMT sites.

Remediation Objectives

Broadly speaking the remediation of UMMT sites has two main objectives, namely:

1) to interrupt pathways of radiological and of non-radiological exposures

2) to mechanically stabilise the sites against environmental processes, such as erosion by water and wind, earthquakes, intrusion by plants and burrowing animals.

The main potential exposure pathways for radionuclides originating from UMMT include ingestion via drinking water or plants, airborne dust inhalation, and direct radiation.

Typical measures to interrupt pathways are liners and cappings. The installation of liners generally is not possible in remediation cases, as this would involve the removal and re-emplacement of large volumes of residues. Hence in practice, lining is only feasible for newly constructed facilities. In most cases a capping is sufficient to keep out the main vector for radionuclide releases into the ground, the infiltrating rain water. The cappings are also designed to prevent dust generation and radon exhalation. In addition certain design elements in the cappings, such as rubble or gravel layers and geotextiles, help to discourage burrowing animals and the penetration by roots.

During the operational phase the contours of waste rock piles and retaining dams are usually chosen so as to minimise the footprint of the facility, to maximise their holding capacity and to minimise the amount of foreign material to be used in their construction. Other design considerations, such as earthquake stability, may also play a role. However, the design base is the operating time horizon and it is implicitly assumed that the retaining structures can be maintained throughout this time horizon. The much longer time horizon after closure requires a different design base, considering events that are less frequent, but of possibly greater magnitude, e.g. more intense rainfall events or higher flooding levels. In addition, it is probable that only less maintenance at less frequent intervals will be undertaken. Therefore after closure, UMMT facilities are re-contoured with shallower slopes and with a view to optimise drainage from the whole area by gravity alone, that is without having to take recourse to pumping. It is unavoidable that these measures result in an increased footprint of the facility.

Unlike for high-level radioactive waste repositories, the design-life of facilities for managing residues from the extractive industries, including UMMT, is not usually specified explicitly. The only life-time specific criteria are that the facilities have to withstand certain environmental events of a specified magnitude and frequency. Thus they may be required to withstand, for instance, a flooding event of a magnitude that is estimated to re-occur only within a 100 year time-frame. Such a statement implies that the design-life of the facility is around (a few) 100 years, assuming also implicitly that it is maintained appropriately. Given that our quantitative database for judging the magnitude and frequency of environmental events spans at best only about 150 years, it is clear that design-lives of (near-)surface structures beyond the 100 year time-span become very speculative.

The majority of designs in civil engineering tacitly assume periodic maintenance, even though the maintenance intervals may be measured in decades only. In any case monitoring is required with inspection periods in the order of (several) years. In other words, such designs require institutional control for maintaining their integrity.

Long-term Stewardship Issues

The collection of measures that may be put in place to main institutional control over radioactive waste management sites is commonly dubbed 'long-term stewardship'. It is easy for the regulator to impose institutional control requirements, but the design and implementation of an appropriate stewardship programme is by no means trivial. The discussions of what constitutes an effective stewardship programme were initiated in the context of deep geological disposal, though in fact there the inherent needs are much less obvious than in the case of UMMT sites. Consequently, in recent years this subject has also been brought up in the context of uranium mining and milling facilities. Thus it was a topic of UMREG (2005) and the IAEA developed a technical report on this subject.

In essence IAEA (2006) concluded that it would be futile to try to develop a stewardship programme for a time horizon that goes beyond three generations, i.e. beyond about 100 years.

Making predictions for economic or even social systems naturally involves large uncertainties; uncertainties that vastly increase as the time horizon increases. Managing the risks arising from these uncertainties is the major challenge in establishing a successful long-term stewardship programme. Stewardship programmes face continuing changes of boundary conditions and processes in all social, technological and economic realms: changing stakeholders, perceptions of risk, state of the art in (remediation) science and technology, societal structures, governance systems, economic circumstances and priorities, etc. A successful stewardship programme will be a programme that has the inherent capability to adapt to these changes.

The emergence and increased adoption of the concept of life-cycle management in many areas of human activities calls for the early consideration of possible stewardship issues. It is typically a requirement in the licensing procedure for new practices to have already prepared a stewardship plan. In the case of past practices or accidents, planning for long-term stewardship is best undertaken during the clean-up phase. However, it must be recognized that remediation typically proceeds in an iterative fashion and that end states appear to be emerging as the *de facto* result of multiple interim actions.

Recognizing the requirements and challenges for a stewardship programme, a number of statements describing a likely successful stewardship programme can be derived. These challenges concern managerial, societal, economic and technical issues. All these issues are strongly interrelated and need to be considered simultaneously during the decision making process for stewardship.

- **Being adaptive**

It is worth remembering that, although the best solutions for a long term stewardship programme currently known may be implemented, these are almost certain to become obsolete in the future with changing perceptions and improved scientific and technical capabilities. It may be futile to try to anticipate all possible perceptions of future generations. There is an inherent danger in attempting to define stewardship programmes

that are sufficiently broad and all-encompassing to be capable of handling every conceivable eventuality and, perhaps, even inconceivable eventualities. In particular, there needs to be an acknowledgement that it is unlikely that deliberate intrusion can be prevented over the long term. Hence, a stewardship programme needs to have provisions for being adaptive and responsive.

