

A Global Overview of NORM Residue Remediation and Good Practice

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IAEA

International Atomic Energy Agency

NORM is what exactly?

Definitions: from IAEA Safety Glossary v. 2.0

Radioactive material

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

NORM

Radioactive material (as defined above) containing no significant amounts of radionuclides other than naturally occurring radionuclides

So if it's not subject to regulation, it's not NORM !

TENORM:

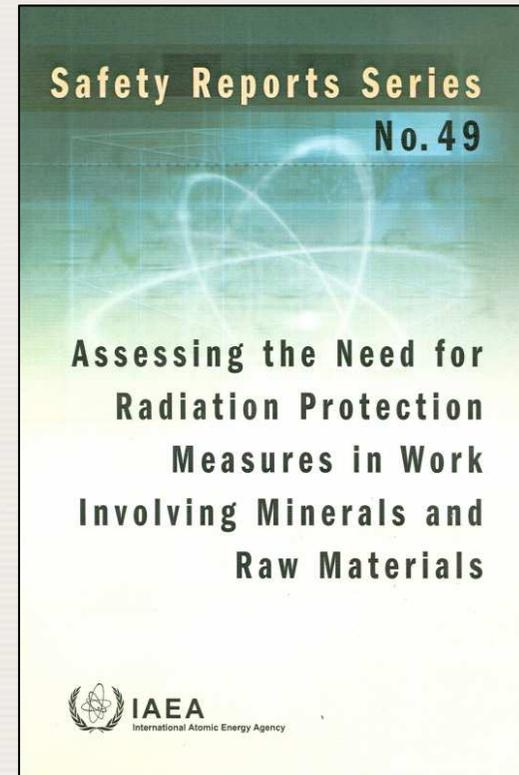
Not defined in the Safety Glossary
It does not serve any useful purpose for radiation protection
Its use is discouraged



Why Good Practice and not Best Practice?

Which industries are affected?

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. Titanium Dioxide
8. Phosphates
9. Zircon & zirconia
10. Metals production (e.g. Sn, Cu, Al, Fe, Zn, Pb)
11. Burning of coal etc.
12. Water treatment – incl. radon



More details in IAEA
Safety Report 49

What are the residues?

They come in a wide range of forms, activity concentrations and volumes

- Waste rock & sub-economic mineralised material
- Process residues
 - Tailings
 - Phosphogypsum
 - Scale
 - Sludge
 - Liquids, precipitates & evaporites
 - Dust
 - Etc, etc

What information is there to assist us?

