Radiation Protection Programme (RPP)
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Radiation Protection Programme (RPP)

- Purpose to demonstrate management responsibility for protection, safety and optimization using management structures, policies, procedures and organizational arrangements
- Employer to establish and manage RPP in close cooperation with company’s Health & Safety team
- Roles and responsibilities to be documented
Radiation protection is only one element in ensuring the overall health and safety of workers, the public, and protection of the environment.

The radiation protection programme (RPP) should be established in close cooperation with those responsible for other areas of protection and safety such as: Industrial hygiene, Industrial safety, Fire safety, Environmental protection etc.

RPP should consider all radiation sources including natural radioactive sources.
The RPP for a NORM industrial facility shall contain the following components:

- Management system
- Assignment of responsibilities
- Controlled and supervised areas
- Local rules and supervision
- Monitoring, recording and reporting
- Education and training
- Health surveillance
The content of the RPP should be commensurate with the nature and extent of the risks:

- Many NORM operations involve only low risks
- There is no real prospect of a radiological emergency
- It is essential to consider the effectiveness of other forms of regulation in minimizing radiological risks:
  - OHS regulation
  - Environmental protection regulation
The hierarchy of control measures

Engineered controls and design features

- Use these first
  - Containment, ventilation, design for ease of decontamination (and shielding)

Administrative controls (systems of work)

- Where use of engineered controls is not sufficient alone to restrict exposures, consider admin controls

Personal Protective Equipment (PPE)

- Use when engineered controls and admin controls are not sufficient to provide adequate protection
Control of exposure - Gamma

- Time, distance and shielding
- Control measures are usually only required for high activity NORM:
  - Facility design with respect to bulk material
    - Distance (dedicated storage areas)
    - Shielding (walls, stockpiles of low activity material)
  - Rules and working procedures
    - Exposure times
  - Warning signs, physical barriers
  - Training and awareness
Control of exposure - Dust

- Complete containment of material in NORM industrial facilities is often impractical, especially where large quantities involved
- Spills and spread of materials to other areas are often of no radiological significance unless activity concentrations are high
- Workplace ventilation (dust may already be controlled by OHS regulation for non-radiological reasons)
• Ventilation
  – In underground mines especially, this can be crucial

• Occupancy time
  – Where there are practical limitations on the provision of adequate ventilation

• Workplaces involving minerals with a high $^{232}\text{Th}$ content, e.g. monazite, attention may have to be given also to the control of thoron ($^{220}\text{Rn}$)
Personal Protective Equipment (PPE)

• Selection of PPE depends on the hazards involved in the work
• Employer should specify appropriate protective clothing in accordance with risk of internal and external exposure
• PPE should provide adequate protection and be comfortable and convenient to use
• For example:
  – overalls or protective coats
  – head coverings
  – safety eyewear
  – gloves
  – impermeable footwear
  – respiratory protection
• Individuals should be trained and wear PPE provided
Depending on the nature of the operation and the risks involved, the following expert services may be needed in a NORM facility:

- Radiation protection and dosimetry
  - Radiation protection officer (RPO)
- Ventilation engineer:
  - e.g. in underground mines and other facilities with high potential for dust and/or radon
- Occupational medicine (for health surveillance)
- Industrial hygiene and safety
- Environmental practitioner
Qualified Experts and Radiation Protection Officer

- Radiation Protection Officer (RPO) to be appointed to oversee compliance with regulatory requirements
- QE and RPO to be provided with adequate equipment, resources and staff
- Employer to consult QE as appropriate on all aspects of the RPP
- QE to report to employer representative with overall responsibility for safety
Local Rules and Procedures

- Management required to establish Local Rules, to ensure protection and safety of workers
- Local Rules to be made known to workers and be prominently displayed or otherwise made available
- Local Rules to be adequately supervised and all workers to be given adequate training to enable them to comply with Local Rules and procedures
Local Rules and Procedures