- **Focusing on realistic time frames**

While there may be no direct solutions for maintaining the ability to manage long-term stewardship for thousands of years, focusing on shorter term (100 years or so) solutions will keep people involved in the site, which will allow for the evaluation of the changes that are needed over time. Spending too much energy on trying to solve the problems of the future with the current knowledge may result in missing the opportunity to make the best decisions for the short term and may result in unreasonable or unrealistic solutions. Stewardship plans cannot be static, but have to be adapted to the development of a site, both with respect to its physical state and its use. Periodic revision of stewardship plans will be necessary.

- **Keeping stakeholders involved**

Stewardship, and by inference the steward's responsibilities, must be defined at the practical level of implementation, i.e. from the bottom upwards. To be understandable and affordable, a narrow definition of stewardship is recommended. If an active relationship between the site and the surrounding population can be developed, it becomes likely that the memory of the site and its properties is maintained and hence the stewardship programme will be sustained.

- **Allowing for economic changes**

As for other aspects of a stewardship programme, it is extremely unlikely that a 'permanent' solution will be found for the economic issues, in particular the funding. Focusing on the nearer term and realistically implementable solutions will make the problem more tractable. This approach implicitly relies on a continued interest in the stewardship programme. Finding a new, revenue generating site use for each stage of the stewardship period is likely to help greatly in the support of the maintenance programme.

- **Engineering with nature**

There is a temptation to develop engineering solutions that are perceived to be viable for the whole perceived stewardship period. As historical experience shows, engineering for long term stability poses a variety of challenges and has to cope with many uncertainties. On the basis of these experiences and system analytical considerations, two paradigms for engineering solutions seem to emerge:

(1) Engineering with, and not against, nature;

(2) Designing with a view to minimising the potential energy stored.

In other words, the engineering designs need to minimize the driving forces for unwanted change and to maximize the potential for desirable change. Above ground structures have a considerable amount of energy stored in them that will be released eventually through natural processes, such as erosion. On the other hand, natural processes, such as diagenesis, could be harnessed to foster the development of stable geochemical conditions.

- **Keeping records 'alive'**

It has been recognized that preservation of the physical integrity of records alone is not a solution. Ensuring their readability and comprehensibility even over relatively short periods of time is a challenge. It appears that strategies that keep records 'alive' are the most efficient solution to convey their message to future generations. The same applies to knowledge, where active usage appears to be the best guarantee for its continued preservation and availability.

- **Monitoring provides feedback**

The uncertainty over the long term effectiveness of a remediation solution requires provisions for monitoring, periodic performance assessment and possibly maintenance. It is this uncertainty that leads to the requirement for long term stewardship. While taking remediation decisions, it is important to explicitly consider long term stewardship issues and obligations when examining remedial options and implementing a final remedy.

Summarizing the above discussion, it seems futile to try to develop a stewardship programme and its associated managerial, societal, economic and technical components for the whole period of the envisaged stewardship requirement. Providing, instead, solutions for the foreseeable future with scope for adaptation and development appears to be the way forward.

One may want to built some safeguarding measures against instances where active stewardship breaks down, e.g. in the case of war. One conceivable option would be to entrust an international institution with monitoring stewardship programmes. This would be done under the assumption that such an organisation is above national conflicts and therefore would have higher probability of survival. It would be helpful, if this organisation also be given certain executive powers to enforce actions that are aimed at maintaining or re-instating institutional control.

There are two candidate organisations for such a role in Europe: the IAEA and the European Commission.

The IAEA does have the advantage of having already in place a legal and organisational framework for maintaining relevant information, namely the 'Joint Convention' (IAEA, 1997). Under the Joint Convention Member States undertake to collect and submit to the Secretariat of the Convention, that is the IAEA, information about all types of radioactive waste. So far this has not been done for UMMT to any great extent, but will be done sometime in the future. A suitable existing database tool would be the Directory of Radioactively Contaminated Sites (DRCS, http://www-drcs.iaea.org/). However, the IAEA has no executive powers over its Member States and can merely act as a clearing-house for information.

To the contrary, the European Commission does have executive powers and could provide a legal basis for action, but currently has no instruments and resources in place that would allow collecting and maintaining relevant information.

The present regulatory framework for UMMT

Overview over national and international regulations

The history of national and international rules and regulations applicable to uranium mining operations *s.l.* is very complex and reflects its development over the past six decades. Several rather different regulatory regimes have their bearing on uranium mining and milling activities. The close interrelations with the defence sector, where usually a different set of rules and regulations applies, adds an additional dimension.

Mining is a sector of human activity with one of the longest traditions of very specific rules and regulations, not the least owing to mining being a high-risk activity. Mining also requires considerable capital investment and a specialised work force that both require adequate protection. However, it was not until very recently that international regulations in the form of Directive EC/2006/21 (CEU, 2006) have addressed mining related issues, namely the problem of mining wastes. National mining laws may also cover workplace exposure and safety aspects (see below).

Another set of applicable rules and regulations pertains to (civil) engineering safety. In national regulatory systems there is often an overlap between the realms of classical civil engineering rules and regulations and those of mining. Mining is traditionally an area apart form other forms of civil engineering.

Virtually all mines have to deal with groundwater and, indeed, regulations related to the management of mine waters are among the oldest instances of water related rules and regulations. While initially the concern was largely quantitative, i.e. concerning the amounts discharged or abstracted and resulting use conflicts and (economic) impacts, in the past 40 year water quality aspects have also come into focus. Earlier national developments in this area were condensed into the so-called EU Water Directive (CEU, 2000).

