Workshop on the Safe Management of NORM residues

Zhiwen Fan, IAEA
Stephane Pepin, FANC, Belgium
Learning objectives

To understand:

• Origins and characteristics of NORM residues,
• IAEA Safety Standards that are relevant to safety of NORM residues management
• Regulatory infrastructure and graded approaches that apply to management of NORM residues
• Strategic options and approach for NORM residues management.
Structure of the Workshop

Three sections:

• Overview of IAEA Safety Standards No. SSG-60 Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and Other Activities, Zhiwen Fan

• Application of Graded Approach for Management of NORM, Stephane Pepin

• Discussions
Section 1.
Overview of IAEA Safety Standards SSG-60
Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and Other Activities

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Outline

• IAEA Function in Safety
• IAEA safety standards framework
• IAEA Safety Standards SSG-60
• Summary
• Further information
Statute of the IAEA

Article III: Functions

To establish or adopt, ..., standards of safety for protection of health and minimization of danger to life and property ..., and to provide for the application of these standards to its own operation as well as to the operations making use of materials, services, equipment, facilities, and information made available by the Agency … ; (Para A.6)
Structure of SSG60

1. Introduction
2. Overview of NORM activities and NORM residues
3. Governmental, legal and regulatory framework for safety
4. Protection of people and the environment
5. System for regulatory control
6. Strategies for NORM residue management
7. The safety case and safety assessment for NORM residues management
8. Safety consideration for long term Management of NORM Residues

Appendix I. Special considerations of residues from uranium production
Appendix II. Residue management plan for uranium production
Appendix III. Closure plan for tailings management facility

References
Annex I. Examples of residues to be assessed for possible regulatory control
Annex II. Sampling and determining radionuclide activity concentrations
Annex III. Example of application of the graded approach in the management of NORM residues
Annex IV. Reuse and Recycling of NORM Residues
Annex V. Bibliography
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 2018 Edition*
Sectors of NORM reside Concerned

1. Uranium mining and processing
2. Rare earths extraction
3. Thorium extraction & use
4. Niobium extraction
5. Non-U mining – incl. radon
6. Oil and gas
7. TiO$_2$
8. Phosphates
9. Zircon & zirconia
10. Metals production (Sn, Cu, Al, Fe, Zn, Pb)
11. Burning of coal etc.
12. Water treatment – incl. radon
## Origin of NORM Residues (Section 2)

<table>
<thead>
<tr>
<th>Industrial activities</th>
<th>Bulk residues</th>
<th>Medium to small amount of residues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tailings</td>
<td>Waste rock</td>
</tr>
<tr>
<td>Conventional uranium production</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Heap leaching for uranium</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>In-situ leaching for uranium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction of rare earth elements</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Production and use of thorium and its components</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Production of niobium and ferro-niobium</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Mining of ores other than uranium ore</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Production of oil and gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of titanium dioxide pigments</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The phosphate and potash industries</td>
<td>Phosphogypsum</td>
<td></td>
</tr>
<tr>
<td>The zircon and zirconia industries</td>
<td>Phosphogypsum</td>
<td></td>
</tr>
<tr>
<td>Metals production (Sn, Cu, Al, Fe, Zn, Pb)</td>
<td>Red mud</td>
<td></td>
</tr>
<tr>
<td>Combustion of coal</td>
<td>Fly ash</td>
<td></td>
</tr>
<tr>
<td>Water treatment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Radiation Safety Basis for Management of NORM residue (Section 4)

- **Case-by-case management of NRs**:
  - < 1 Bq/g
  - But > 1 mSv/a

- **Regulated**:
  - > 1 Bq/g
  - > 1 mSv/a

- **Out of scope**:
  - < 1 Bq/g
  - < 1 mSv/a

- **Exempted**:
  - > 1 Bq/g
  - < 1 mSv/a

- Recycle into construction materials and disposal

- 1 Bq/g

- 1 mSv/a
Policy and Strategy (Para 3.1-3.4, Section 3, SSG-60)

- Two levels of strategy: national level, sector level and activity level (project level)
- Nation level strategy covers strategy for inventory investigation, establishment of regulatory framework (Section 5), and development of engineering infrastructure (Section 8)
- Section 6 Strategies for NORM Residue Management is more focus on project level issues
Policy and Strategy (Para 3.1-3.4, Section 3, Section 6, SSG-60)

