Decommissioning and Closure of Mining and Minerals Processing Facilities in South Africa

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Talk Outline

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• Role of the regulatory body
• Exposure situations
• Characterisation of the facility
• Removal of residual process material
• Dismantling and demolition
• Final radiological survey
• Risks to the public from legacy sites
• Summary
Introduction
Introduction

- South Africa has a large and diverse mining and minerals processing industry that started over a hundred years ago.

- In this presentation decommissioning and closure activities that are typically associated with the mining and minerals processing facilities are discussed.

- Details on the site characterization, closure criteria and assessment methodology are also discussed.
Closure objectives

The objectives of closure is to ensure that the waste management facilities are left in a condition that will ensure their continued compliance with the requirements for the protection of human health and the environment.
Role of the regulator
Role of the regulator

• At a time agreed upon with the regulatory body, and at least five years before the anticipated closure date, the operator should submit a final closure plan for regulatory approval.

• The closure plan is then reviewed by the regulatory body so as to verify its effectiveness.

• The design of the programme is based on the safety assessment in which impacts on human health and the environment over an appropriate period into the future should be considered.
Role of regulator

- Prior to implementing any closure activities, it is important that the closure plan is approved by the regulatory authorities.

- The plan is required to include the changes in technology, regulations, and public concerns that have occurred since the facility was initially authorised, opened and operated.
As part of an institutional control programme, all relevant records of the location and characteristics of closed facilities, restrictions on land use and on-going monitoring and/or surveillance requirements are maintained in accordance with applicable legal requirements.
Role of the regulatory body

• The primary objective of the Regulatory Body is to ensure that the operator fulfil its responsibility to protect human health, and the environment from possible adverse radiation effects arising from NORM facilities.

• Some of the main functions of the Regulatory Body are to:
  – Establish regulations and guides, upon which its regulatory actions are based.
  – Review and assess submissions on safety from the operators both prior to authorisation and periodically during operation as required.
Exposure situations & dose assessment
Exposure pathways

• The decommissioning tasks that will be performed could result in an environmental release from the facility and which have an impact on the local environment must be identified.

• The potential pathways that could be involved with these releases are described and the potential discharge for each task evaluated.
## Exposure pathways

### Exposure Circumstances

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<th>Normal Exposure</th>
<th>Potential Exposure</th>
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<td><strong>Potential Exposure</strong></td>
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<th>Public</th>
<th>Effluent Discharge</th>
<th>Accidental Releases</th>
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<td>Waste Management</td>
<td>Source Loss</td>
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<td>Transport</td>
<td>Future Exposure</td>
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<th>Workers</th>
<th>Operations</th>
<th>Accidental Release</th>
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<td>Maintenance</td>
<td>Source Loss</td>
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<td>Decommissioning</td>
<td>Shield Loss</td>
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Exposure pathways

Conceptual Exposure Model

**SOURCE**
Release or Spill
Materials and Affected Media

**TRANSPORT**
Air, Soil, Groundwater, or Surface Water Migration Mechanisms

**RECEPTOR**
Human or Ecological Point of Exposure
Exposure pathways

**Typical Pathways**

- Atmosphere
- Groundwater
- Surface water
- Soil
- Terrestrial Plants
- Terrestrial Animals
- Aquatic Plants
- Aquatic Animals
- Sediment
- Dose to Humans
Dose assessment

Steps in the process:

• Identify radionuclide source term

• Analysis of the transport of radioactive material

• Defining the release scenarios and pathways to the environment and humans
Dose assessment

- Determine and analyse the consequences of release to humans and environment
- Compare the consequences to regulatory criteria
- Iterate if necessary
Environmental impact

• During decommissioning of NORM facilities, radioactive and nonradioactive pollutants may be released to the environment.