A field that has perhaps the longest history of international harmonisation efforts is radiation protection. Radiation protection concepts were first developed by those that handled radiation sources (i.e. radioactive materials and equipment generating and emitting radiation) to ensure that they were protected from harmful effects. International collaboration in this field dates back to the beginning of the respective research. The developments culminated in the issuing of the Basic Safety Standards (BSS) of both UN-related organisations, such as IAEA, ICRP, WHO, ILO, PAHO and FAO plus OECD-NEA, (IAEA, 1996) and of Euratom (CEU, 1996).

Uranium milling facilities are normally ‘regulated practices’ under the respective national nuclear or atomic (energy) laws. Nuclear regulations are typically cross-cutting regulations, covering aspects such as radiation protection, environmental impact, plant safety and security, as well as workplace exposures. In practice they often take precedence over other potentially applicable legislation. Disposal facilities, such as tailings ponds, while they are operational are usually covered by nuclear licenses. Decommissioning and remediation has the objective of de-licensing a site. De-licensing of UMMT sites, however, may have the condition that some form of institutional control remains, ending in a long-term stewardship programme eventually.

In more recent years environmental impact assessment (EIA) emerged as a tool to control and license complex activities and facilities that may impact on more than one

environmental compartment. Directive 97/11/EC (CEU, 1996) now makes EIA mandatory for a wide range of projects – see the more detailed discussion below. EIA harnesses together the assessment of impacts that then will be covered by regulations specific to environmental compartments, such as water discharges, air emissions, noise etc.

Current European Commission Directives in general are designed for application to new projects and not so much for remediation cases. It is not so clear, if and under what circumstances certain Directives would have to be applied to the case of remediation of UMMT. However, a remediation project itself will have a certain environmental impact and its execution, therefore, may be subject to one or the other Directive. Certainly, when off-site waste management facilities are proposed, their licensing would be subject to international legislation.

Below, existing international contractual and legal instruments are reviewed in brief with respect to their potential relevance for UMMT remediation and long-term stewardship projects.

Environmental Impact Assessment - Directive 97/11/EC

The Directive on assessing the effects of projects on the environment was introduced in 1985 (CEU, 1985) and amended in 1997 (CEU, 1997). Member States had to transpose the amended EIA Directive by 14 March 1999 at the latest.

Environmental impact assessment is a procedure that ensures that the environmental implications of decisions are taken into account before such decisions are being made. The process involves an analysis of the likely effects on the environment, recording these effects in a report, undertaking a public consultation exercise on the report, taking into account the comments and the report when making the final decision and informing the public about that decision afterwards.

The EIA procedure ensures that environmental consequences of projects are identified and assessed before they are authorised given. The public can give its opinion and all results are taken into account in the authorisation procedure of the project. The public then is informed of the final decision. The EIA Directive outlines which project categories shall be made subject to an EIA, which procedure shall be followed and the content of the assessment.

Following the signature of the Aarhus Convention (see below) by the European Community on 25 June 1998, the EC adopted in May 2003 Directive 2003/35/EC (CEU, 2003) amending, amongst others, the EIA Directive. The amended Directive intends to align the provisions on public participation in accordance with the Aarhus Convention on public participation in decision-making and access to justice in environmental matters.

An IMPEL report (IMPEL, 1998) explains the complex interrelation between EIA and other international instruments, such as the IPPC (CEU, 1996), the SEVESO Directive (CEU, 2003b) and the EMAS Regulation (CEU, 2001b).

The European Commission also provided a clarification on the Directives' Article 2(3) (EC, 2006) that provides for the exemption of projects from EIA, if for instance, the project is in the interest of national security. Transposition of Article 2(3) into national law is optional as such, its omission resulting in more stringent national EIA legislation.

Annex I to the Directive provides a list of projects that are likely to fall within the applicability of the Directive. According to this list, basically all components of nuclear energy systems will have to be subject to EIA, including the mining of uranium or thorium ores, their processing, the construction of power generation facilities, and activities that are related to the construction and operation of repositories for radioactive waste.

Public Participation – UN Conventions

Two United Nations conventions are addressing the public participation issues arising in the context of projects with potential environmental impact, the so-called Aarhus- and Espoo-Conventions. It could also be noted here that the current FP7 project ARGONA (http://www.argonaproject.eu/) addresses the whole complex of governance in radioactive waste management.

The Aarhus-Convention. The UNECE (United Nations Economic Commission for Europe) Convention on 'Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters' (UNECE, 1998) was adopted on 25 June 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference as part of the 'Environment for Europe' process. The Aarhus Convention links environmental rights and human rights,

— acknowledging an obligation to future generations;

— establishing that sustainable development can be achieved only through the involvement of all stakeholders;

— linking government accountability and environmental protection;

— focusing on interactions between the public and public authorities in a democratic context and

— forging a new process for public participation in the negotiation and implementation of international agreements.

The Convention promotes government accountability, transparency and responsiveness, granting the Public rights and imposing on contracting parties and public authorities obligations regarding public participation and access to information as well as justice. However, the Convention also contains a number of other important general features.

To be in compliance with this convention, it is likely that any long-term stewardship plans will have to undergo a public consultation.

The Espoo (EIA) Convention sets out the obligations of contracting Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. The Convention was adopted in 1991 and entered into force on 10 September 1997.

The Convention is intended to help make developments sustainable by promoting international co-operation in assessing the likely impact of a proposed activity on the environment. It applies, in particular, to activities that could damage the environment in

other countries. Ultimately, the Espoo Convention is aimed at preventing, mitigating and monitoring such environmental damage.

