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- Situation concerning uranium mine and mill tailings in the European Union

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COMMISSION STAFF WORKING PAPER

**SITUATION CONCERNING URANIUM MINE AND MILL TAILINGS IN THE
EUROPEAN UNION**

1. INTRODUCTION

Uranium mine and mill tailings are residues from uranium mining and processing (milling). They still contain a small amount of uranium, but also other naturally radioactive elements such as radium and thorium. Furthermore there are waste piles consisting of ore with too low a grade for processing.

Residues from uranium mining and milling are characterised by their content of naturally occurring radioactive substances which are all long-lived or in equilibrium with long-lived parent nuclides. Although, compared to mining, milling activities are normally concentrated in few locations, this can still result in a relatively large number of disposal sites for tailings, compared to other radioactive waste. In addition, these sites are rather large in terms of both volume and surface area. Coupled with residual uranium in tailings and other radionuclides, heavy metals and chemicals, this results in an environmental legacy that will stretch far into the future.

Due to the high volume and large surface areas of these residues, they typically cannot be effectively isolated from the biosphere in the way that other radioactive waste can, such as by concentration and confinement. This waste has to stay above ground, secured by covers and engineered structures to protect the population and the environment. They clearly require long-term custody in order to control the radiation exposure of the general public. This is also the reason for not including this type of waste in the scope of the Commission Reports on the management of radioactive waste and spent fuel management in the European Union^{1,2}.

Today the main producers of uranium are located outside the European Union (EU). Only a few mines are still in operation inside the EU, although this may change with the revival of nuclear energy and increased uranium prices. In the past, uranium was mined in Europe mainly since the 1940's for civil and military applications. Most of these mines have been shut down, and are subject to varying degrees of decommissioning/rehabilitation.

¹ COM(2008) 542 final.

² SEC(2008) 2416.

The residues of these past six decades of mine and mill processing of uranium ore in Europe have resulted in a considerable legacy. Although this legacy is much smaller in volume than that resulting from other types of metal or coal mining, the enhanced radioactivity associated with uranium mining requires specific attention.

Given these concerns, the Commission ordered a focused study³ into the situation of uranium mine and mill tailings in the European Union, which was completed in 2006 and identified the current tailings liabilities in Europe, their status, the future plans for these sites and any associated hazards. The follow-up Commission report entitled ‘The Long-Term Safety of Uranium Mine and Mill Tailings in an Enlarged EU’⁴ of 2008 provided a further analysis and update of this study. In the light of a potential revival of the EU uranium industry, it extends the scope from merely managing legacies of the past to preventing the creation of future liabilities.

This document gives an overview of the situation, including the legal context, concerning uranium mine and mill tailings and focuses on current issues. It also draws conclusions with regard to the need for an effective set of measures for coordinated institutional control of uranium mine and mill tailings, referred to as ‘long-term stewardship’. The document addresses issues concerning both managing existing uranium mine and mill legacies and improving sustainability while meeting the increasing demand for uranium. It also clarifies the applicable European legislation to ensure optimal coordination between the relevant texts.

2. HEALTH AND ENVIRONMENTAL ASPECTS

The exposure of members of the public is small compared to the exposure of miners, who, especially in underground mining, can be exposed to doses close to the limit for occupational exposure laid down in Council Directive 96/29/Euratom⁵.

The exposure of members of the public depends on the nature of the residues, which relates to the type of mining and ore processing. Residues of ore with too low a grade for processing can have a higher uranium concentration than those prevailing in the soil in the region. This may cause enhanced external exposure and enhanced levels of outdoor radon. Indoor radon may be significantly increased if such residues are recycled as construction materials. Uranium is also highly chemically toxic, which is of greater concern than its radioactive properties. In addition, there may be other residues associated with ore treatment processes such as arsenic, acid and other heavy metal residues.

Uranium mine and mill tailings may cause contamination of ground water or surface water. When properly managed and monitored, the engineered structures, e.g. dams or controlled drainage systems, should prevent such contamination. Radon also needs to be considered since this noble gas is generated by the parent radium-226, which is an important constituent of the residues. Radon exhalation from old mine shafts is also a concern. Inhalation of dust with enhanced levels of natural radionuclides may be an important pathway as well.

³ TREN/04/NUCL/S07.39881.

⁴ The Long-Term safety of Uranium Mine and Mill Tailing Legacies in an Enlarged EU, EUR 23660 EN — 2008, European Commission, JRC.

⁵ OJ L 159, 29.06.1996, p. 1.