• The government should establish a P&S that is appropriate to the national situation.
  ➢ Acknowledge existing governmental, legal and regulatory frameworks.
  ➢ Be consistent with the national P&G for development of activities that generate NORM residues.
  ➢ Take into account the national P&G for safety, for management of non-radioactive waste and for radioactive waste management.
  ➢ States may choose to integrate key elements of the strategy for NORM residue management into their national policy, legal framework and regulatory instruments. In such cases, a separate national strategy for NORM residue management might not be necessary.
Strategy for capacity building

IAEA Safety Standards SSG-60

Regulation

Infrastructure

Initial criteria

Identified list of activities

Facility specific inventory

Sector/regional inventory

Inventory of activities

Inventory of facility NORM residues

Compiled inventory of NORM residues
System for Regulatory Control (Section 5, SSG-60)

Activities with residues of concern

- Uranium mining and processing
- Rare earths extraction
- Thorium extraction & use
- Niobium extraction
- Non-U mining
- Oil and gas
- TiO₂
- Phosphates
- Zircon & zirconia
- Metals production (Sn, Cu, Al, Fe, Zn, Pb)
- Burning of coal etc.
- Water treatment
- Processing, reuse/recycle
- Storage and disposal
- Decommissioning/closure
- Plus +++

Growing interaction between operator and regulatory body

1. Notification
2. Exemption
3. NORM Practices with Authorization
4. Clearance
5. Reuse/recycle: Landfill

Evaluation of national situation

List of NORM activities
Identification of NORM residues

- Step wise judgement
- 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.
- 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.
Process and criteria for Regulatory Control

Other activities Involving NORM

- Notification

Uranium production

- License

≥ 1 Bq/g

- Screening Assessment

- *Meet Exemption criteria

* Exemption criteria can be in the order of 1 mSv/y or other that is defined by the regulatory body.

Used in construction materials

- Construction material requirements

≥ 1 Bq/g

- Screening Assessment

- *Meet Exemption criteria

Exemption

Registration or License

- Clearance
- Reuse and recycle
- Disposal in landfill
- Disposal as radioactive waste
- Long term management facility

Authorized management options

Registration or License

License

YES

No
Strategies for NORM Residue Management (1/2) (Section 6, SSG-60)

- Assessment of the potential for generating different types of residue, based on the design and operation of similar facilities;
- Measures to control the generation of residues;
- Processing (sorting, characterization, segregation and treatment);
- Clearance, if applicable;
- Reuse and recycling;
- Discharge to the environment;
- Long term management, including disposal where appropriate.
Strategies for NORM Residue Management (2/2) – Clearance

Residues in authorized facility → Processing

Non-radioactive Material

Yes → Generic clearance

No → Specific clearance

Yes → Reuse/recycle

Landfill

NORM waste

Remains under regulatory control
Strategic approach for long term management of NORM waste
Long Term Safety (Disposal), (Section 7 and Section 8, SSG-60)

• Safety case and safety assessment is required to be conducted during development of facilities for long term safety of NORM residues
• Safety considerations for such facilities include:
  – Siting
  – Design and construction
  – Operation
  – Decommissioning of facilities and closure of the facilities
  – Long term management and institutional control
Solution oriented

<table>
<thead>
<tr>
<th>Understand NORM residues</th>
<th>Regulation in a graded approach</th>
<th>Reuse/recycle</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey</td>
<td>Exemption</td>
<td>Internal (one operator)</td>
<td>Municipal landfill</td>
</tr>
<tr>
<td>Identification</td>
<td>Notification</td>
<td>Cross sectors (various operators)</td>
<td>Hazardous waste landfill</td>
</tr>
<tr>
<td>Characterization</td>
<td>Registration</td>
<td>Cross borders</td>
<td>RW near surface disposal</td>
</tr>
<tr>
<td>Safety assessment</td>
<td>License</td>
<td></td>
<td>RW sub-surface disposal</td>
</tr>
<tr>
<td>Categorization</td>
<td>Clearance</td>
<td></td>
<td>(injection of contaminated liquid is one of the example)</td>
</tr>
<tr>
<td>with connection to subsequent management options</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 2.
Application of Graded Approach for Management of NORM