The Convention ensures that explicit consideration is given to environmental factors well before the final decision is taken. It also ensures that the people living in areas likely to be affected by an adverse impact are told of the proposed activity (UNECE, 2006). It provides an opportunity for these people to make comments or raise objections to the proposed activity and participate in relevant environmental impact assessment procedures; and it ensures that these comments and objections are transmitted to the competent authority and are taken into account in the final decision.

While the Espoo-Convention provides for the opportunity of all affected parties to contribute, the guidelines for implementation (UNECE, 2006) note that it is unclear how this can be effected in an international, transboundary context. This reports cites a case where the same information as for the national stakeholders was made available in translation to equivalent stakeholders in the neighbouring country. Thus for instance, Finland informed the Russian public about a planned new nuclear power plant. The additional costs arising from such undertaking are usually met by the proponent of a project according to the ‘polluter pays’ principle. There may be also instances where the proponent country’s government or an international body (e.g. EBRD) meets such costs.

Considering what is known about existing UMMT sites in Europe, the only site where trans-border effects may occur is the Sillamäe tailings pond in Estonia. Here indeed international exchange of information occurred between the concerned states around the Baltic Sea. All other UMMT are located such that a significant trans-border effect is not likely.

Comments on the Recommendations by Report TREN/04/NUCL/S07.39881 (VRIJEN et al., 2006)

Ad Recommendation 1 – Harmonising of approach and methodologies

"It is recommended to the European Commission to investigate whether and in what manner technical assistance could be provided to Romania and Portugal in order to harmonise their approach and methodologies with those already applied in the other countries in Europe."

Both countries, Romania as well as Portugal, have benefited in the past from financial aid and knowledge-based support from the European Union and the IAEA in order to deal with their UMMT legacies.

As is outlined in Annex I below, Portugal has made good progress with the remediation of its legacies. The work on the main mill tailings pond at Urgeiriça is scheduled to be completed still in 2008 and was undertaken in compliance with international standards and following international guidance. There appears to be no need for further harmonisation of the relevant regulations in Portugal or to foster the application of international standards.

As is outlined in Annex II, the situation in Romania appears to be somewhat different. It continues to be difficult to obtain clear and authoritative information on the status of the UMMT management facilities at Feldioara, which are part of an ongoing uranium ore milling operation. It may need to be investigated by what means (e.g. application of Directive 97/11/EC and of the Aarhus-Convention in case of license extensions) more openness could be achieved, although the submissions to the 'Joint Convention' (IAEA, 1997) go already some way now. While Romania assured in their submission that remediation works are undertaken according to internationally accepted standards and practices, very little authoritative information on the actual operations is coming forward.

Ad Recommendation 2 – Financial support to trigger remediation implementation in countries with weaker economies

"It is strongly recommended to the European Commission to investigate the possibilities for financial support to trigger uranium tailings disposal site remediation for those disposal sites that still have not started the implementation of the remediation measures or where currently available financing for the remediation solutions is so limited that the remediation process is phased over too long a time period."

Given the constraint resources available throughout the Member States for such projects, in particular for orphaned sites, a strict risk-based approach and prioritisation to remediation is needed. Where this has not been done already on a national basis, the European Commission might want to support such risk assessment and prioritisation in selected Member States. Much of the necessary information has been collected already, e.g. in the context of PHARE and by the IAEA, so that work would consist mainly in updating it and assessing the current risk. Based on this assessment prioritisation for some targeted support could be made.

Ad Recommendation 3 – Improvement of Quality Management

"It is strongly recommended to the European Commission to investigate the possibilities to assist countries with a weaker quality management history in their developments to improve the strictness of their procedures and to involve independent experts in the supervision of project implementation."

It is good policy to involve independent experts in the development of solutions for UMMT and in the supervision of their implementation, for instance through peer reviews. Various Member States do this in an informal way by presenting their cases at relevant conferences, e.g. UMREG, UMH (Freiberg), and other fora, e.g. international expert groups, such as those organised by the IAEA. The participation of key personnel in such activities, which exposes them and their work to peer review, is probably more effective than setting up formal overall QM procedures. QM procedures for the execution of actual engineering works appears to be state-of-the-art in most Member States now for public works. In cases where the operating company undertakes the remediation measures itself, the responsible government might want to install some independent review of the works, beginning with the design phase. If the EC funds technical measures, they may want to instigate that formal QM procedures are put in place, which also provides a re-assurance that public money is spent in an efficient way.

Recommendation 3 further discusses long-term stewardship issues. However, as has been discussed above, the problems cannot be solved by formal QM procedures. The problems have to be addressed at a different conceptual level.

Ad Recommendation 4 – Institutionalising long-term site management

"It is strongly recommended to investigate whether a common policy at Community level could be a good tool to support the Member States to arrive at working solutions for proper institutionalising of long-term monitoring, surveillance and maintenance for periods of time of hundreds of years or more. Working solutions that are realistic, acceptable, sufficient, adequate, defendable and not too dissimilar from one another."

The current international thoughts on long-term stewardship beyond a hundred year time-frame have been discussed above. Experts agree that long-term stewardship programmes have to be always site specific, taking into account the nature of the site, local attitudes, economic conditions, existing regulatory framework etc. It may be, therefore, counterproductive for the European Commission to make detailed prescriptions for the implementation of stewardship programmes. The Commission, however, might wish to ensure that such programmes are put in place were needed. As suggested above, the Commission might also wish to act as a supra-national clearinghouse or repository for information about relevant sites with a view to ensure that such information is not lost in the long term. This could be co-ordinated with international activities, such as the implementation of the 'Joint Convention' (IAEA, 1997) and the related database tools (NEWMDB, DRCS).

