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Radiation Protection Programme (RPP)

- Radiation protection perspectives
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- Local operating instructions
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- Monitoring for operational control
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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 co-operation 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.

RPP – main components

- 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

RPP – main components

- 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)

Control of exposure - Radon

- 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}Th content, e.g. monazite, attention may have to be given also to the control of thoron (^{220}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



Qualified experts

- 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

Classification of areas

- 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

- 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

Requirements for Controlled Areas -2

- 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)

- 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 (eg. 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

- 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

- 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

- 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.

Monitoring

- Elements of the program will require monitoring of:
 - Gamma
 - Dust
 - dust concentrations,
 - particle size and
 - 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



Education and training

- 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

Audit and reviews

- 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

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