S. Pepin (Federal Agency for Nuclear Control, Belgium)
Overview

- Belgium: institutional landscape
- Overview of Belgian NORM regulations
- Overview of notifications from NORM industries
- Generic exemption/clearance levels
- Acceptance criteria for NORM
- Application to the phosphate industry: three case-studies – three types of regulatory control
Belgium: institutional landscape

Belgium = federal state
Radiation protection = federal
⇒ FANC competent for all aspects of RP (workers & public exposure, environmental monitoring of radioactivity, licensing, inspections,...)
⇒ If waste declared as radioactive waste: managed by ONDRAF/NIRAS (national radioactive waste agency)

Environment (other than radioactivity) = regional
⇒ Environmental authorities regulates non-radioactive aspects of waste management and soil remediation

+ Federal ministry of Economy (consumer products, building material)
+ Food Safety Agency (responsible for safety of food chain)

Assignment of responsibilities in decision process
Belgian NORM regulations: overview

Belgian NORM regulations => Royal Decree of July, 20 2001

Art. 4: list “work activities involving natural radiation sources”
Art. 9: industries are submitted to declaration
if AC > exemption levels (e.g. 0.5 Bq/g Ra-226)

Objective of declaration: dose-impact assessment (workers and population)
⇒ if possibility to exceed 1 mSv/a, corrective measures or licensing

<table>
<thead>
<tr>
<th>Royal Decree 20/07/2001 (Belgium)</th>
<th>GSR – Part 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declaration</td>
<td>Notification</td>
</tr>
<tr>
<td>Corrective measures</td>
<td>Registration</td>
</tr>
<tr>
<td>Authorization</td>
<td>Licensing</td>
</tr>
</tbody>
</table>

! If significant changes in processes or raw materials, new declaration (e.g. new declaration for decommissioning)
# Overview declarations

<table>
<thead>
<tr>
<th>Sector</th>
<th># declarations</th>
<th># notification (no corrective measures)</th>
<th># registration (corrective measures)</th>
<th># license</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater treatment facilities</td>
<td>31</td>
<td>30</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Storage, handling and processing of zircon and zirconia</td>
<td>17</td>
<td>17</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Storage, handling and processing of phosphate ores</td>
<td>10</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Production of non-ferrous metals</td>
<td>10</td>
<td>7</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Processing, valorization and recycling of NORM residues</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Production, storage, use and handling of thorium-based materials</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Extraction and transport of natural gas and shale-gas</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Oil refineries</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Geothermal energy – including exploration phase</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Titanium dioxide production</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Primary production of rare earths</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Coal-fired power plant</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Distribution of consumer products with AC &gt; RP 122 II</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Primary iron production</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>96</strong></td>
<td><strong>62</strong></td>
<td><strong>33</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

Corrective measures apply to:

<table>
<thead>
<tr>
<th>Occupational exposure</th>
<th>discharges</th>
<th>Residue management</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>10</td>
<td>31</td>
</tr>
</tbody>
</table>
Generic exemption/clearance levels for NORM residues

⇒ Use of clearance/exemption levels of European Commission document “Radiation Protection 122 Part II”

Derived from a dose criterion of 0.3 mSv/a

If AC < clearance: no additional constraints for residue management (exception: mono-landfill):

(dynamic) clearance from further surveillance

If AC > clearance: follow-up necessary
⇒ facilities accepting NORM residues must notify FANC
⇒ Acceptance criteria in function of type of treatment (~ specific clearance)

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Clearance/exemption levels (Bq/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-238sec (incl. U-235sec)</td>
<td>0.5</td>
</tr>
<tr>
<td>U nat</td>
<td>0.1 (mono-landfill)</td>
</tr>
<tr>
<td>Th-230</td>
<td>5</td>
</tr>
<tr>
<td>Ra-226+</td>
<td>10</td>
</tr>
<tr>
<td>Pb-210+</td>
<td>0.5</td>
</tr>
<tr>
<td>Po-210</td>
<td>0.1 (mono-landfill)</td>
</tr>
<tr>
<td>Th-232sec</td>
<td>5</td>
</tr>
<tr>
<td>Th-228+</td>
<td>0.5</td>
</tr>
<tr>
<td>K-40</td>
<td>5</td>
</tr>
</tbody>
</table>