Ad Recommendation 5 – Harmonising of public involvement and enforcing the application of the EIA Directive to the remediation of uranium mining and milling legacies

"It is recommended to the European Commission to reconsider the current discrepancy in the investigated European countries in EIA enforcement regarding the remediation of uranium liabilities and to aim to make all such remediation activities subject to the obligation to conduct an EIA. Only this will ensure a well regulated and properly balanced two-directional public involvement in key decisions on health and environment issues in the remediation of uranium liabilities."

The rational given for this recommendation in VRIJEN et al. (2006) is somewhat confused, as it actually addresses harmonised regulatory criteria, such as discharge limits, and not the application of the EIA Directive.

The Aarhus-Convention and the Directives 2001/42/EC, 2003/35/EC and 2001/42/EC in principle provide for a harmonised approach to guide remediation of UMMT with full public involvement. All these instruments allow a certain discretion in the way how projects are implemented and take into account Member States' pre-existing regulatory framework. Further harmonisation could only concern the actual implementation of the Directives. In fact, the problem has been recognised and various documents, e.g. EC (200?) and EC (2006) provide further guidance.

One would need to consult with DG-LEX how the application of the EIA Directive to specific cases could be enforced, if at all. However, this must be seen in the more general context of transposing Community legislation into enforceable national legislation.

The harmonisation of reference and limiting values, e.g. for radioactive discharges or exposures, continues to be discussed in various fora. From a purely scientific point of view this discussion is not adding much to the substance, as all of the values chosen to date in Member States are at or below detection levels. The numerical values are often chosen for convenience or political, rather than for demonstrable scientific reasons. There is, however, a public perception problem. The public at a given site may raise the question why the remediation criteria chosen for the site of their concern seem to allow higher residual concentrations or discharges than at other sites. It appears that for public acceptance reasons harmonisation can only move to lower values. Redefinition of criteria may then force Member States to re-assess already remediated cases (as happened in France), possibly resulting in renewed work without adding more real protection. One may consider harmonisation, if it applies to new cases only, but this may also cause public acceptance problems, as the public indeed might demand re-assessment of closed cases. Given the limited financial resources available for the remediation of (orphan) UMMT sites, it may be more efficient to address the open cases as discussed under point 3 above.

Ad Recommendation 6 – Follow-up on the effect of implementing Directive EC/2006/21

"It is recommended to the European Commission to follow-up in what manner implementation of the new Council Directive EC/2006/21, regarding waste management for the ore extraction industry in Europe, will be carried out in those countries that are dealing with uranium mine and mill tailings disposal sites."

Directive EC/2006/21 states:

"(10) Moreover, while covering the management of waste from the extractive industries which may be radioactive, this Directive should not cover such aspects as are specific to radioactivity, which are a matter dealt with under the Treaty establishing the European Atomic Energy Community (Euratom)."

This paragraph seems to exclude UMMT, whether at legacy sites or currently operating ones. It covers, however, wastes from extractive industries that contain NORM.

It may be desirable to develop a Directive similar to EC/2006/21 that addresses specifically the mining of uranium and thorium as part of the nuclear fuel cycle. As the majority of legacy sites have been dealt with already and as the process of developing such Directives is lengthy, it is not unlikely that the remaining legacy sites have been dealt with by the time it would come into force. For this reason the efficiency of developing a Directive that (also) intends to cover legacy sites may be questioned. However, if the processes that we currently experience as 'nuclear renaissance' are sustained, they will result in a substantially increased demand for nuclear fuel and ensuing increases in prices for uranium in particular. Various countries are already reconsidering their decision to close uranium mining activities (see e.g. OECD-NEA/IAEA, 2008). If uranium mines are being redeveloped, then it may become difficult in various instances to distinguish between legacy sites and operating facilities. Licensing procedures for new operations will have to take into account such situation.

Any new Directive covering the front end of the nuclear fuel cycle will need to take into consideration the current activities to establish a 'code of best practices' for the uranium mining industries world-wide, supported by WNA (http://www.world-nuclear.org/), the OECD-NEA and the IAEA.

Conclusions and Recommendations

Current State - It appears that the majority of UMMT legacies in Europe have been made safe and are remediated to acceptable environmental standards. There remain a few open cases, where the respective projects have not been concluded yet, but are well under way. In some cases, notably for Romania, little substantive information on the current state of UMMT facilities and any plans for their closure and remediation are available.

Long-term management needs - While many remediation projects have been concluded in a technical sense, meaning that the necessary civil engineering projects have been completed, their long-term fate is not so clear. Institutional control needs to remain in place and in some cases continuous and active maintenance is needed. Typically, remediation solutions are designed in a way that leachate and run-off waters have to be collected and treated in a plant in order to meet regulatory discharge limits. Such solutions can only be sustained over a time-frame of a few decades at most.

Long-term stability of solutions - Another concern is that UMMT sites are located in high-energy environments, e.g. at slopes or in valleys. While the chosen technical solutions may be safe from a purely engineering point of view and when maintained properly, it is unclear what will happen, if institutional control breaks down at some point in time. Therefore, such sites will remain a liability and a system of long-term stewardship has to be put into place. ***A long-term prognosis and risk rating might useful as a decision-aiding tool for developing long-term stewardship programmes***.

