Case Study Surface Mining

Training Package on Occupational Radiation Protection in Uranium Mining and Processing Industry
Process Description

• Most common mining method for ore body that is close to surface or has surface expressions
  – Generally most economic method for shallow low grade deposits
  – Bench mined
Design your own open cut uranium mine

- Depth of deposit?
- Uranium grade?
- Localised geology/hydrogeology?
- Climate & topography?
- Ore crushing?
- Ore carriage?
Model Mine Default Design

- Deposit extends to 200m
- Ore grade ~0.3%
- Ore hosted in schist rock with some localised faulting
- Major aquifer at 70m, dewatering possible
- Tropical environment (wet/dry seasons)
- No major water features nearby
- Flat topography
- Trucked to surface jaw crusher to feed mill
Design & Operation – Mine Design

- All support facilities (offices, rest areas, maintenance workshops, etc.) should be situated away from mine, associated stockpiles & crushing
- Dust suppression should be a primary concern to control occupational, environmental & public exposure
- Gamma exposures can be easily determined from ore grade
- Water control (pit dewatering)
Determine the Exposure Pathways

• For each stage/exposure group assign a relative level for the importance of the exposure pathway
  – VH-very high, H-high, M-medium, L-low, VL-very low

• Special is for unusual cases such as maintenance
### Determine the Exposure Pathways

<table>
<thead>
<tr>
<th>Stage/Pathway</th>
<th>Gamma</th>
<th>Radon</th>
<th>LLRD</th>
<th>Special</th>
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</thead>
<tbody>
<tr>
<td>Production</td>
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<tr>
<td>Drill &amp; Blast</td>
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<td>Pit Maintenance</td>
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## Model Answers

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<td>M radon in deep pits</td>
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What are the potential critical areas for radiation protection?
Critical Areas – Model Answers

• External gamma exposure from stockpiles & in mine
• Inhalation of dust in pit & around crusher
• Inhalation of radon in confined spaces for ore handling
• Contamination of vehicles & other equipment (pit dewatering pumps)
What Monitoring is Required

• **Gamma** – which groups need personal monitoring, can monitoring be optimised?

• **LLRD** – Sizing, solubility, personal monitoring program for SEGs?

• **Radon** – monitoring methods, program to make dose assessment, localised or default DCF, where to locate monitors?

• **Contamination** – what are the critical areas/equipment?

• **Control Monitoring** – what program needs to be developed to monitor controls?
## Develop a Monitoring Program

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## Develop a Monitoring Program – Model Answers

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<td>Area</td>
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Model Answers – Monitoring

• Gamma – Personal monitoring for all work groups working in pit or stockpiles, selective monitoring for others
• LLRD – Determine AMAD & solubility, develop SEGs & implement appropriate personal monitoring program, area based monitoring can be used for workshops/offices
• Radon – Area based monitoring, averages to be applied based on occupancy, measurements to determine localised or default DCF requirements
• Contamination – Program to monitor vehicles & equipment leaving mine, inspection of offices, workshops & rest areas
• Control Monitoring – Regular inspections of dust suppression
What Controls do you need for your mine?
Model Answers for Controls

• Gamma – Ensure office & workshops remain away from stockpiles, use of clean fill for base in production areas
• Radon – Enclosed cabins & offices with flow through AC
• LLRD – Dust suppression (water trucks, water sprays at crusher)
• Contamination – clearance processes, housekeeping schedules
Dose Assessment

• How do assess gamma for those not given personal monitors?
• What is the dose conversion factors for the various areas and what does it consider – radionuclides, particle size, solubility
• How will radon areas be selected?
• What is the process for selecting SEGs?
Dose Assessment Model Answers

• Workgroup averages for workers without personal monitors
• LLRD, use equilibrium & assume default AMAD, use maximum DCF for each radionuclide solubility.
• Radon areas can be broad (i.e. office/workshop if located nearby)
• Discuss with operators their tasks to determine SEGs & take statistically valid sampling
Key Messages

• All non-critical work & infrastructure away from operations (pit, stockpiles & crushing)
• Use enclosed cabins with flow through AC for production & drilling
• Determine critical information (DCF, particle sizes, solubility) but can use conservative assumptions
• Develop effective monitoring program & review regularly
• Inspect all controls regularly & work with operations to ensure they are maintained
Thank you!