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IAEA Work Programme on NORM – Achievements and Challenges

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Purpose of Talk

To outline:

• NORM related safety requirements and guidance.
• Activities of the Department of Nuclear Safety and Security in regard to NORM, and
• challenges in regulating NORM industries

Only brief mention will be made of activities carried out in other departments. This talk consolidates information on the NORM related activities of staff in NSRW.
What is NORM?

NORM (Naturally occurring radioactive material) definitions:

• **NORM**: Radioactive material containing no significant amounts of radionuclides other than naturally occurring radionuclides (regulatory decision & activity concentration of process material is the key)

• **NORM Residues**: Material that remains from a process and comprises or is contaminated by naturally occurring radioactive material (NORM).

• **NORM waste**: Naturally occurring radioactive material for which no further use is foreseen.

Therefore, a NORM residue may - or may not - be waste.

*Source - IAEA Safety Glossary 2007 Edition*
NORM Industry Characteristics

• The regulation of NORM industries often involves multiple regulatory authorities.

• NORM industries are strongly driven by economic viability of individual projects. When profit margins are small the pressures to keep costs low are large. This makes the graded approach to regulation especially important.

• NORM residues are almost always long-lived.

• NORM residue volumes are usually orders of magnitude larger than the volumes of conventional radioactive waste from nuclear power production.

• There is limited flexibility in regard to siting of tailings management facilities.

• Awareness of issues of radiation protection may be limited in some NORM industries.

• Non-radiological hazards comprise a significant portion of the hazard, often the dominant factor.
Range of activity concentrations in soil, ores and minerals

Activity concentration (Bq/g)

Data from UNSCEAR 2000

Non-optimum use of regulatory resources

Optimum use of regulatory resources

Uranium ores, U-238
Monazite, Th-232
Pyrochlore, Th-232
Zircon, U-238
Ilmenite, Th-232
Rutile, U-238
Phosphates, U-238
Bauxite
Other metal ores, U-238 or Th-232
Soil, U-238
Soil, Ra-226
Soil, Th-232
Is NORM a priority for the IAEA?

Safety for uranium production (i.e., fuel cycle) is a priority for the IAEA, among other things as expressed in IAEA General Conference resolutions. Other NORM is not emphasized as much as uranium.

Industrial sectors other than uranium production are not routinely amongst the stakeholders the IAEA engages.

When a group of Member States request assistance for a particular NORM residue issue we address it (e.g., TC Missions, the Phosphogypsum Working Group).
The IAEA NORM Programme

NORM is a cross-cutting issue, but the IAEA does not have an across-the-board NORM Programme.

The Uranium Production Cycle team in NEFW does have an integrated programme for promotion of sustainable U-production.

Various groups in the technical departments of the Agency have NORM-related activities that are coordinated to a greater or lesser degree.

The IAEA Technical Cooperation Programme implements training events and expert missions and there are various extra-budgetary activities related to NORM residue management and worker protection.
3.1. The requirements for planned exposure situations apply to the following practices:

(f) the mining and processing of raw materials that involve exposure due to radioactive material;

3.4. Exposure due to natural sources is, in general, considered an existing exposure situation and is subject to the requirements in Section 5. However, the relevant requirements in Section 3 for planned exposure situations apply to:

(a) Exposure due to material\textsuperscript{17} 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 \textsuperscript{40}K is greater than 10 Bq/g.

When the industrial practice is one where NORM residues > 1 Bq/g it becomes a practice subject to the requirements for planned exposure situations, and in turn some form of regulatory control.
NORM industries and existing exposure situations (GSR Part 3)

BSS, Section 5, Page 92

5.1. The requirements for existing exposure situations in Section 5 apply to:

(a) Exposure due to contamination of areas by residual radioactive material deriving from:

   (i) Past activities that were never subject to regulatory control or that were subject to regulatory control but not in accordance with the requirements of these Standards;

*NORM residues, like any other radioactive residues, present an existing exposure situation when derived from past industrial activities that were not subject to adequate control.*
NORM and existing exposure situations (GSR Part 3)

BSS, Page 30, Footnote 17

A situation of exposure due to radionuclides of natural origin in food, feed, drinking water, agricultural fertilizer and soil amendments, construction materials and residual radioactive material in the environment is treated as an existing exposure situation regardless of the activity concentrations of the radionuclides concerned.

The reference to residual radioactive materials in the environment in Footnote 17 applies not only to NORM residues.
Exemption (GSR Part 3)

BSS, Schedule 1, Page 106

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.

Footnote 60. Material containing radionuclides of natural origin at an activity concentration of less than 1 Bq/g for any radionuclide in the uranium decay chain or the thorium decay chain and of less than 10 Bq/g for $^{40}$K is not subject to [i.e., excluded from] the requirements in Section 3 for planned exposure situations (para. 3.4(a)); hence, the concept of exemption from the requirements of these Standards does not apply for such material.

Footnote 60 implies that exemption does not apply to NORM residues < 1Bq/g because they are out of scope of planned exposure situations.
I.12. Radioactive material within a notified practice or an authorized practice may be cleared without further consideration provided that:

(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, which is commensurate with typical doses due to natural background levels of radiation.