Knowledge preservation - A sustained stewardship programme is an essential, though often only tacitly assumed, element of remediation solutions. To support stewardship, one may envisage a knowledge-preservation tool that has a fair chance to survive the break-down of institutional control at a regional or national level, e.g. in the wake of armed conflict or civil unrest. Such tool could consist of a database that holds pertinent information on UMMT sites. Several Member States have already drawn up databases on a national level and the IAEA has attempted to do this on an international level. ***The European Commission may want to consider building on these knowledge preservation activities***.

Regulatory needs - Considering that the majority of UMMT legacies with a significant risk potential have already been addressed from an engineering point of view, the expenditure of developing a Directive for these cases does not appear to be justified. It may be however, worthwhile to prevent new legacies being created by the dawning nuclear renaissance ***by developing a legal instrument akin to Directive 2006/21/EC that is applicable to operating UMMT sites***.

Effects of a nuclear renaissance - It should also be considered that report TREN/04/NUCL/S07.39881 was drafted under the implicit assumption that uranium mining might cease with dwindling demand due to nuclear power generation being phased out in many countries. The likely 'nuclear renaissance', however, will shift the interest from a mere managing of legacies from the past to preventing the creation of future liabilities.

Externalisation of risk and impact - Another aspect to consider is that the front-end costs of nuclear energy systems in Europe are largely externalised to countries overseas. It is currently predominantly Canada, Niger and Australia, where much of the uranium production takes place. The environmental standards of uranium production in these countries are at internationally acceptable level, though long-term stewardship issues have arisen and will continue to arise there. Moreover is the production in the hands of a limited number of companies, one of which has its headquarters in France, which can be controlled reasonably well. Of concern, however, are 'junior' producers in countries such as Kazakhstan or Mongolia that appear on the market. ***The European Commission may want to look into ways to ensure environmentally sustainable nuclear energy systems and to prevent the creation of future legacy sites from uranium mining around the world***. Similar activities to make (metal) mining activities more sustainable have been undertaken e.g. by UNEP (http://www.unep.fr/scp/metals/mining.htm).

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Annex I - Update on the UMMT Situation in Portugal

Introduction

Since the data collection for Report TREN/04/NUCL/S07.39881 (VRIJEN et al., 2006), considerable progress in the actual implementation of remediation measures at the UMMT sites in Portugal has been made. In the following a short summary of the uranium mining legacies and their current status is given (based on CARVALHO, 2007, and pers. comm. with F. Carvalho, 01.10.08).

The Portuguese Uranium Mining Industry

Mining for radioactive ores began as early as 1908 with the initial focus on radium, uranium being only a by-product. In the wake of WWII and with the advent of commercial nuclear power, focus shifted to uranium and an extensive prospecting programme covered the whole of the country. Active uranium mining and processing took largely place in the province of Beiras in central Portugal and continued until 2001. Some 400 deposits were identified, 120 were studied in greater detail, but only 61 were actually exploited. A central uranium ore mill was constructed at Urgeiriça. Here higher grade ores were processed, while lower grade ores, for which transporting would have been uneconomic, were pre-milled on heap-leaching pads at the respective mines. Consequently the majority of tailings are located in two ponds near the Urgeiriça plant. Heap leaching residues remained near the respective mine sites and are used to backfill open cast mines.

Un-remediated mining residues and unsatisfactorily decommissioned mines caused and continue to cause some environmental impacts and health risks to the adjacent population, but this is not subject of this report.

Remediation Programme

Mine and mill ownership and, hence, responsibility for institutional control over the decades passed through several hands, with the *Empresa de Desenvolvimento Mineiro* (EDM) being the last owner before shut-down in 2001. The mining and milling residues were assessed by the Portuguese Geological Survey and a preliminary radiological survey undertaken by the *Instituto Tecnologico e Nuclear* (ITN).

In 2001 the Decree 198-A/2001 was passed that stipulated the programme of work on abandoned mining and milling sites, including those for uranium. In it 30 uranium mining related sites were identified and the organisation put in charge of remediation, EXMIN, performed detailed site investigation works in the following years. EXMIN also upgraded institutional control measures, such as fencing, warning signs and acid mine water treatment. An independent commission (CAC) was nominated to oversee and review site assessment and remediation work. Remediation plans were developed in 2003/2004 and implementation begun in 2005.

Public concern over possible exposures led to the Portuguese Parliament recommending in 2001 a public health and environmental risk assessment that was subsequently undertaken by three public research institutions; the results were published in 2005 and 2007 respectively (FALCÃO et al., 2005,2007). The studies concluded that

— there has been some dispersal of mining and milling residues, but the dispersal is limited; dispersed residues have resulted in some slight local surface and groundwater contamination and should be monitored;

— suspended dust from uncapped tailings may have given rise to some additional dose to members of the public in the vicinity;

— an enhancement of the body burden by uranium daughters was detectable through analyses of human hair;

— the health level of the public in the vicinity of the most contaminated areas is lower than that of reference groups and the frequency of chromosomal aberrations suggests exposure to radiation; no confounding factors could be identified.

The recommendations made in the above reports were endorsed by the government.

The remediation criterion selected was 1 mSv/year added dose to members of the public resulting from the former mining and milling sites. The work was also to be in compliance with Directive 96/29 EURATOM (CEU, 1996a).

The remediation plans for the major UMMT site at Urgeiriça called for a relocation of dispersed tailings and remaining below-grade ore to the older tailings pond, Barragem Velha. The tailings pond and its retaining dams were to be re-contoured and a cap consisting of clay and a geotextile and finally layers of gravel and topsoil were to be installed. Work commenced in 2006 and is nearly completed in autumn 2008.