 заметка: База помогает избежать повторного ввода текста.
## Acceptance criteria: reference values

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Activity concentration</th>
<th>Input (single batch of residues)</th>
<th>Output (after processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill for hazardous waste</td>
<td>$C_{\text{exemption}}$</td>
<td>RP 122 II</td>
<td>$C_{\text{average}} &lt; 0.2$ Bq/g</td>
</tr>
<tr>
<td></td>
<td>$C_{\text{max}}$</td>
<td>50 Bq/g</td>
<td></td>
</tr>
<tr>
<td>Landfill for non hazardous or inert waste</td>
<td>$C_{\text{exemption}}$</td>
<td>RP 122 II</td>
<td>$C_{\text{average}} &lt; 0.2$ Bq/g</td>
</tr>
<tr>
<td></td>
<td>$C_{\text{max}}$</td>
<td>10 Bq/g</td>
<td></td>
</tr>
<tr>
<td>Mono-landfill</td>
<td></td>
<td>&lt; 0.1 Bq/g: no restrictions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 0.1 Bq/g: site-specific approach</td>
<td></td>
</tr>
</tbody>
</table>
### Acceptance criteria: reference values (2)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Activity concentration</th>
<th>Input (single batch of residues)</th>
<th>Output (after residue processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Co-)incineration</td>
<td>$C_{\text{exemption}}$</td>
<td>RP 122 II</td>
<td>- Activity index (building)</td>
</tr>
<tr>
<td></td>
<td>$C_{\text{max}}$</td>
<td>10 Bq/g</td>
<td>- RP 122 II (road construction)</td>
</tr>
<tr>
<td>Building materials</td>
<td>$C_{\text{exemption}}$</td>
<td>RP 122 II</td>
<td>- Activity index (buildings)</td>
</tr>
<tr>
<td></td>
<td>$C_{\text{max}}$</td>
<td>10 Bq/g</td>
<td>- RP 122 II (road construction)</td>
</tr>
<tr>
<td>Other uses</td>
<td></td>
<td>Case by case (dose assessment &lt; 0.3 mSv/y)</td>
<td></td>
</tr>
</tbody>
</table>
Summary

NORM

< 0.5 Bq/g?

Mono-landfill?

Exemption/clearance

Notification compulsory

Registered operator

Acceptance criteria OK?

Specific assessment

acceptance
Current situation

➤ 2020: 11 sites authorized for disposal of NORM residues
6 “mono-landfill” (4 related to phosphate industry, 1 titaniumdioxide, 1 non ferrous)
2 landfills for hazardous waste
1 landfill for non-hazardous waste
1 incinerator for hazardous waste
1 facility for pre-treatment of hazardous waste
➤ Environmental monitoring
➤ Inventories of NORM – record-keeping

Quantities:

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphate 1 (PG stack)</td>
<td>110 000 m³/yr – capacity 7 560 000 m³</td>
</tr>
<tr>
<td>Phosphate 2 (CaF₂ sludge)</td>
<td>2012-2017: 337 000 m³ from remediation (capacity: 2 400 000 m³)</td>
</tr>
<tr>
<td>Phosphate 3 (remediation material)</td>
<td>Capacity: ~ 1 500 000 m³</td>
</tr>
<tr>
<td>Phosphate 4 (PG stack)</td>
<td>(2013 – 2017) 139 254 m³</td>
</tr>
<tr>
<td>TiO₂ landfill</td>
<td>40 000 ton/yr filtercake (capacity ~ 900 000 ton)</td>
</tr>
<tr>
<td>Non ferrous metal production</td>
<td>Capacity 550 000 m³</td>
</tr>
<tr>
<td>Landfills</td>
<td>(2013 – 2017) 1479 tons</td>
</tr>
</tbody>
</table>
Application to the phosphate industry in Belgium

**Long history:**
from the 19th century…

- **Different locations**
- **Various processes:**
attacks with H₂SO₄, HCl, HNO₃
- **Various products:**
phosphoric acid, fertilizer, feed phosphate,…

