Waste Safety Standards Committee

38th Meeting

24-25 November 2014

Agenda W.9.2

Status and Issues in Development of Management of Radioactive Residues from Mining, Mineral Processing, and other NORM related Activities (DS459)

Z. Fan, and J. Rowat
Waste and Environmental Safety Section
Division of Radiation, Transport and Waste Safety
Outline

• Background
• Status of the development of DS459
• Remaining Issues
  • Emphasis placed on uranium production in overall guidance
  • In-situ leaching for uranium (ISL)
  • Exemption of NORM residue
  • Criteria and their application for long term management of NORM residues
• Way forward
Background

• WS-G-1.2: Management of Radioactive Waste from the Mining and Milling of Ores (2002),
• WASSC 31 (June 2011) Concluded that: WS-G-1.2 is to be revised at the light of the new requirements and developments.
• WASSC 32 (Nov 2011) and CSS 31 (March 2012) endorsed the DPP
• Proposed title: Management of Radioactive Residues from Mining, Mineral Processing, and other NORM related Activities
Background - Issues to be addressed (1/2)

- The inclusion of “in situ recovery”, as this has become a major resource recovery and process for uranium.
- NORM residues can include other contaminated objects, like pipes, scaling, sludge, etc.
- Risk based approach and graded approach to managing different residues, based on the wide range of activity levels in NORM residues.
- Regulation and management of mixed residues (i.e., containing radiological and non-radiological contaminants).
- Differences among some Member States in their regulation of NORM, which may or may not include uranium and thorium mine and milling residues.
Background - Issues to be addressed (2/2)

- General updates to document to reflect current IAEA terminology, definitions, references etc.
- **Predisposal management** of Radioactive Waste (GSR Part 5). For example, pre-treatment, treatment, storage, transport, and conditioning.
- Residues may contain other components which may be retrieved, and segregation of residue, reuse and recycle, and disposal should be addressed.
- Make connection to remediation or decommissioning, and how these activities can generate a waste or a residue in the context of NORM.
Status - Preparing the draft

- DPP: September 12-16, 2011
- 1\textsuperscript{st} CM: 3-7 September 2012
- 2\textsuperscript{nd} CM, 15-19 April 2013
- 3\textsuperscript{rd} CM, 4-8 November 2013
- Home-based assignment to improve the draft
- 4\textsuperscript{th} CM 1-4 September 2014 for review of draft text
1. INTRODUCTION
2. GOVERNMENTAL, LEGAL AND REGULATORY FRAMEWORK
3. SCOPE OF REGULATORY CONTROL
4. PROTECTION OF PEOPLE AND THE ENVIRONMENT
5. SAFETY ASSESSMENT AND SAFETY CASE
6. GENERIC APPROACH OF NORM RESIDUE MANAGEMENT
7. SAFETY CONSIDERATIONS IN LONG-TERM MANAGEMENT OF NORM RESIDUES

REFERENCES
ANNEXES
Status – Scope covered

- Uranium mining and processing
- Rare earth extraction
- Thorium extraction and use
- Niobium extraction
- Non-U mining – including radon
- Oil and gas
- TiO₂
- Phosphates
- Zircon and Zirconia
- Metal production (Sn, cu, al, Fe, zn, Pb)
- Burning of coal etc.
- Water treatment – including radon

Safety assessment and safety case
- Funding
- Management system
- Decommissioning
- Disposal
- Storage
- Reuse/Recycle

Characterization
- Generation
- Treatment
- Transport

Construction
- Design
- Siting

Planning

Liquid waste
- Manufactured items containing NORM
- Contaminated items

higher activity waste
- Bulk minerals processing residues other than uranium mill tailings
- Waste rock, mineralized waste rock and similar residues
- Uranium mill tailings

In-situ leaching waste
Status – Issues resolved

- Step-wise screening approach
- Life cycle of NORM residues from generation control to long term management
- Graded approach for safety assessment and for options for NORM residue management
- Responsibilities of government, operator and regulator
- Well balanced for:
  - Uranium mining and milling versus other NORM residues
  - Process versus category
  - Predisposal versus disposal (Long-term management)
- Identification of need for further supporting safety documents
Remaining issues

- Emphasis placed on uranium production
- In-situ leaching for uranium (ISL)
- Exemption of NORM residues – case-by-case management
- Criteria and their application for long term management of NORM residues
Weight attached to uranium production

- Current DS459: Management of Radioactive Residues from Mining, Mineral Processing and other NORM Related Activities
- A title change would draw attention to uranium safety, for example ‘Management of Radioactive Residues from Uranium Production and other NORM Related Activities’
In-Situ Leaching for Uranium (ISL)

- Primary supply
  - Open pit
  - Underground mining
  - In-situ leaching

- In-situ leaching
  - 2009: 36%
  - 2010: 41%
  - 2013: 47%

Data from WNA

Image courtesy Heathgate Resources

Rössing U mine, Namibia, Copyright © 2010 Rio Tinto
McArthur River uranium mine, Canada
## Contrasting ISL with other forms of uranium production

<table>
<thead>
<tr>
<th>Open-pit</th>
<th>Underground</th>
<th>ISL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big volume of tailings which cause significant concerns</td>
<td>Significant potential risk of groundwater</td>
<td></td>
</tr>
<tr>
<td>Large stockpiles of waste rock, sub-economic ore and/or overburden</td>
<td>Much smaller waste rock production volumes</td>
<td>Large volume of waste water</td>
</tr>
<tr>
<td>Potential for waste water, drainage and seepage to cause environmental problems</td>
<td></td>
<td>Waste sludges and evaporate salts of high specific activity but small volume</td>
</tr>
</tbody>
</table>
3.1(f) the **mining and processing of raw materials** that involve exposure due to radioactive material;

3.4 (a) Exposure due to material in any practice specified in para.3.1 where the activity concentration in the material of any radionuclide in the uranium or thorium decay chains is greater than 1 Bq/g or the activity concentration of $^{40}$K is greater than 10 Bq/g.

I-4. For radionuclides of natural origin, exemption of bulk amounts of material is necessary considered on a case by case basis by using a **dose criterion of the order of 1 mSv in a year**, commensurate with typical doses due to natural background levels of radiation.
Exemption scheme for NORM residue

- Bulk residue reuse as construction materials & Bulk residue landfill
- Regulated
- Out of scope
- Exempted

1 Bq/g

1 mSv/a
Criteria and their application for long term management of NORM residues

- **Disposal of Radioactive Waste SSR 5: 2.15(b)** a disposal facility (considered as a single source) is so designed that the calculated dose does not exceed a dose constraint of **0.3 mSv in a year** or a risk constraint of the order of **$10^{-5}$** per year.

- **GSR Part 3: I-12(c)** For radionuclides of natural origin in residues that might be recycled into construction materials or the disposal of which is liable to cause the contamination of drinking water supplies, the activity concentration in the residues does not exceed specific values derived so as to meet a dose criterion of the order of **1 mSv in a year**, commensurate with typical doses due to natural background levels of radiation.
Challenging issues for long term management of NORM residues

- Dilution/dispersion versus isolation/containment
  - Terminology, amongst NORM community differs from nuclear fuel cycle community
  - Practice, phosphogypsum in agriculture
- Safety consideration and safety assessment
  - Long half-lived radionuclide
  - Large volume
  - Close to human activities
Way forward

• Given its scope, this is a complex SG
• To address ISL adequately, we need to develop an ISL specific safety guide, or at least a safety report
• Further consultancies to improve DS459, particularly on:
  • Exemption as applied to NORM residue
  • Criteria and their application for long term management of NORM residues
Thank you