• Local rules and procedures must be developed and tailored to the type of NORM facility involved
• For example, in underground mines and other workplaces where exposure to airborne dust and/or radon is of significant concern, special reference may need to be made to:
  – Monitoring of dust and/or radon
  – The maintenance of adequate quality/quantity of ventilation air
  – The control of ventilation
  – The provision of alternative means of ventilation if the normal ventilation system fails
Area classification should be considered when there is occupational exposure to radiation

Prior radiological evaluation to identify areas in need of classification

Two types of areas to be clearly defined in the RPP;
   – Controlled Areas
   – Supervised Areas
Controlled areas

- To be designated when specific measures for protection and safety are required for:
  - Controlling exposures or preventing the spread of contamination
  - Preventing or limiting the likelihood and magnitude of exposures in anticipated operational occurrences and accident conditions
Requirements for Controlled Areas -1

- Delineated by physical or other suitable means
- Radiation warning symbol and access instructions to be displayed at access points
- Access restriction by physical or administrative means as appropriate
- Information, instruction and training for persons working in area
Measures for protection and safety within area to be established, e.g.

- Physical measures to control the spread of contamination
- Local rules and procedures

Personal Protective Equipment, changing facilities and monitoring equipment to be provided at entrance to area (where appropriate)

Monitoring equipment, washing facilities and storage for contaminated PPE to be provided at exit from area (where appropriate)
Supervised areas

- To be designated when it is necessary for exposure conditions to be kept under review (when not already designated as a controlled area)
- Areas where prior radiological evaluation predicts effective dose greater than 1 mSv per year should be designated as supervised areas
- Delineation and signs may be appropriate but not always (e.g., if accessible to the public)
Classification of areas

- The classification of areas and means of access control may require special consideration in some types of NORM facility.
- It may be appropriate in some underground mines with high exposure potential (e.g. radon) to designate the entire underground area as a controlled area, rather than trying to distinguish between controlled and supervised areas.
- Physical barriers or existing access controls provide a means for classification of areas.
  - e.g. physical barriers, locks and interlocks
Overview of Monitoring

- Measurement of radiological parameters in an operating NORM facility provides the diagnostic information necessary for maintaining protection and safety.
- Departures from normal operating conditions and the need for correction are quickly detected.
- The RPP should include provisions for:
  - Monitoring the performance of control equipment such as ventilation.
  - Identifying deficiencies in design or operation.
  - Predicting and explaining trends as the operation proceeds.
    - Enables the planning of mitigatory measures in the longer term.
    - An essential part of the optimization process.
Overview of Monitoring

- A comprehensive survey of gamma, dust and radon should be conducted during initial operation, in greater detail than during the pre-operational assessment.
- The frequency and scale of ongoing monitoring depends on the exposure levels and their variability, as determined in the initial and subsequent assessments.
- In facilities with a high potential for radon and/or dust, the RPO and ventilation officer should liaise closely in the execution of the monitoring programme.
- Undertaken by qualified person.
- The monitoring data should be used to predict individual exposures.
- The monitoring programme should be specified in the local operating instructions.
- Survey locations and monitoring results must be properly recorded.
Monitoring is required where NORM is:

- Produced
- Processed
- Handled
- Stored
- Transported
- Disposed

Three types of monitoring are generally recognized, requiring different levels of expertise:

- Task monitoring
- Routine monitoring
- Special monitoring
Task Monitoring

- Monitoring applies to a specific task.
- It provides data to support the immediate decisions on the management of the task.
- It may also support the optimization of protection.
- Examples:
  - Checking for contamination of clothing before leaving an area where NORM decontamination work is being carried out
  - Monitoring the radon levels at the exit points of fluids and gases in an oil and gas production facility during maintenance
  - Measuring gamma dose rates where high activity NORM may accumulate, including when equipment is opened for operational reasons
  - Determining whether items meet clearance criteria prior to release
Routine Monitoring

• Associated with continuing operations
• Intended to meet regulatory requirements
• Demonstrate that the working conditions, including the levels of individual dose, remain satisfactory.