3. CURRENT SITUATION IN THE EUROPEAN UNION

The Commission study^{3,4} confirmed that mine and mill tailings sites in the EU are located in 12 Member States — Bulgaria, Czech Republic, Estonia, France, Germany, Hungary, Poland, Portugal, Romania, Slovenia, Spain and Sweden. In total, there are 87 tailings objects at 63 sites that have been in operation over the years. They contain approximately 314 million m³ of uranium mine and mill tailings, covering an area of 2530 ha in total. Their individual volumes vary from a few thousand to several tens of million m³ per object. Most of these sites are no longer in operation. More than 40 objects have already been completely remediated. Some 20 others are currently being remediated while for the remaining objects, remediation has yet to start.

Many of these uranium mine and mill tailings disposal sites were constructed and operated at a time when public and workplace health risks and environmental concerns were less of a focus than they are today. The growing awareness of national authorities over the last two or three decades coupled with increased public concern has not only led to the closure of tailing disposal sites, but in most cases to the need to remediate them. The main purpose of remediation has been to interrupt pathways of radiological and non-radiological exposure and to mechanically stabilise the sites against natural processes.

The costs of remediation work are site specific and can be considerable. In cases where uranium production has ceased and the mines and mills are abandoned, especially where companies have ceased to operate or even exist, the responsibility for remediation, including financing, falls to the state.

One area of particular concern has been the legacy from the extensive uranium mining and milling activities in Central and Eastern European Countries. The governments of these countries have faced not only financial difficulties, but also lacked local expertise for remediation. The PHARE programme administered by the European Commission has been the main channel for EU financial and technical cooperation with Central and Eastern European Countries. PHARE assistance has been provided to assess the situation and to identify remediation priorities and objectives, to actually implement remediation work, stimulate the development of national remediation programmes and support cooperation between the countries involved.

To date, individual Member States and the European Union have dedicated considerable efforts and resources to dealing with the legacies and liabilities from uranium mining and milling activities. The situation in each country is different and each site is unique in many aspects. Local climate, geology and topography largely determine the extent of remediation measures needed. These measures must be identified with close regard to locally available resources, which means each country or each site will use ‘best practice’, as evidenced in many cases. The approach taken by the unified Germany to manage the legacies of the uranium industry developed in the former GDR (WISMUT act) is a good example at national level. The approach developed by the Czech Republic to manage the legacies of uranium industry, especially from vast in situ leaching activities is another example at national level. France has developed a holistic approach to tackle its specific issues resulting from its past uranium industry activities. The recently completed project for remediating the Sillamae site in Estonia may serve as an example for resolving a relatively small but complicated case with potential cross-border risks and impacts through extensive international cooperation such as with the Nordic countries and the EU.

In summary, the Commission study came to the conclusion that, in most cases, the tailings objects in today's EU do not have an intolerable impact on the environment and health and only in a few sites have potential cross-border impacts been observed. Nevertheless, in a number of cases, more work must be done to ensure the long-term stability and long-term performance of the sites.

While in the past the primary objective for remediating tailings disposal sites was to seal off and provide shielding covering, there seems now to be a shift to more structured and conceptual remediation plans that first assess the risk factors concerning a specific object and its location and surroundings. Thereafter risk mitigation is translated into technological remediation steps.

The design of cover systems now places much more emphasis on long-term stability and also to long-term performance to prevent future environmental problems through loss of integrity, due to wear or neglect. Engineering approaches and modelling tools have improved significantly in this direction over the last 30 years or so.

One highly important issue remains to be sufficiently addressed in almost all Member States, namely **long-term stewardship** of existing legacies to ensure long-term monitoring, surveillance and maintenance (see item 5).

4. LEGAL SITUATION AND EU LEGAL INSTRUMENTS

The history of national and international rules and regulations applicable to uranium mining and milling operations is very complex and reflects developments over the past six decades. Several different regulatory regimes have applied to uranium mining and milling activities at both Community and national levels. Mining is a sector with a long tradition of very specific rules and regulations. The management of mine waters is among the oldest instances of water-related rules and regulations. Apart from radiation protection and waste management measures, a wide range of quantitative criteria has been developed in various countries.

In more recent years, environmental impact assessments, including public participation, have emerged as a tool to control and license complex activities and facilities that may impact on more than one environmental aspect. Radiation protection has perhaps the longest history of international harmonisation.

Regarding EU legislation, a distinction must be made between rulemaking under the Treaty on the Functioning of the European Union and the Euratom Treaty. Details are given in the Annex.