• These releases are controlled in compliance with appropriate national regulations.
Environmental impact analysis

• Dose to critical group = sum of doses via all discharge routes and pathways

• Doses are calculated on a per age group basis

  1-2 years
  2-7 years
  7-12 years
  12-17 years
  Adult
Characterisation of the facility
Characterization of the facility

• Authorisation holder conducts safety assessment for decommissioning and for implementing a safe approach during the work. Safety assessment report is informed by:
  
  – The survey conducted to identify the inventory and location of radioactive materials and other hazardous materials.

  – An adequate number of radiation and contamination surveys conducted to determine the radionuclides, maximum and average dose rates, and contamination levels for inner and outer surfaces throughout the facility.
Characterization of the facility

- Results of such surveys assists in the preparation of radiation and contamination maps.

- Special surveys to determine the penetration depth and extent of contamination may also be necessary.
Removal of residual process material
Removal of the residual process material

• Significant amounts of residual process material may be present in both planned and unplanned locations at the time of shutdown.

• This material, which may consist of high activity NORM waste, can give rise to hazards when disturbed by decommissioning operations.

• Appropriate information on the disposition of the material should be provided.
Removal of the residual process material

- Even when the bulk of the residual process material has been removed, a significant amount of radioactive contamination may remain.

- The expeditious removal of the residual process material, which would be beneficial and would reduce requirements for monitoring and surveillance, is considered.
Decontamination
Decontamination

The objectives of decontamination include:

• Reduction of potential on-site and off-site radiological hazards associated with further decommissioning activities;

• Reduction of exposure to permit manual dismantling;

• The reclassification of areas to a less hazardous category;

• The salvage of equipment, materials or premises, including clearance for unrestricted use;
Decontamination

Before any decontamination technique is selected, an evaluation of its effectiveness and of the potential for reducing total exposure should be performed.

Examples of decontamination techniques:

• High pressure washing
• Sandblasting
• Acid leaching
The evaluation of the decontamination technique include:

- The probable radiation doses involved;
- An assessment of the potential impact on the workers and the environment;
- Assessments of the primary and secondary wastes arising from the decontamination, including their volumes, nature and activity.
Decontamination

Consideration is given to the compatibility of waste with existing systems for treatment and disposal.

In any case, before waste is generated, adequate arrangements for disposal or storage are in place.
Dismantling
Dismantling

There are many options available for dismantling, and their selection depends on the types and characteristics (size, shape and accessibility) of the equipment and structures to be dismantled.

Some considerations:

• The dismantling equipment to be used should be reliable and simple to operate, decontaminate and maintain.

• There should be effective methods available for controlling airborne radionuclides.
Dismantling

- There should be effective methods available for controlling hazardous materials other than radiological materials.

- The waste containers and the associated handling systems and routes for movement should be designated prior to the start of dismantling work.

- The time necessary to perform the dismantling task should be evaluated.
Dismantling equipment

Specialised grinder for skimming the surface of concrete. Useful for removing high grade gold deposits from concrete.
Dismantling equipment

Safe demolition of steel/concrete

First sheering down the roof

And then crushing down the

Concrete and brick walls
Dismantling equipment

• Largest demolition sheers
Demolition
Demolition

• In many cases, activities for decontamination and dismantling are aimed at making the demolition of the building structure a non-radiological activity.

• Care is exercised during demolition to ensure that contaminated material is segregated from non-contaminated material.
Final radiological survey
Final radiological survey

At the completion of decontamination and dismantling activities, a radiological survey of the facility is performed to demonstrate that the residual activity is acceptably low and within the criteria set by the regulatory body and that the decommissioning objectives have been fulfilled.
Final radiological survey

- The criteria established by the regulatory body is in terms of measurable quantities that can readily be compared with field measurements.

- Sampling for chemical contamination could be combined with the radiological survey.
Risk to the public arising from legacy sites
Summary
Summary

• Uncontrolled closure and decommissioning of mining and milling generates a range of different wastes which have the potential to impact the public and the environment.

• There is a range of pathways by which the operation may cause exposure and these may change over the life of the facility.

• Tailings and sometimes waste rock are generally have most significant potential impacts.

• Economic and social factors are a important consideration for both the operator and the regulator.
Thank you....