Heap leaching residues and other mining and milling residues at the numerous sites are to be relocated into the nearest open mine pits, namely Quinta do Bispo, Murtórios, Prado Velho and Bica. (Acid) drainage from most of the sites needs to be treated and monitored for the foreseeable future.

The overall cost of the remedial activities at the former uranium mining and milling sites is estimated to amount to 12 M€ and they will be completed by 2012.

To date functioning institutional controls have prevented any serious exposures of the public in the vicinity of the mining and milling sites. They also prevented largely the misuse of mining and milling residues, e.g. for construction purposes, and thus the associated exposures. However, acid discharges from mining and milling facilities have caused some contamination of small creeks, but due to the relatively low solubility of uranium, this contamination has not spread very far. There have been also instances of breaking seals of mine shafts for pumping (contaminated) water for agricultural purposes.

Long-term management

The funding for the remediation activities is shared by the Environment and the Economics Ministries, with the latter being the nominal owner of the sites. The intention is to transfer site ownership to the local communities after the completion of the remediation works. No organisational or financial arrangements and plans beyond this have been made for the long-term stewardship of the sites. It is expected that some sites, where compatible with the institutional control requirements, might be used for recreational purposes. ITN will continue with the radiological monitoring for the foreseeable future.

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Annex II - Update on the UMMT Situation in Romania

Introduction

Since the report TREN/04/NUCL/S07.39881 was drafted, Romania has become a full Member of the European Union. It was expected that the information flow on the nuclear programme in Romania, including its uranium mining and milling activities, would improve, but it is still difficult to get authoritative and first-hand information. For instance, the latest edition of the OECD-NEA/IAEA 'Red Book' (OECD-NEA, 2008) had to take recourse to estimates, as no information on the current situation of the uranium industry was forthcoming and no sustained contact to responsible organisation could be established (J. Slezak, IAEA, pers. comm. 01/10/08). Attempts to contact the uranium mining company by email failed.

Presumably the most authoritative information on radioactive waste, including UMMT, can be found in the submissions to the Review Meetings of the 'Joint Convention' (IAEA, 1997). By nature, however, these submissions do not go into great detail and so far provide little information on any remediation achievements and further plans.

Outline of the Romanian nuclear industry

Romania remains a country with an active fuel cycle programme and any remediation and long-term stewardship plans have to be viewed in this context. The front-end of the fuel cycle programme currently is designed to carter for the domestic demand.

Uranium mining activities are led by the (now autonomous) *National Uranium Company* (CNU, www.cnu.ro), which operated four uranium mining branches at Feldioara, Bihor, Banat and lastly Suceava, which is the last remaining operational mine with a production capacity of around 100 t U per annum. Reasonably inferred resources are currently estimated at 3150 t U based on an extraction price of 110 €/kg U (CEU, 2007).

At Feldioara, CNU operates two milling-refining-conversion plants with a 300 t/y capacity each (IAEA, 2005). Romania is the single supplier in Europe for CANDU fuels. The *National Nuclear Power Company* (FCN) operates a conversion plant in Pitesti. The present capacity of FCN Pitesti (110 t U/y) will be increased in accordance with the requirements of the Cernavoda nuclear plants. FCN Pitesti has been qualified by AECL (http://www.aecl.ca/) as a CANDU (http://www.candu.org/) fuel supplier (CEU, 2007). These figures indicate that Romania has to import uranium and is not (yet?) self-sufficient.

Radioactive Waste Management

The *National Commission for the Control of Nuclear Activities* (CNCAN, www.cncan.ro) is a state-secretary commission with competences in all nuclear related matters: safety, safeguards, transport and public health, including emergency measures. The national Nuclear Authority falls under the *Ministry of Education and Science* (www.mct.ro) while the national energetic strategy falls under the *Ministry of Economics and Commerce* (www.minind.ro).

Requirements related to the content of the radioactive waste management facilities from uranium mining and milling are included in the "Radiological Safety Norms for

Radioactive Waste Management from Uranium Mining and Milling". Apparently these Norms contain also provisions for the long-term management of UMMT.

The *National Agency for Radioactive Wastes* (ANDRAD, www.andrad.ro) is the national competent authority for the coordination of the safe management of spent nuclear fuel and radioactive wastes, including their disposal. Stipulated by Law 320/2003, ANDRAD has developed, submitted for approval to Nuclear Agency, and published in The Official Bulletin No. 818 of 6 September 2004, "The National Strategy on Medium and Long Term Management of Spent Nuclear Fuel and Radioactive Waste, Including the Disposal and the Decommissioning of Nuclear and Radiological Facilities".

Within the National Strategy ANDRAD will

— conduct its activities based on the Yearly Activity Plan and establish the necessary financial resources for coordination at national level of the management of spent fuel and radioactive waste;

— set-up and manage the national final repositories for spent nuclear fuel and radioactive waste;

— create and maintain a national data base on spent fuel and radioactive waste;

— characterise spent fuel and radioactive waste with a view to their management;

— elaborate technical standards and procedures for the management of spent fuel and radioactive waste, including disposal and decommissioning;

— coordinate the decommissioning process for the nuclear and radiological installations;

— ensure, directly or by third parties, the physical protection of the repositories;

— cooperate with similar foreign organisations to ensure the use of the best available technologies for disposal of spent fuel and radioactive waste.