- IAEA Guidance in many forms

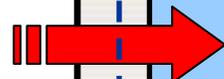
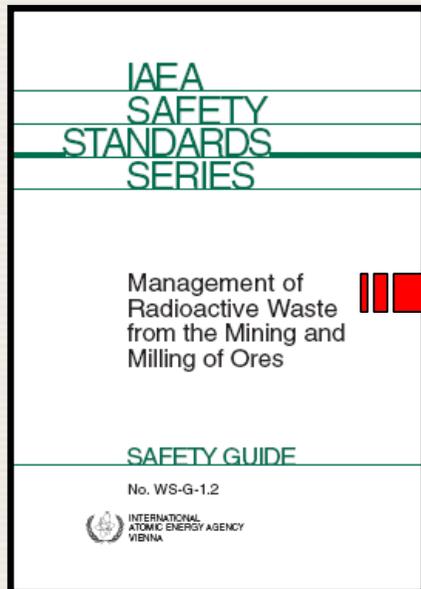
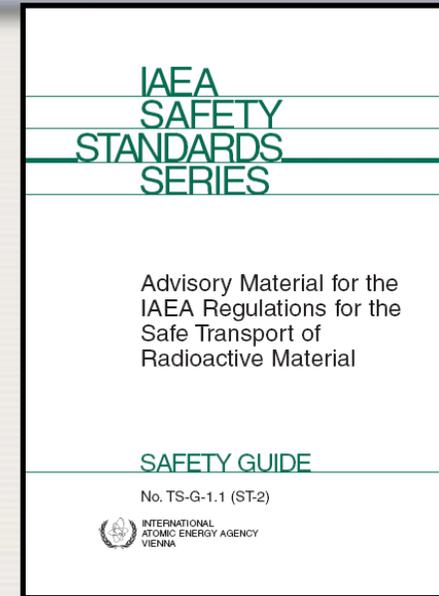
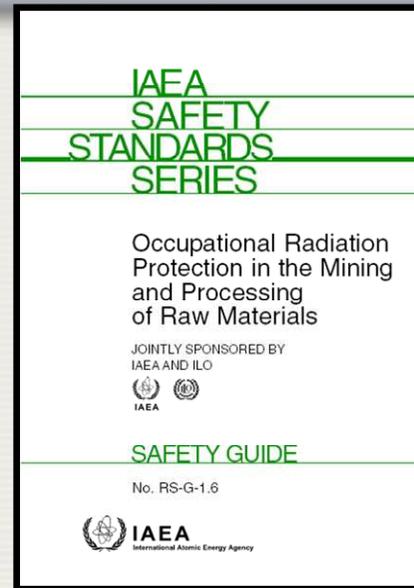
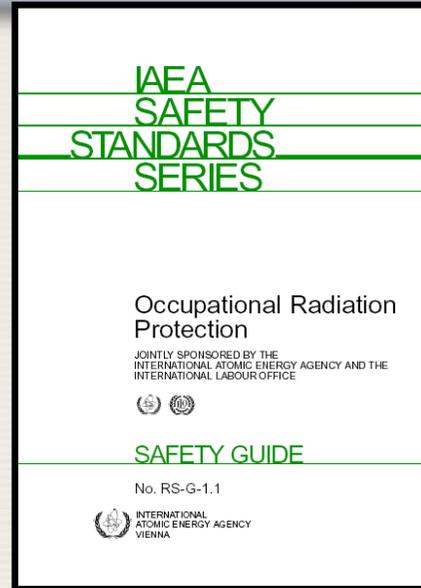
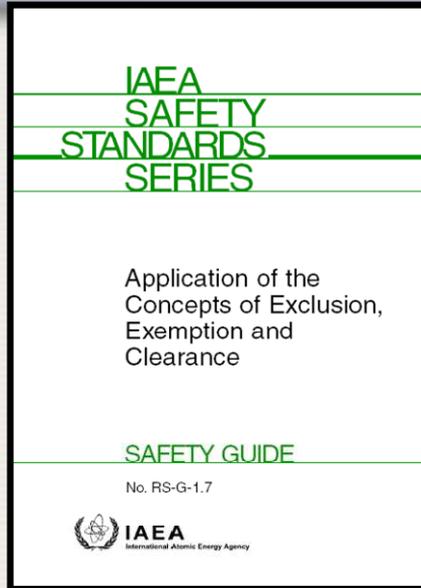
- Safety Fundamentals
- Safety Standards Series – Safety Guides
- Safety Reports
- NE Series Reports
- Technical Reports
- TECDOCS

- Other Sources

- National Standards and Guidelines
- Industry Handbooks and Guidelines
- Etc etc



Safety Guides containing specific recommendations on natural sources



DS 352

NORM

Residues

DS 400

Public exposure to natural sources

GSG-1

Classification of Radioactive Waste

Documentation

IAEA
SAFETY
STANDARDS
SERIES

Management of
Radioactive Waste
from the Mining and
Milling of Ores

SAFETY GUIDE

No. WS-G-1.2

SAFETY SERIES No. 118

SAFETY STANDARDS

safety series

International
Basic Safety Standards
for Protection against
ionizing Radiation
and for the Safety of
Radiation Sources

IAEA Safety Standards
for protecting people and the environment

Regulations for the
Safe Transport of
Radioactive Material
2005 Edition

IAEA Safety Standards
for protecting people and the environment

Fundamental
Safety Principles

Jointly sponsored by
Euratom FAO IAEA ILO IMO OECD/NEA PAHO UNEP WHO

Safety Fundamentals
No. SF-1

Radiation Protection and
Radiopharmaceutical
Management in Mining and
Mineral Processing

IAEA
SAFETY
STANDARDS
SERIES

Occupational Radiation
Protection in the Mining
and Processing
of Raw Materials

JOINTLY SPONSORED BY
IAEA AND ILO

SAFETY GUIDE

No. RS-G-1.6

IAEA
SAFETY
STANDARDS
SERIES

Occupational R
Protection

JOINTLY SPONSORED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY
AND THE
INTERNATIONAL LABOUR OFFICE

SAFETY GUIDE

No. RS-G-1.1

WNA Policy Document

Sustaining Global Best Practices
in Uranium Mining and
Processing

Principles for Managing Radiation,
Health and Safety,
Waste and the Environment

World
Nuclear
Association



When should we apply regulation?