Under the **Treaty on the Functioning of the European Union**, more harmonisation is expected now that a Directive is in force which regulates the management of waste from extractive industries (Directive 2006/21/EC⁶). Being under the Treaty on the Functioning of the European Union, it excludes aspects that are specific to radioactivity, but includes all other environmental and public aspects. The aim of this Directive is to comprehensively improve the way in which waste from extractive industries is managed by specifically addressing environmental and human health risks that may arise from waste treatment and disposal. The Directive contains provisions on important aspects such as best available

⁶ O J L 102, 11.04.2006, p. 15.

techniques, waste management plans, major-accident prevention policy, regulation, public participation, construction, management, closure and after-closure of waste facilities, pollution prevention and financial guarantees, notably linked with site rehabilitation and liabilities. It also lays down requirements on waste disposal sites from the past. The Commission has approved and published a reference document⁷ on best available techniques, but it does not cover uranium mining and milling waste.

By 2012, Member States have to establish an inventory of the closed and abandoned facilities which cause serious negative environmental impacts or have the potential to become a serious threat. The Commission will finalise a guidance document for the establishment of these inventories in 2011.

Radiological aspects of the management of waste from extractive industries, including current and past uranium mining and milling activities, are covered by Chapter III of the **Euratom Treaty** and secondary legislation. Four articles in Chapter III (Articles 35-38) directly refer to levels of radioactivity in the air, water and soil and are important regarding surveillance and the radiological impact of current and past uranium mining and milling activities. They set obligations for continuous environmental monitoring and reporting of the level of radioactivity in the air, water and soil and empower the Commission to verify the operation and efficiency of monitoring facilities. Furthermore, the Commission issues opinions on plans to release radioactive effluents, including those from uranium mining and milling operations. Lastly, the Commission will make recommendations to Member States and in cases of urgency can issue a directive requiring the Member State concerned to take all necessary measures to prevent infringements. These provisions form part of a consistent and coordinated set of laws designed to ensure compliance with the Euratom Basic Safety Standards, laid down in Council Directive 96/29/Euratom.⁵

According to these Basic Safety Standards (BSS), the exploitation and closure of uranium mines are subject to prior authorisation by Member States, which must ensure that justification, optimisation and dose limitation principles are respected. Authorisation is also required for the disposal, recycling and reuse of residues, such as from uranium mining, unless they comply with clearance levels established by national competent authorities on the basis of basic criteria laid down in the BSS and the technical guidance published by the Commission.

As regards the situation of existing uranium mine and mill tailings disposal sites in Europe, the Basic Safety Standards also lay down specific rules on intervention in case of lasting exposure resulting from past practice, including, if necessary, demarcating the concerned area, monitoring arrangements and restricting access or use of land or buildings situated in the demarcated area. Additional Commission recommendations cover the protection of the population against the dangers arising from radon in dwellings and in drinking water.

This legal analysis shows that the existing EU legislation covers all aspects of the management of waste from extractive industries which may be radioactive and falls within the scope of Directive 2006/21/EC. For that reason this type of waste is excluded from the scope

⁷ European Commission, Reference document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities, January 2009, http://eippcb.jrc.ec.europa.eu/reference/_download.cfm?twg=mmr&file=mmr_adopted_0109.pdf

of the Commission proposal for a Council Directive on the management of spent fuel and radioactive waste⁸.

In conclusion, it appears at first glance that EU legislation sufficiently covers the issues at stake regarding uranium mine and milling, both for past and future activities. However, the reference document for best available techniques⁷ needs to be supplemented and the issue of integrated long-term stewardship for both radioactivity and other aspects merits a more thorough analysis.

5. OPEN ISSUE: LONG-TERM STEWARDSHIP

Although many remediation projects have been technically completed, the long-term future of the sites is unclear. Uncertainty over the long-term effectiveness of remediation solutions means that sites must be monitored, surveyed and maintained.

It is this uncertainty that triggers the need for long-term stewardship, to find institutional solutions for the development of the site over many years, both with respect to its physical state and its use. Institutional control must remain in place over the long-term and have a secure financial basis. Monitoring must be adequate and efficient and valid data should be available to the national authorities, the public and the Commission. In some cases, continuous and active maintenance is needed. Records need to be kept 'alive' to provide adequate information when needed.

When taking remediation decisions, it is important to explicitly consider long-term stewardship issues when examining remedial options and implementing a final remedy. From a quality management point of view, the use of independent reviews of planned works is likely to significantly improve public acceptance, as would independent monitoring.

A strict risk-based approach and prioritisation is needed for tailing sites where implementation of the remediation measures has not yet started or where currently available financing for the remediation solutions is so limited that the remediation process is phased over an excessively long period of time.