• Examples:
  – Regular dust monitoring of production workers
  – Monthly gamma survey of workplaces
Special Monitoring

- Investigative in nature
- Where incomplete information is available
- It is intended to provide detailed information
- Examples
  - During commissioning stage of new facilities,
  - During decommissioning
  - Following major modifications to facilities or procedures,
  - When operations are being carried out under abnormal circumstances.
• Elements of the program will require monitoring of:
  – Gamma
  – Dust
    o dust concentrations,
    o particle size and
    o potential for inhalation
  – Radon and decay products
  – Surface contamination

• Monitoring depends on the work environment

• (Refer to earlier lecture on monitoring for more detail)
Monitoring of controls

- Identify the key controls for radiation protection
- Monitor that the controls are working
- For example:
  - Ventilation system performance
    - Regular measurements should be made of the flow rates at the inlet and outlet of the auxiliary ventilation duct to demonstrate that leakages are under control
  - Effectiveness of interlocks and access systems
    - Checks if they are working
  - Effectiveness of cleanup procedures
    - Workplace inspections
  - PPE is maintained and used correctly
    - Correct use, wear and tear,
  - Good housekeeping
Monitoring of assessment of dose

- Assessment of doses is required for:
  - Optimization of protection
  - Compliance with dose limits
  - Individual dose records

- Use individual or workplace monitoring, or a combination of both, as appropriate

- Individual monitoring of a subset of workers may be appropriate for groups of workers with similar work patterns and moderate exposure levels
Dose Assessment Monitoring

• Monitor the exposure pathways;
  – Gamma
  – Dust
  – Radon and decay products
The education and training programme should include topics specific to radiation protection in NORM industrial operations. Depending on the type of NORM facility, such topics might include:

- The properties and health effects associated with:
  - Uranium, thorium, radium, etc.
  - U, Th series radionuclides in dust
  - Radon, thoron (where appropriate) and progeny
- Measurement of airborne activity (dust, radon)
- The functioning and purpose of the ventilation system, and its importance for radiation protection
- The purpose of and methods for controlling and suppressing airborne dust
Worker’s health surveillance

• Health surveillance programmes for workers in NORM industrial facilities need be no different in principle from those for general industrial activities involving exposure to radiation

• Such programmes are:
  – Based on the general principles of occupational health
  – Designed to assess the initial and continuing fitness of workers for their intended tasks

• The working and environmental conditions in many NORM facilities, especially mines, may be different from those in normal facilities involving radiation sources

• In order to be familiar with such conditions, the occupational physician in charge of the health surveillance programme may need to periodically visit the workplaces concerned.

• May not be required for all industries
The RPP should be regularly audited and reviewed by persons who are technically competent to enhance the effectiveness and efficiency of the RPP.

Audits and reviews should be performed using written procedures and check lists at appropriate intervals:

- When required by the regulatory body
- When considered necessary by management
- Following implementation of a new RPP or addition of significant new content
- Following significant reorganization/revision of the RPP
- To implement previously identified corrective actions
Key Messages

- The levels of detail should be commensurate with the risk (i.e.; a graded approach)
- RPP should be established and maintained for NORM facilities
- The content of an RPP is based on components outlined in GSR Part 3
- Control measures should include; engineered, administrative controls and provide PPE necessary to ensure objective achieved
Exercise

If you were thinking about a mine what might you think about for ventilation?

- Ventilation systems are crucial in underground mines for the control of dust and/or radon
- Design should be an integral part of mine planning/development
  - Where possible, radon buildup should be minimized by:
    * Not passing fresh air through mined-out areas
    * Achieving a ‘one pass’ system
  - Air velocities should not be so high as to resuspend dust
  - Air intakes and exhausts should be well separated
  - Primary ventilation should be operated continuously if possible
  - Access of workers to any non-ventilated areas should be prevented unless specially authorized and adequately protected
  - Fixed work stations in return airways should be avoided
    * If this is not possible, provide operator booths with filtered air supply