

## *RAPPORTEUR SUMMARY OF OPENING SESSION AND TOPICAL SESSION 1*

**W. Schroeyers**

Nucleair Technologisch Centrum (NuTeC),  
UHasselt — XIOS Hogeschool Limburg,  
Diepenbeek, Belgium

### 1. INTRODUCTION

This report briefly summarizes the sessions of day 1 (22 April 2013) of the Seventh International Symposium on Naturally Occurring Radioactive Material (NORM VII), in Beijing, China. From the opening ceremony, it was clear that the NORM VII symposium aims to create a forum for discussion on best available practices for sustainable development and radiation protection for NORM processing industries.

### 2. MANAGING EXPOSURE TO NATURAL SOURCES: INTERNATIONAL STANDARDS AND NEW CHALLENGES

The radiation protection standards and regulatory approaches being adopted at the national level still need to be further harmonized, especially in developing countries with limited regulatory resources. The International Basic Safety Standards (BSS), published by the IAEA in 2011, provide requirements reflecting the concepts of planned, existing and emergency exposure situations. The BSS promotes a graded approach. A legislator perspective on NORM: “If it is not defined in national legislation as needing to be regulated, then it is not NORM”. Important challenges and issues that need to be dealt with when adopting the revised BSS in national regulatory approaches are listed below:

- (a) Practicality is a very important issue when regulating exposure to NORM;
- (b) A challenge is to adopt recycling or by-product use to reduce the amount of NORM waste;
- (c) More attention needs to be paid to stakeholder involvement and communication;
- (d) Standardization of measurement methods and protocols is important for the evaluation of practices.

These challenges and issues were considered by several speakers. Clearly these are some of the central issues that were considered in Topical Session 1.

### 3. MINING: MOVING TOWARDS COMPREHENSIVE EXTRACTION

China is a mineral rich country with more than 168 types of mineral resource. The United States of America has the largest thorium reserves in the world. Australia is characterized by large distances and at least 96 mines. Australia hosts more known uranium resources (1 673 000 t of uranium) than any other country. A large amount of exploration for oil and gas, uranium, rare earths, phosphates and mineral sands, and metalliferous deposits is ongoing in Australia.

In the past, radiation protection was considered to be ‘an interesting idea’ in uranium mining. Remediation of the Alligator Rivers Region was eventually dealt with by ‘putting everything back in the pit’. Modern mining companies have to assure cleanup from the start of the operation. In Australia, a company needs to provide a deposit of 100% of the estimated costs for the remediation before startup.

Bad ventilation and high radon concentrations are common in underground mines in China. In 15% of non-uranium mines, radon concentrations can exceed 1000 Bq/m<sup>3</sup>. Health effects are reported for miners exposed to the highest radon concentrations. Effective regulations and measures are required to protect the miners.

A study involving risk perception among non-uranium miners was reported. In this study, 2836 miners were interviewed and only 1.8% of them had a correct perception of health risk resulting from exposure to radon. Risk and harm perception are complicated issues. For comparison purposes, it can be useful to ask similar questions regarding the perceived risks to various groups: experts and non-experts.

Mining of NORM containing ores presents specific challenges for the supervising authorities. Guidance for industry is required to support the implementation of various aspects of NORM regulations. Currently, we have a global market without global regulation or standards and this is a cause of instability. If one fulfils the requirements of the collaboration model, which means to find an equilibrium between the interests of stockholders and concerned parties, then a new ‘social licence’ can be obtained. In this context, the idea of ‘comprehensive extraction’ is rapidly gaining ground. Comprehensive extraction requires a long term approach. Three key features of comprehensive extraction are:

- (1) Disturb the ground only once;
- (2) Extract all useful materials;
- (3) Leave no waste behind (use or recycle residues).

In the future, there is a good chance of another uranium mine in Australia: 'The future involves U'. Stakeholder and stockholder involvement is important when starting a new mine. An evidence based approach to risk management should be incorporated into a long term strategic resource plan.

#### 4. THE NORM PROCESSING INDUSTRY: HOW TO HANDLE MEASUREMENT PROTOCOLS AND PRACTICAL ISSUES

Throughout several presentations, a treasure of information — including many facts and figures on NORM exposure for millions of workers in China — was discussed. The average dose received by millions of workers in China is 2.1 mSv/a. Several radiation protection issues associated with NORM exposure were considered. Out of a survey consisting of on-site investigations of 11 000 enterprises in China from 11 types of NORM industry, it was found that more than 300 enterprises have raw materials or residues with  $^{238}\text{U}$  or  $^{232}\text{Th}$  activity concentrations exceeding 1 Bq/g.

