Case Study – Exploration

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

Exploration Description

- Exploration is the process by which prospective uranium deposits are found, identified, classified, verified, quantified and demarked for ownership
- Often exploration is performed by small or inexperienced companies and the primary target may not be uranium
- Radiological controls may not be as extensive as for other stages of the development of a uranium resource
- Doses arising from exploration are typically low providing normal OHS practices are followed (particularly PPE e.g. dust masks during dusty operations)

Some Aspects of Exploration

- Claim staking;
- Office work – reviewing geologic data and data analysis;
- Geophysics – ground and aerial surveys;
- Soil and water sampling;
- Radiological studies – e.g. radon emanation from soils;
- Drilling and core sampling;
- Core storage;
- Test pitting and trenching;
- Construction of adits and shafts for underground exploration;
- Extraction and off site testing of bulk samples for metallurgical testing;
- Test mining to verify mining methods and feasibility; and
- On site disposal of wastes arising from exploration

A Typical Exploration Drill Site

The Radiation Protection Aspects

- For exploration the radiation protection requirements centre around the following aspects:
  - Drilling
  - Bulk sampling (tonnes) with earth movement or creation of tunnels for larger scale trials
  - Coring from exploration wells
  - Storage and potential disposal of material collected during exploration
  - The exploration site if the uranium is at or near surface
  - Off site study of the sampled material

Build your own Exploration Program

- Chose your resource target: shallow or deep, high or low grade, large or small
- Chose your drilling method: wet based – diamond or mud rotary; dry based – air rotary or air percussion; other – auger, push drilling, sonic, reverse circulation
- Are you doing a bulk excavation: if yes then surface scrape, deep excavation, underground portal
- Chose your storage of samples: bags in open shed, core farm, shipping container,
- Will the material be disposed of on site: sumps, chips, cores, bulk samples

Model Answer: Build your own Exploration Program

- Large area low grade deposit – near surface with surface expression
- A combination of air percussion for bulk samples and diamond drilling for mineral resource confirmation compliance
- If there are positive drilling results then plans for bulk sampling via a surface scrape to 10 metres
- Cores and chips stored in a series of shipping containers, if bulk sampling occurs than a bunded area created for the scraped material
- Cores and chips stored for 5 years for mineral resource confirmation purposes and then disposed of on site in drilling area, if bulk sampling occurs then material back in scraped area and covered

Determine the Exposure Pathways for your Plant

- For each stage 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

Exposure Pathways for your Exploration

Stage/Pathway	Gamma	Radon	LLRD	Special
Drilling program				
Bulk sampling				
Sample storage				
General site				
Off Site				
Well logging				

Model Answer: Exposure Pathways for your Exploration

Stage/Pathway	Gamma	Radon	LLRD	Special
Drilling program	M	L	H*	*PPE often used
Bulk sampling	M	L*	M	* Radon may concentrate in scrape
Sample storage	M	H*	L	*radon in sealed containers can be VH if not ventilated prior to entry
General site	M	L	L*	*upwind of drilling
Off Site	L	L	M*	Cutting sample preparation of ore samples
Well logging	M	L	L	Using of gamma and neutron sources

What are the potential critical areas for radiation protection

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Model Answer Critical Areas

- Dust generation during air percussion drilling
- Radon concentrations in storage containers if they are not ventilated prior to entry

What Monitoring is Required

- Gamma – which groups need personal monitoring, can monitoring be optimised
- LLRD – breakdown what radionuclides in what areas, how to determine, activity measurement
- Radon – where and when to monitor
- Contamination – what is the critical areas and do you need biological monitoring (uranium in urine)

Model Answer Monitoring

- Gamma – As there is unlikely to be any radiation support on site, the cheapest method is to use personal dosimetry for all people working on mineralised area or the storage area
- Radon progeny – No personal monitoring, some radon TED for area levels on site. Special practices for entry to storage containers requiring forced ventilation for an hour prior to entry
- LLRD – Personal air sampling for drillers. Samples measured for alpha activity or weighed on site with a percentage sent away for alpha counting to derive activity concentrations
- Contamination monitoring not performed as not expected to be a significant pathway. Urine analysis only considered if there is a accident with the potential for direct ingestion or injection

What are Some of the Critical Controls

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Model Answer: What are Some of the Critical Controls

- Use of respiratory protection (PPE) during drilling which generates dust
- Position the offices and camp on a un-mineralised location upwind of the operations to reduce gamma & LLRD
- Ensure shipping containers have forced ventilation for at least an hour prior to entry
- Safety using of gamma and neutron sources

Dose Assessment

- How to determine LLRD dose

Model Answer Dose Assessment

- Calculate LLRD dose using the time the workers are on site, the workgroup average airborne activity and a dose conversion factor based on equilibrium and an AMAD of 5μm
- If alpha counting not available on-site, as interim step measure mass and use mass concentration (mg/m^3) and multiply it by the measured activity (Bq/mg) to get the average airborne activity concentration. If the activity is unavailable use the concentration of the higher grades in the ore body (conservative approach)

Key Messages

- Doses from exploration are generally low, variation requires investigation
- Lack of active radiation protection oversight may lead to higher exposures
- Gamma is normally the dominant pathway for surface deposits
- The exposure pathway with the highest potential for enhanced exposure is LLRD
- With good OHS practices the most likely dominant pathway will be gamma and this can be easily managed to ensure workers are well below limits

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Thank you!