General Methodologies for Control

Training Package on Occupational Radiation Protection in Uranium Mining and Processing Industry
Occupational Health & Safety Considerations
Operational Hazards

• Occupational exposure to radiation is only one hazard at an operation.
• Many other hazards have higher risks
  – Explosives, chemicals, vehicles, machinery, dusts, etc.
• Safety generally focuses on acute hazards while health has a main focus on chronic hazards
• To ensure effective control of all health & safety hazards an effective management system is required
• Radiation protection requirements must fit into the overall occupational health & safety management system
Overview of OHS Management

• An effective OHS management system includes:
  – Means to identify and assess hazards
  – Identification & assessment of relevant controls
  – Means to review control effectiveness
  – Incident investigation processes & feedback of learnings
Safety Culture

• Culture refers to the factors that influence behaviours & attitudes in an organisation

• Factors that can influence the safety culture include:
  – Senior management commitment that safety is the overriding priority
  – Senior leaders reinforce safety culture at every opportunity
  – Management support through provision of appropriate resources
  – Leadership influencing work groups regarding acceptable safety practices
  – The management system reinforces a learning and questioning attitude at all levels of the organization
  – Engagement of workers in health & safety planning
Emergency Management

• Emergency response plans are required for the general operation of any mining or milling process.

• The presence of radioactive materials adds some complexities to the emergency management processes.
  – Appropriate advice should be sought during development.

• Protection of people, plant and environment remain the critical order for the focus of all emergency management.
Hierarchy of Control
Overview

• The hierarchy of control is a risk management system to eliminate or reduce risk
  – Higher controls are more effective
  – Lower controls require more supervision & participation
Definitions

• Elimination
  – Eliminate the source of radiation. Difficult to achieve in planned exposure situations but elimination of exposure pathways may be possible

• Substitution
  – Hard to achieve in planned exposure situations. Substitution must be considered to reduce exposure from specific pathways (i.e. wet vs. dry processes)

• Engineering
  – These controls are best applied during operation design. They must be inspected & maintained to ensure effectiveness.
Definitions

• Administration
  – Policies & procedures that are required to be followed. These have been developed to minimise exposures

• Behaviour
  – This is a reflection of the safety culture & is heavily influenced by leadership. Organisations whose employees demonstrate & reinforce good behaviours apply administration controls & wear PPE

• Personal Protective Equipment (PPE)
  – Where higher level controls are not feasible PPE can be implemented to ensure protection. Selection & use must abide by appropriate standards & equipment must be fit for purpose
Dose Minimisation Techniques

• Time – Minimising time spent in high dose rate areas will reduce exposure for all pathways.
  – Use direct reading equipment (electronic personal dosimeters (EPD)); task rotation; sign posting high dose areas (supervised & controlled); meal/meeting areas outside of mineralisation/high dose areas

• Distance – Maximising the distance of person from sources reduces exposure
  – Keep high occupancy areas away from stockpiles/high dose areas; plant design to maximise operator distance

• Shielding – Simple engineering controls generally already in use
  – Processing tanks, pipes & vessels; shotcrete; ventilation; vehicle exteriors;
Exposure Pathways
Overview

• Primary exposure pathways for consideration
  – External exposure to gamma
  – Inhalation of radon & radon progeny
  – Inhalation of long lived radioactive dust (LLRD)
  – Ingestion, wound contamination & absorption

• Modules developed to specifically look at each pathway
<table>
<thead>
<tr>
<th>Activity Type/Pathway</th>
<th>External Gamma</th>
<th>Inhalation Radon Progeny</th>
<th>Inhalation LLRD</th>
<th>Ingestion, wound contamination &amp; absorption</th>
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<td>M</td>
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<td>M</td>
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<td>Surface Mining</td>
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<td>ISL</td>
<td>L</td>
<td>L/H (degassing)</td>
<td>L* (M dry clean up)</td>
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<tr>
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<td>M</td>
<td>L/H (H confined spaces, M buildings)</td>
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<tr>
<td>Processing</td>
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<td>L (H confined spaces, M buildings)</td>
<td>L (VH final product)</td>
<td>L/M (final product)</td>
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<td>VL</td>
<td>VL/H (accident)</td>
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<td>M</td>
<td>L/H (process plant decom)</td>
<td>L/H (process plant decom)</td>
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Key Messages

• Radiation protection must be integrated into the occupational health & safety management system
• An organisation’s safety culture has a major impact on doses
• The hierarchy of controls should be used to determine appropriate control for all hazards
• Preference needed for elimination, substitution & engineering controls
• Controls of time, distance & shielding can be applied
• Risk from exposure pathway dependent on operational activity
Facilitated Discussion 1

• Describe the hierarchy of control & discuss how higher level controls are more effective?
  – Elimination, substitution & engineering controls do not rely upon individuals to implement and are therefore more effective as they have been planned in the design phase of the operation to reduce exposure
  – Administration, behaviour & PPE all require individual willingness for their effective implementation. These are the easiest controls to circumvent by individuals
Facilitated Discussion 2

• How can the dose minimisation techniques of Time, Distance & Shielding be used to control exposures from the primary exposure pathways?
  – Example answers: minimising time around gamma sources; increase distance of high occupancy area from sources; use of shotcrete or effective ventilation.
Thank you!