The IAEA recommendation is to use the graded approach:

1. Decision not to regulate (exemption)
 - If dose is less than ~1 mSv/a
2. Notification
 - If dose is far below the dose limit
(similar to exemption but regulator remains informed)
3. Notification + registration
 - Limited controls for gamma and dust needed
4. Notification + licensing
 - Specific measures to control actions of workers – only when dealing with very high activity material in significant quantities

Always be aware of other possible risks

Radiation risk in NORM related situations is often not the most significant risk to people and the environment

Do not forget:

- Chemistry (especially heavy metals)
- Physical risks
- Associated risks (fuels, explosives, etc)

Characteristics of NORM residues

Usually one of two general forms:

- Large volume and low specific activity

OR

- Small volume and high specific activity

..... But never forget to expect the unexpected e.g. A mixture



Objectives of disposal and remediation

- Disposal
 - Stay contained and isolated from the environment
 - Minimise risks of spread of contamination, especially into water-borne pathways
 - Minimise future maintenance requirements
- Remediation
 - Maximise opportunities for future use and minimum controls
 - Get agreement of stakeholders – consult & discuss

What are the options?

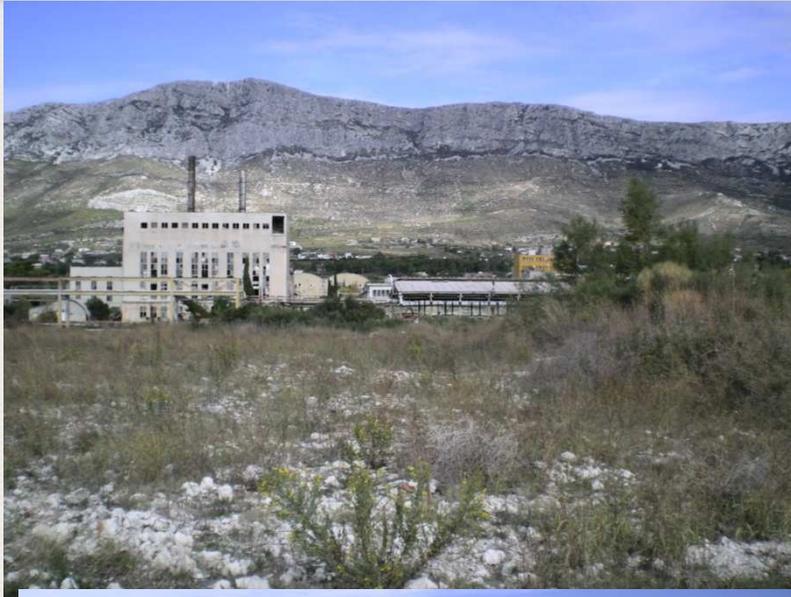
Really only three options:

- Concentrate and contain
 - Tailings dams, burial, land fill, boreholes, etc
- Dilute and disperse
 - Some liquid effluents, some solid residues
- Decay storage
 - Only applicable to some specific flue dusts

Industry case studies- Phosphates

- Major global industry (and here to stay)
- Biggest residue issue is Phosphogypsum – large volume & low activity
- Also scales – small volumes but high activity
- Much recent interest in uranium recovery as part of phosphoric acid production so other considerations may arise
- Sites vary greatly in size, often by water
- Remediation options can be varied

Some sites are smallCroatia



Some are very small....Cyprus



Some are largeHuelva



IAEA

Pointer 37°15'06.64" N 6°55'29.16" W

Image © 2005 DigitalGlobe

Streaming ||||| 100%

© 2005 Google

Eye alt 23291 ft

Phosphogypsum – Other uses.....



Road on a PG Base,
Florida, USA



Industry case studies- Oil and Gas



Industry case studies - Water



Industry case studies- Scrap Metal



Industry case studies- Metal Slag



Industry case studies- Coal and Ash



Mineral sand mining



Mineral Sand mining - remediation



Mineral Sand mining - remediation



Uranium mines: Our objective is–

Puy de L'Age, France



This...a
remediated
uranium mine used
for a trout fishing
club.....

Taboshar, Tajikistan



.....not this – an
abandoned uranium
mine and mill site



Puy de l'Age uranium mine - France



Institutional control - Uranium mines



Summary

- NORM industries are becoming better known and their radiation safety and remediation issues recognised
- Some liabilities are very, very large - whilst others equally troublesome may be small
- We have many legacies to manage as well as current and future production
- There are success stories out there- We must build on our successes
- Remember issues are always site specific to some degree
- The scale and nature of the residue issue will vary a lot
- Innovative solutions do exist, look around
- Identify and communicate with stakeholders

Conclusions

- NORM residue management and remediation is a growing issue
- As public concerns about energy, food and environment grow we need to become more innovative in dealing with the NORM residues
- Don't over regulate
- Think “residue” before “waste”
- There have to be better solutions and it is up to us to develop them

NORM disposal – Australia