Another important aspect is that various countries are already reconsidering their decision to close uranium mining activities. If uranium mines are redeveloped, it may become difficult to distinguish between legacy sites and operating facilities. Regulatory and management approaches for new operations must take into account such situations.

6. CONCLUSIONS

Radiological risks of current and past uranium mining and milling activities are regulated under Chapter III of the Euratom Treaty and its secondary legislation. Extensive instruments are available and while implementation is the responsibility of national authorities, the Euratom Treaty has given strong supervisory powers to the Commission. A few years ago, the Commission included uranium mining and milling sites in its Article 35 verification programme. Given **the number of existing sites in the enlarged European Union,**

⁸ COM(2010) 618 final

increasing the number of annual site verifications could contribute to stricter implementation of existing rules.

Pursuant to Article 36, Member States send monitoring data on radioactivity levels in the environment to the Commission. The Commission publishes regular reports based on these data. The information received is also uploaded into a REM⁹ database, which has operated for several years at the Joint Research Centre in Ispra and can be accessed on request. In general, there is little information received from Member States on environmental monitoring of uranium mining and milling sites.

On the basis of the experience gained during site verifications, the Commission will consider whether it would be appropriate to prepare a **Recommendation addressed to Member States on the application of Article 36 concerning the monitoring of radioactivity levels in relation to uranium mines, whether or not in operation.** Such a Recommendation should identify the sampling media, the types of measurements and their periodicity, sampling strategies and the procedure for reporting to the Commission.

Uranium mine and mill tailings management presents today a twin challenge: to manage existing legacies of uranium mine and mill tailings by establishing effective long-term stewardship and to avoid such legacies in the future. The need for stewardship is broadly recognised by experts as a part of responsible management of uranium mining and processing projects, which must include waste management and disposal, site decommissioning, remediation and closure.

Consequently, **establishing long-term stewardship programmes at national level** appears as a useful solution to ensure a more effective implementation of the Community framework for managing uranium mining and milling residues. Stewardship programmes should integrate all the measures under existing Community and national legislation and take on board all closely interrelated managerial, societal, economic and technical aspects during the decision-making process.

Effective stewardship should also take into account continuing changes to social, technical and economical conditions and processes, such as changing stakeholders, perceptions of risk, science and technology, societal structures, governmental systems, economic circumstances and priorities. A successful stewardship programme will have the inherent capability to adapt and respond to these changes.

Long-term stewardship objectives can best be achieved if relevant national programmes are site-specific (sites under operation, shut down or closed/decommissioned), focus on realistic timeframes and keep stakeholders involved. This would allow implementation of working solutions that are acceptable, adequate and sufficient, as well as evaluation of changes needed over time. **Regular peer reviews and revision of stewardship programmes** should support their implementation.

Knowledge preservation is an essential prerequisite for a successful stewardship programme. For this purpose, there could be advantages in enhancing the Commission role as a clearing house for information at Community level. This could require creating a **comprehensive**

⁹ Radioactivity Environmental Monitoring.

database on uranium mine and mill tailings in the EU, based on the work already undertaken.

The analysis developed in this paper is expected to facilitate the discussion on the long-term regulatory and management approaches to uranium mining and milling waste in the context of the overall policy on radioactive waste management as an integral part of sustainable development of the nuclear fuel cycle. It will form a basis for the **European High Level Group on Nuclear Safety and Waste Management (ENSREG)**¹⁰ to develop a common understanding and, if appropriate, suggest a common approach to establishing long-term stewardship programmes.

In implementation of Article 22 of Directive 2006/21/EC, the Commission will develop a **guidance document on inspection** of the mining waste facilities – including Uranium mines. Uranium mining will be included in the **reference document for best available techniques** during the next revision of the document. The Commission will continue **exchange of information** between Member States on the **rehabilitation of abandoned and closed facilities**.

¹⁰ Commission Decision of 17 July 2007 (2007/530/Euratom), Official Journal L 195, p. 44.