However, according to the Romanian Governmental Ordinance OG 11/2003, republished in 2006, UMMT are beyond ANDRAD's activities for the time being and ANDRAD does not see any involvement in the future (pers. comm. Gheorghe Negut, 27/10/08). The financing of decommissioning, remediation and long-term care of UMMT sites is not clear at present. The lack of a long-term strategy was also noted following the review of the 1st Joint Convention submission (CNCAN, 2005).

National Uranium Company (CNU) Waste Management Facilities

Detailed information on the Romanian uranium mining and milling programme is difficult to obtain. Perhaps the most comprehensive set of information is available through the submissions to the 'Join Convention' (IAEA, 1997). The following is an excerpt from the Romanian submission to the 2nd Review Meeting of the 'Joint Convention' (CNCAN, 2005).

The uranium mill of the Feldioara branch of CNU is located some 30 km from the town of Brasov (250,000 inhabitants). Since the commissioning of the plant, the mill tailings were deposited into two lined ponds that have a water cover and are located about 600 m away from the mill. The siting and design of the ponds conforms to the "National security standards for geological research, radioactive raw materials mining and milling", issued in 1975. The site was chosen because of a clay layer in the area and utilising the Cetãtuia valley that was considered suitable for building a long and stable pond. The two tailings ponds are named Cetãtuia II and Mittelzop respectively.

Figure AII-1: Presumed satellite view of the uranium milling facility at Feldioara. The ponds are located in a valley, upstream of settlements (to the right). The date when this image was taken is unknown.

Cetãtuia acts as a settling and storage pond for the tailings and was developed in three sections, taking account of demand and availability of funds for the construction.

The first section is now in a closing-out stage, having been used over the 1978 - 2001 period. It is estimated that in total about 4,500,000 t of tailings were deposited, containing around 2000 Ci ^{226}Ra. The total surface area of the first section is 368,000 m^2. An engineered clay liner of 30 cm thickness was put into the bottom of the pond. The embankments were lined with two layers of a polythene foil and a sandwich layer of bitumen and rubber. On one side a natural clay layer provides the sealing. A drainage system catches excess water and also the rainfall run-off from the surrounding area. The closing-out procedure aims to transform the pond into a permanent repository, provided that the planned design will meet the regulatory safety requirements.

The second section of the Cetãtuia pond was commissioned in October 2001 after a lining had been installed. It has a capacity of around 880,000 t of tailings with a footprint of 133,000 m^2. Currently it contains about 11 Ci ^{226}Ra.

A third section of the Cetãtuia pond, located uphill in the Cetãtuia valley from the other two sections, is scheduled to be commissioned after 2011, when the other sections have been closed out.

The Mittelzop pond serves as the final settling pond for fines, receiving the overflow from the Cetãtuia pond. In 1996, a channel was built between the Cetãtuia and Mittelzop ponds, enabling a natural flow of excess water from Cetãtuia down to Mittelzop, thus avoiding the use of pumps. This pond was commissioned in 1978, together with the

Cetãtuia pond and the milling plant. Its volume is about 300,000 m^3 and it has a surface area of about 87,000 m^2 . The dam of this pond is 5 m high. Supernatant waters from this pond are pumped to a treatment plant where remaining traces of uranium are removed. The treated waters are discharged into the river Olt. After closure, also this pond will be transformed into a permanent repository, provided that the planned close-out solution satisfies the regulatory requirements.

In between the two tailings ponds two trench-type disposal facilities for solid wastes had been constructed that were more recently supplemented by a facility with concrete walls. The old facilities were closed-out and covered with a clay layer. The new facility has a trapezoidal cross-section and currently a useful storage area of 1,640 m^2, giving a maximum storage volume of 6,560 m^3 inside the 5 m high concrete walls. The fourth wall has not been constructed yet, permitting to increase the storage capacity in the future, if needed. The estimated operational period will be 10 years. Once the facility is full, it is planned to cover it with a 50 cm thick compacted clay layer, thus converting the storage facility into a final repository. The new facility was built in compliance with Law 111/1996 that establishes the security standards for nuclear activities, the Radiological Safety Fundamental Norms of 2000 and the 2005 Norms for Physical Protection in the Nuclear Field. Nothing has been reported on the safety assessment procedures for the conversion into a disposal facility and on the provisions for long-term care.

Currently institutional control around the storage/disposal sites is maintained by a wire fence. Within a 3 km radius there are no permanent dwellings.

Other UMMT facilities

There have been a considerable number of sites around the country, where mining was undertaken, resulting in mining wastes (CNCAN, 2003,2006). It appears, however, that all the milling was undertaken in Feldioara, so that there are no other UMMT sites, but no confirmation for this is available.

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Abstract
The political changes from the late 1980s onwards have led Europe-wide to programmes for dealing with the uranium mining and milling legacies. A report drafted on behalf of the European Commission described the situation as it had developed by the end of 2005. With the EU having been enlarged since then, it appeared necessary to review the findings and conclusions of this report. The earlier report also did not provide conclusive thoughts on the long-term management of uranium mine and mill tailings.
The present report
— reviews the current situation in Romania and Portugal, singled out in the earlier report as needing further attention. It is concluded that Portugal has made good progress, while the situation in Romania continues to be unclear;
— reviews the bearing that international regulations, such as the EC Environmental Impact Directive, and conventions, such as the Aarhus and Espoo conventions, might have on the management of uranium mine and mill tailings sites;
— also develops thoughts on the long-term management of uranium mining and milling sites that are not fit for free release. These thoughts are based on the current international discussion of the subject.

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