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General Methodologies for Control

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



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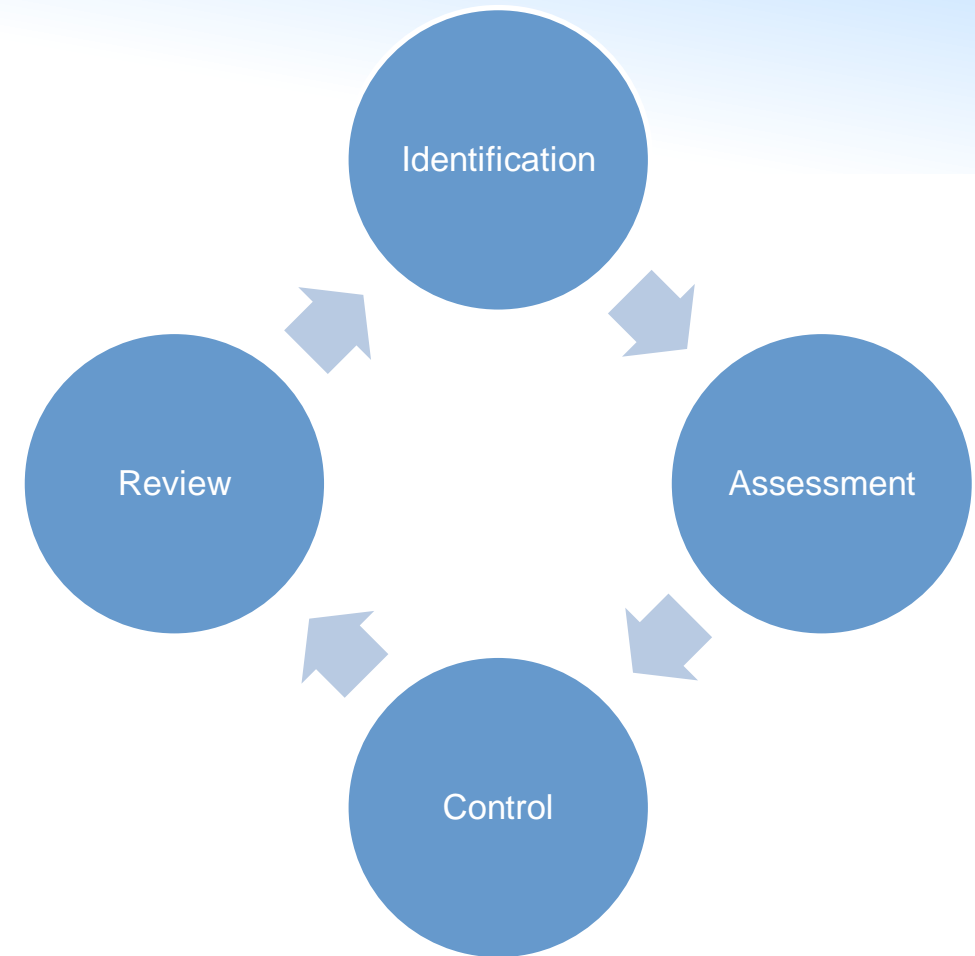
Occupational Health & Safety Considerations

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



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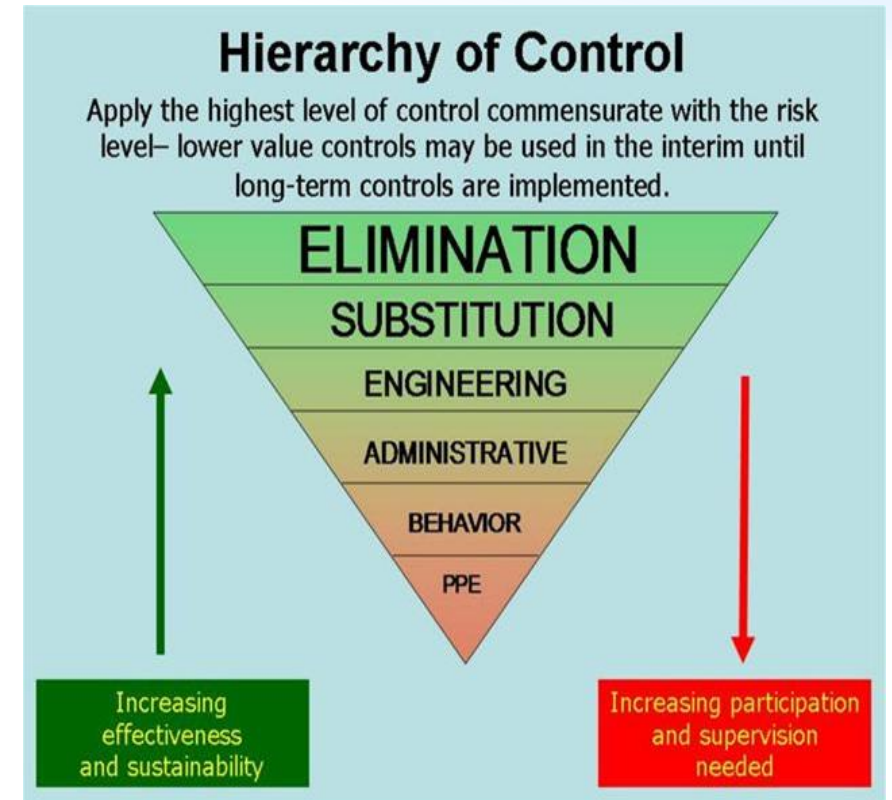
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Hierarchy of Control



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;



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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

Exposure Pathway Profile



| Activity Type\Pathway | External Gamma | Inhalation Radon Progeny | Inhalation LLRD | Ingestion, wound contamination & absorption |
|-----------------------|-------------------|------------------------------------|---------------------------|---|
| Exploration | L | L | M | L |
| Underground | M | H | L | L |
| Surface Mining | M | M | L | L |
| ISL | L | L/H (degassing) | L* (M dry clean up) | L |
| Heap | M | M | L | L |
| Processing | M | L (H confined spaces, M buildings) | L (VH final product) | L/M (final product) |
| Non-Conventional | Process dependent | Process dependent | Process dependent | Process dependent |
| High Grade | VH | VH | H | H |
| Tailings | M | M | M (dried) | L |
| Transport | M | VL | VL/H (accident) | VL/H (accident) |
| Decommissioning | M | M | L/H (process plant decom) | L/H (process plant decom) |

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.



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Thank you!