A radionuclide balance was determined for a coal fired power plant and the stack emissions of the aerosol  $^{210}\text{Po}$  were determined. A stack sampling instrument was developed to sample the aerosol radionuclides. Micromorphological analysis of the aerosol  $^{210}\text{Po}$  from the stack was performed by means of scanning electron microscopy.

NORM has become a widely recognized issue in the oil and gas industry. Different restoration activities, the characterization of NORM residues and the technical challenges of properly evaluating the activity concentrations in such residues were discussed. New NORM related issues are arising. In the United States of America, hydraulic fracturing techniques have seen a massive increase and oil and gas companies need to implement NORM related education and awareness (in both English and Spanish) and proper analytical techniques for characterization of NORM. A large amount of personal protective equipment is required when working with NORM in the oil and gas industry.

When companies are dealing with ores, products and residues with enhanced concentrations of radionuclides of natural origin, many practical issues arise:

- What is a radioactive material and when do we have to do something?
- The problem of 'greater than 1 Bq/g' = 'radioactive?' = 'dangerous?' = 'extremely low concentration?'

- The label ‘radioactive’ is difficult to remove! Is it possible (useful?) to seek exemption for the materials? Is it possible to negotiate sale terms with the customers for these materials?
- How can we develop our process to reduce the radionuclide concentrations?
- Blending is a normal industrial process: Why is this such an issue with NORM?

A very important aspect that was dealt with is that we need radiation control appropriate to the magnitude of the risk.

## 5. FROM MANAGEMENT OF NORM RESIDUES AND CONTAMINATED SITES TO RESIDUE RECYCLING/USE?

Iron and steel manufacturers are a large industrial source of environmental contamination — 3100–6200 million t of waste are produced in the United States of America. A study was reported regarding the distribution of radionuclides in the various incoming and outgoing material flows during processing steps of iron ore in Egypt. In this study, samples from four companies were analysed. Exposure pathways for the public and workers were assessed. An important finding was that the concentration of other toxic elements such as cadmium, lead and zinc turned out to be much more problematic than the NORM content of the investigated materials. When evaluating the recycling/use options of NORM residues, the presence of other toxic components might present a much bigger problem that can block several opportunities for such recycling/use.

The phosphogypsum management policy implemented within the Taparura project in Sfax, Tunisia, was aimed at the reduction of the impact of the phosphogypsum residue by finding a better waste management approach with a limited radiological impact. The Taparura project involves the reclamation of 6 km of beaches, removal of contamination, backfilling and environmental and radiological follow-up. Attention is given to the concept of a ‘sustainable city’: the remediation project considers the social, economic and environmental role of region.

Removal options for uranium and thorium from the Kvanefjeld (southern Greenland) rare earth and uranium deposit were discussed and more details regarding the hydrometallurgical flowsheet developed for the Kvanefjeld deposit were given. The current status of the Kvanefjeld multielement project was proposed: currently a feasibility study is ongoing. The department of NORM throughout the flowsheet was discussed in detail. It is the goal to produce uranium as a separate product.

In the United States of America, the phosphate production process is under consideration as a source of co-extraction of uranium, rare earths and thorium. In regulation and dose modelling, a conservative approach is generally used. A drawback of an over-conservative approach to NORM residue recycling/use is that such an approach will generate too much waste, so care needs to be taken to find an equilibrium between radiation protection of the population and allowing recycling/use options for residues.

## 6. CONCLUSIONS

Mining is moving towards long term approaches such as comprehensive extraction. Stakeholder–stockholder cooperation is important when starting a new mine, also in the NORM processing industry and when dealing with the recycling/use of NORM residues.

Practicality is a very important issue when regulating exposure to NORM. There is a need for radiation control appropriate for the size of the risk. An important challenge is to go for recycling/use of NORM residues to reduce the amount of NORM waste. The control measures need to assure radiation protection of the population and workers while allowing recycling/use options for NORM residues. When implementing protective measures and looking for recycling/use options, there is a need to consider NORM issues and the presence of other toxic elements in these residues. The standardization of measurement methods and protocols is important for the evaluation of practices.