- **recent decommissioning projects**
Application to phosphate industry

⇒ Various processes and products
⇒ Various residues (different both in composition, activity concentrations and quantities)
⇒ various exposure circumstances
⇒ need for proportionate control measures ("one size does not fit all")

Three case studies:
In each case, same raw material (sedimentary phosphate rocks) is used
- Production of superphosphate fertilizers (sulfuric acid process)
- Production of nitrophosphate fertilizers (nitric acid process)
- Decommissioning of a dicalciumphosphate production unit (chloric acid process)
Different patterns => different regulatory control
Case 1: production of superphosphate fertilizers

See Section 7 of IAEA Safety Report 78

⇒ Direct reaction of phosphate rock with sulfuric acid to produce fertilizers
⇒ No production of huge amount of residues (such as phosphogypsum)
⇒ No selective precipitation or concentration of radionuclides
⇒ Radionuclides of raw materials essentially diluted in end products

- Limited quantities of residues
- Activity concentrations in residue are small

⇒ This activity was regulated through notification only (no control measures)

Initial notification in 2008
Inspection and review in 2016: no significant changes
Case 2: Production of nitrophosphate fertilizers

Reaction of phosphate rocks with nitric acid
⇒ Bulk residue = chalk (CaCO₃) with diluted activity concentration (~ 0.1 Bq/g) not of regulatory concern
⇒ Accumulation of Ra-226 on filter clothes
⇒ Up to 200 Bq/g
⇒ filters are cleaned with water-jetting before disposal
⇒ limited quantities (~ 1 m³ / yr)

- Limited quantities of residues – limited exposure time (only during maintenance operations)
- But activity concentrations in residue are significant

⇒ This activity was regulated through registration
- Cleaning procedure (including PPE) approved by RP expert
- Registration of quantities of filter clothes
Case 3: Decommissioning dicalciumphosphate production unit

**Closure of DiCalciumPhosphate facility**  
(HCl process)  
⇒ end of phosphate production in 2013

**Planned decommissioning**  
⇒ partial reuse of installations for another production (CaCl₂)

**Declaration** submitted to FANC including:

- Descriptions of the installations to be dismantled;
- Radiological measurements (dose-rate + activity concentration of representative samples);
- Work protocol incl. protection measures for workers;
- Proposal for disposal of residues;
- Planning of operations;
## Case 3: Decommissioning dicalciumphosphate production unit

<table>
<thead>
<tr>
<th></th>
<th>U-238</th>
<th>Ra-226</th>
<th>Pb-210</th>
<th>Po-210</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Bq/g)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scales on external side of reactor vessel (1)</td>
<td>5.6</td>
<td>1.12</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Scale in gutter decanter (2)</td>
<td>10.7</td>
<td>136</td>
<td>70</td>
<td>94</td>
</tr>
<tr>
<td>Scale in washing decanter (3)</td>
<td>3.4</td>
<td>780</td>
<td>240</td>
<td>159</td>
</tr>
<tr>
<td>Incrustation in gutter (4)</td>
<td>240</td>
<td>1.12</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Scale precipitation cones (5)</td>
<td>1.26</td>
<td>0.25</td>
<td>3.6</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: FANC
Case-study 3: decommissioning dicalciumphosphate production unit

• Significant activity concentrations + big quantities of contaminated material

FANC licensed decommissioning activities

- follow-up external doses of workers (time-registration during work operations + dose-badge) + protection against inhalation/ingestion;
- Phasing of activities
- Waste register;
- Monitoring releases (waste water);
- Clearance procedure (approved by radiation protection expert);
- Appointing a Radiation Protection Officer
Conclusions

• Same NORM (phosphate rock) may lead to very different patterns of exposure and/or type of residues;
• Need for a regulatory framework to accommodate these differences (*graded-approach*)
• Approach for exemption/clearance of NORM
• Generic and specific clearance
• Different regulatory tools: notification, registration, licensing
Q&A

Regulatory Forum for Safety of Uranium Production and NORM (REGSUN)

https://gnssn.iaea.org/main/REGSUN/SitePages/Home.aspx

Thank you!