Generic clearance level for NORM in Schedule 1 of BSS is 1 Bq/g.
Scope of regulation for NORM residues as per BSS

- Past practices are an existing exposure situation (Section 5 of BSS).
- Exemption dose criterion for NORM residues: of the order of 1 mSv/a
- Generic clearance level <1 Bq/g (U and Th decay chain), 10 Bq/g for $^{40}$K
- Specific clearance values derived to meet a dose criterion of the order of 1 mSv/a
NORM waste - disposal

If a NORM residue is declared to be radioactive waste, the applicable safety standards apply.

SSR-5, Page 13.

For disposal of radioactive waste to comply with the public dose limit of $1 \text{ mSv/a}$, a disposal facility (considered as a single source) is so designed that the calculated dose or risk to the representative person who might be exposed in the future as a result of possible natural processes affecting the disposal facility does not exceed a dose constraint of $0.3 \text{ mSv}$ in a year or a risk constraint of the order of $10^{-5}$ per year.
## Relevant Safety Publications

### Safety Requirement
- Governmental, legal and regulatory framework for safety, GSR Part 1 Rev. 1 (2016)
- BSS, GSR Part 3 (2014)
- Management system for facilities and activities, GSR-3 (2006)
- Safety assessment for facilities and activities, GSR-4 Rev. 1 (2016)
- Predisposal requirement, GSR-5 (2009)
- Decommissioning of facilities, GSR-6 (2014)
- Disposal requirement, SSR-5 (2011)
- Transport requirement, SSR-6 (2012)

### Safety Guide
- **DS459 Management of radioactive residues from NORM activities**
- DS453 Occupational radiation protection in mining and processing
- DS468 Remediation process for contaminated areas
- GS-G-3.3 Management system for predisposal of radioactive waste
- GS-G-3.4 Management system for disposal of radioactive waste
- DS447 Predisposal of radioactive waste from nuclear fuel cycle
- DS442 Regulatory control of radioactive release
- SSG23 The Safety Case and Safety Assessment for the disposal of Radioactive Waste
- SSG31 Monitoring and surveillance of radioactive disposal facilities
- SSG32 Protection of the Public against Exposure Indoors due to Natural Sources of Radiation

### Safety Reports
- 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
Previous Agency work on NORM residues management.

Safety Reports Series 49 addresses the question under what circumstances does it become necessary to regulate?

The characteristics of NORM residues and the implications for their management are specific to the industrial process.
Previous Agency work on NORM residues management.

The Agency organizes the NORM symposia – next one in Rio de Janeiro, Brazil, 18-21 Oct 2016.

The Agency also develops many topical reports on aspects of NORM Management.
Documents under development

Safety Standards:


Safety Reports and other supporting documents:

– Safety Infrastructure for Uranium Production
– Safety of In-situ Recovery for Uranium Production
– Uranium mining & processing,
– Coal and Coal Ash industry,
– RP and NORM Residue Management in the Industrial Uses of Thorium
– Decision Making of Remediation Activity (DD792);
– Remediation guidelines for regulators (9 Vols).
– TECDOC: Interim measures for protection of the public;
– TECDOC: Review of remediation plans.

Training Materials

– Recently developed a seven module remediation training course (circa 140 lectures), including manuals, e-learning materials for U sites.
Networks/ information exchange

• RSLS: International Forum for Regulatory Supervision of Legacy Sites.
• CGULS: Coordination Group for Uranium Legacy Sites
• ENVIRONET: Network on Environmental Management and Remediation
• OPRNET (web based): including the Information System on Uranium Mining Exposures (UMEX)
Challenges in regulating NORM

Continuing to provide appropriate standards for management of NORM residues, and providing for the application of these standards presents the Agency with many challenges.

NORM is a cross-cutting issue.
It cuts across many broad industrial sectors (e.g., mining and minerals production, energy, chemical industries). Management of NORM residues it is just one of many issues for most of these industrial sectors. *Explaining the Agency standards as they apply to NORM to such a broad range of interested parties is a challenge.*
Challenges in regulating NORM

Recommendations in regard to reuse/recycle and blending of NORM residues with other materials.

The “waste hierarchy” – familiar to many industrial sectors - promotes reuse/recycle as a means to avoid disposal.

Blending of radioactive waste is a practice that has long been discouraged because it involves dilution.

Blending of NORM residues is practiced in some Member States.

Additional information on reuse/recycle of NORM residues (including blending) would be of value for Member States.
Challenges in regulating NORM

• Remediation of sites contaminated by NORM residues. There are many legacy sites that have NORM residue contamination.

• Providing for long term safety of NORM residues. Due to the combination of long half-lives of radionuclides and large volumes of residues. Long term stewardship is a fact of life for NORM residues.

• Special attention to the graded approach to regulation (regulatory measures and resources commensurate with the risk) based on good knowledge and understanding of the diverse industrial sectors involved is needed for regulation of NORM industries including their residues.
Challenges in regulating NORM

• Radiation protection experience is limited in many industry sectors, uranium mining being an exception.
• Industry specific guidance is needed to address the radiological issues of NORM industries.
• There is a need to improve the process of sharing RP operational management experience amongst various industrial sectors – in this regard proprietary barriers are counterproductive.
• There is a need to develop a common language for engaging open and transparent dialogues with stakeholders (e.g. decision makers, regulators, the public, industry, etc.). In this regard, a new network for NORM community should be considered.
• Synergies with the conventional worker health and safety issues should be strengthened.
• Consideration should be given to systems optimisation.
• Building stakeholder trust is important for management and operation of NORM sites.
Thank you!