Impacts of NORM Standards on Mining and Minerals Processing

Sharing Some Practical Perspectives

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Content

- **Background**
- The mining sectors
- NORM requirements in Practice
- Practical Examples
- Conclusion and thoughts

Background To This Presentation

- Rapid development in NORM requirements in recent years (IAEA guides, national regulations)
- “Traditional” mining and processing has been slow to recognise the requirements and appreciate impacts
- Complex issue for both new and existing operations
- Lack of clarity; requires clear regulations, competent regulators, competent company
- Share some of the observations and some thoughts

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Sectors Impacted

- Almost any metal deposit that contains elevated U or Th
- Base metals through to exotics
- Any processing facility that treats metal ores
  - Concentrators (sulphides, oxides)
  - Smelters / refineries
- Processes that involve bulk storage or movement of materials
- Processes that handle products and wastes from these processes

Existing Operations Characteristics

- Tight operating parameters
- High capital investment – requires servicing
- Operating cost control
- Productivity improvements
- Retrofitting difficult to justify
- Additional requirements

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New Project Characteristics

- Project development (5-10 years)
- Up to 5 years for project approval
- Approval processes can be open ended
- Costs $500m - $10b
- Financing difficult - assurance on investment returns
- A very fine balance to get new projects up and running …

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IAEA Basic Safety Standard

- Radioactive material is material (irrespective of whether processed or not)
  - that contains no significant amounts of radionuclides other than naturally occurring radionuclides

  AND
  - is designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity

- Material containing natural uranium (U_{nat}) >1Bq/g (head of chain)

- Doses from exposure to material are less than 1mSv/y

- Clarification by IAEA (RS-G-1.7) (for purposes of regulatory control)

What if Material is > 1Bq/g ?

Apply a "graded approach" to regulation

Consider exemption as first option

1. Exemption (decision not to regulate)
   - Dose < 1mSv/y
2. Notification (similar to exemption but regulator stays informed)
   - Dose < 1mSv/y
3. Notification and registration
4. Notification and licencing

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This is all about risk assessment and risk management

Where control is proportional to risk

ALARA
Optimisation

However, in practice…….

Exemption mechanisms are not obvious in national regulations

Why ?

- Difficulty in conducting dose/risk assessments
- Difficulty in assessing the dose/risk assessments
- 1Bq/g is a clear unambiguous trigger (can be measured or inferred from gamma)
- Reluctance to grant exemption (precautionary approach, regulatory conservatism or public concern)
- Once a material is defined as radioactive, the label is difficult to then remove

From A Practical Perspective

1Bq/g is……

The cut off for a definition of a radioactive material

and

A defacto “limit”

What Does This Mean ?

Your material is radioactive !!

- Fear, liability, health and environmental impacts
- Import and export constraints
- Added regulatory scrutiny
- Materials “dirty”

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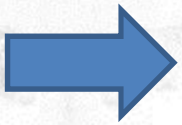
Observations

What does 1Bq/g mean in practice for the mining and processing industry ?

New for Most Sectors

- Sectors that understand
  - Uranium mining/processing
  - Minerals sands



- RP culture is mature
- Internal capacity/capability
- Developed over many years
- Understand delicacy of approvals

- Sectors that DO NOT understand
  - Base metals (Cu, Fe)
  - Rare earths (?)
  - Coal

- No internal competence
- Limited regulatory competence
- Approach is super conservative and controls can be over engineered
- Advice from a number of (sometimes competing) sources
- Fear

Perceptions

- Raw materials, wastes, products now “radioactive”
- Uncertainty over whether materials are dangerous
- Materials are “seen” differently
- Added requirements on producer and customers
- Confusion between NORM, radioactive and nuclear
- Everyone is cautious and conservative

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Flow On Effects

- Becomes the definition of radioactive material for other purposes, for example;
  - Unclear if it triggers a “nuclear action” under regulation
  - Customs intervention and interest
  - A whole new level of assessment (non human biota, mobilisation, dose modelling, characterisation)

- Questions;
  - Is the waste a “radioactive waste” and therefore require additional controls ? (LLRW repository, licencing),
  - Who is responsible for waste from processing of NORM,
  - Labelling of the materials

Risk Inequality

- Radioactivity becomes the dominant risk, regardless of the magnitude…..

Occupational Exposure
Smelter Tapping

Occupational Exposure
Smelter Tapping

- Concentrate contains up to 1Bq/g of Po210 and Pb210
- Smelting volatilises radionuclides – released during tapping
- Calculation of inhalation dose gives about 5mSv/y
- Based on dust/fume levels of 20mg/m^3
- Advice was to limit radionuclides in feed
- …

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- **TLV for copper fumes is 0.5mg/m^3**

The Cu fume level is 40 times the TLV !!!

Product Specification Criteria

- Metal concentrate export/import;
  - For smelting
  - 0.2Bq/g Ra226
  - 0.5% As

- Metal concentrate;
  - Low in sulphur, but contains > 1Bq/g NORM
  - Advised by customer to blend with low NORM – high sulphur material

What Does 1Bq/g Look Like ?

Radionuclide	Activity (Bq/g)	Concentration
U^{238}	1	80ppm
U^{234}	1	4.1ppb
Th^{230}	1	1.5ppb
Ra^{226}	1	30ppt
Po^{210}	1	7ppq
Pb^{210}	1	0.4ppt

Technology difficulties at the ppb, ppt and ppq levels requires – IX or SX

Direct Cost Impacts

- $100's million to reduce product from 2Bq/g to < 1Bq/g
- $10's million for tailings lining and underdrainage systems
- Penalties / increased treatment charges
- Approval delays
- Operational constraints (monitoring, external scrutiny, regulatory scrutiny)
- Material considered to be inferior (loses premium)
- Specialist waste disposal

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Thoughts and Observations

- Messy and confusing and contradictory – easier to keep your head in the sand
- >1Bq/g seen as “radioactive” and therefore dangerous – wrong message
- More active in saying that exemption is OK
- Develop and reinforce understandable, simple, standard risk assessment methods (not based on conservative situations)
- Safety net for “poor performers”
- Need to drag industry to the table

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Thank you for listening

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