ANNEX

EU legal instruments

1. EURATOM TREATY, BASIC SAFETY STANDARDS

Four articles in Chapter III (Articles 35-38) directly refer to levels of radioactivity in the air, water and soil and are important regarding surveillance and the radiological impact of current and past uranium mining and milling activities. Article 35 stipulates that each Member State must establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and empowers the Commission to verify the operation and efficiency of these facilities. Article 36 requires Member States to periodically communicate information to the Commission on the checks referred to in Article 35 so that it is kept informed of the levels of radioactivity to which the public is exposed. Under Article 37, the Commission issues opinions on whether, and to what extent the implementation of plans giving rise to releases of radioactive effluents is liable to result in radiological consequences for neighbouring countries; mining and milling of uranium is included in the operations which are examined by the Commission. Lastly, under Article 38, the Commission shall make any recommendations to Member States with regard to the level of radioactivity in the air, water and soil and in cases of urgency, and shall issue a directive requiring the Member State concerned to take all necessary measures to prevent infringement of the Basic Standards. These provisions form part of a consistent and coordinated set of laws designed to ensure compliance with the Euratom Basic Safety Standards.

According to the Euratom Basic Safety Standards, in particular Article 4(1)(a) of Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation¹¹, exploitation and closure of uranium mines are subject to prior authorisation by Member States which shall ensure that justification, optimisation and dose limitation principles are respected. Residues from uranium mines are subject to the requirements of Article 5 of Council Directive 96/29/Euratom relating to authorisation for disposal, recycling or reuse of radioactive substances or materials containing radioactive substances from a practice subject to the requirement of authorisation. The disposal, recycling or reuse of these residues is permitted without further consideration, provided they comply with clearance levels established by national competent authorities, which shall follow the basic criteria used in Annex I to the Directive and the technical guidance published by the Commission.

As regards the situation of existing uranium mine and mill tailings disposal sites in Europe, according to Article 53 of Council Directive 96/29/Euratom on intervention in case of lasting exposure resulting from the after-effects of a past practice, Member States must, if necessary and in line with the extent of the exposure risk, ensure that:

- the area concerned is demarcated;
- arrangements are made to monitor exposure;

¹¹ OJ L 159, 29.06.1996, p. 1.

- any appropriate intervention is carried out, taking account of the specific nature of the situation;
- access to or use of land or buildings situated within the demarcated area is regulated.

Concerning radon gas, Recommendations 90/143/Euratom and 2001/928/Euratom ensure the protection of the population against the dangers arising from radon in dwellings and in drinking water.

2. TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION — DIRECTIVE ON WASTE FROM THE ORE EXTRACTIVE INDUSTRY

Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC¹² provides for measures, procedures and guidance to prevent or reduce adverse effects on the environment and any resultant risks to human health, brought about as a result of the management of waste from extractive industries. According to the general considerations¹³, this Directive also covers the management of waste from extractive industries which may be radioactive (i.e. including uranium mining and milling).

Transposition of the Directive into relevant national regulations and administrative provisions, which was scheduled for no later than 1 May 2008, has been achieved in most Member States and the Commission recently adopted a package of implementing measures in accordance with Article 22 of the Directive¹⁴.

The aim of this Directive is to improve the way in which waste from extractive industries, such as waste rock or tailings, is managed by specifically addressing environmental and human health risks that may arise from waste treatment and disposal phases. The Directive includes provisions on:

- Waste management plant for minimisation, treatment, recovery and disposal of extractive waste;
- Application of best available techniques;
- Major-accident prevention and information;
- Regulation — applications, permits and inspections;
- Public participation;
- Construction and management of waste facilities;

¹² O J L 102, 11.04.2006, p. 15.

¹³ See notably recital (10) of the Directive: *‘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)’*.

¹⁴ Commission Decisions on waste facilities classification (2009/337/EC), on inert waste (2009/359/EC), on technical guidance for the financial guarantee (2009/335/EC), on reporting (2009/358/EC), on waste characterisation (2009/360/EC).

- Closure and post closure of waste facilities;
- Prevention of water status deterioration, air and soil pollution;
- Compulsory financial guarantee to cover the obligations of the permit and site rehabilitation;
- Environmental liability,
- Inventory and methods for rehabilitating closed waste facilities.

The Directive applies to all new waste facilities. For existing activities, transitional provisions are foreseen to allow all existing permits to be adapted before 1 May 2012. In addition, Member States are required to establish an inventory of potentially harmful closed and abandoned mining waste facilities by 2012. The Commission has organised exchanges of information between Member States to develop methodologies on the inventories and on rehabilitating the identified closed facilities.

The Directive also requires the Commission to draft technical guidelines for inspections to be carried out on the waste facilities by the national competent authorities. Member States are also required to report every three years to the Commission on implementation of the Directive using the questionnaire recently adopted by the Commission.¹⁵

¹⁵ Commission Decision (2009/358/EC) of 29 April 2009 on the harmonisation, the regular transmission of the information and the questionnaire referred to in Articles 22(1)(a) and 18 of Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from extractive industries, O.J. L 110, 1.5.2009, p.39.