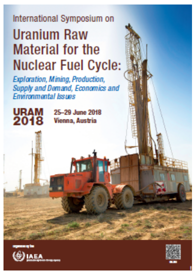

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Effective Radiation Monitoring: Back to Basics

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INTRODUCTION

Radiation monitoring programs are a key aspect of the role of radiation practitioners in the uranium mining and mineral processing sector. An effective monitoring program enables ongoing assessment of the integrity of existing radiation exposure controls; an upward trend in monitoring results can indicate failure of controls or the need to design and implement additional controls. Outputs from radiation monitoring programs allow operations to demonstrate compliance with regulatory requirements, and provide a solid base of factual data that can be drawn upon for communication of relative risk or in the event of scrutiny from regulators, from the workforce, or from community representatives. Importantly, competent radiation monitoring conducted with a good awareness of the mining or mineral processing operation can provide feedback to assist in decisions which optimise both production and radiation exposures at the same time.

BACKGROUND

Uranium mining and mineral processing operations are regulated under a range of frameworks administered at international, national and local levels. Underlying the frameworks and regulatory systems is the ICRP "System of Radiological Protection"[1]. This consists of:

• Justification –where a project should only proceed if the benefits outweigh the risks;
• Optimisation –where doses and impacts should be as low as reasonably achievable (ALARA); and
• Limitation –where absolute upper limits are established.

To put this framework into practice, operations are generally required to implement a radiation management plan (RMP). In Australia the Mining Code [2], requires each operation to produce an RMP, which will typically include an outline of operational parameters, exposure pathways and controls, and a radiation monitoring program. Radiation management plans are structured so that compliance with the document demonstrates compliance with relevant regulatory frameworks, and are reviewed and approved by the appropriate regulatory body.

Practicality and ease of implementation are key factors for successful RMPs. Radiation management is most effective when it takes a risk-based approach, specific to the operation –and the assessment of risk needs to be based on a comprehensive understanding of potential radiation exposure pathways.
It is therefore essential that an operational radiation monitoring program is both relevant and effective with an end goal of being valuable both for demonstrating regulatory compliance and for informing operational radiation management decisions.

Radiation monitoring programs in uranium mining and processing operations should aim to:

• Characterise exposures;
• Prove the effectiveness of controls;
• Ensure that controls are commensurate with the risk;
• Be practical;
• Communicate results effectively.

It is difficult to compare the effectiveness of monitoring program because they need to be suitable for the particulars of the operation. Traditional management KPIs may therefore be, to some extent, misleading for measuring the effectiveness of programs. Observation and review of monitoring in various uranium mining and mineral processing operations at all stages from exploration to closure indicates that while the effectiveness of a monitoring program is difficult to quantify, there are common factors which characterise good operational radiation management.

Awareness of radiological characteristics (in other words "know your processes!")

Undertaking an evaluation of the radionuclide balance through process and effluent streams during the early stages of operation helps to ensure that potential radiation exposure pathways are understood. The differing characteristics of naturally occurring radionuclides can cause concentration or dilution as a consequence of chemical or physical properties –or as a consequence of ingrowth or decay depending on the age of products relative to the half lives of any radionuclides present.

Characterisation of radionuclide deportment allows a radiation monitoring program to be correctly structured and adequately resourced with the correct equipment to measure potential exposures from the radionuclides that are expected to be present in any given area or circuit.

Adaptability and Ability to Respond to Changing Conditions

As operations naturally evolve over time, a flexible monitoring program that avoids complacency and maintains a curious and considered approach will help to ensure that changing exposure scenarios are captured.

Ability to Undertake Investigative Monitoring (Moving from Compliance Monitoring to Risk Based Monitoring)

Adequate resourcing is required so that radiation management can exceed basic compliance, to focus on industry best practice and optimisation of exposures. Using this approach, compliance is naturally achieved as a consequence. There are key differences between radiation monitoring for regulatory compliance and radiation monitoring to support a target of best practice radiation management.

A focus on achieving regulatory compliance will promote a minimal approach which targets fulfilment of monitoring quotas. It seeks to demonstrate compliance and allows little scope to deviate from the prescribed program to capture any operational changes or un-programmed work.

Mining and mineral processing operations are typically driven by cost optimisation, and in that climate it is often difficult to attract the additional resourcing that enables radiation monitoring and management to go beyond a basic compliance focus. The benefits of a robust and curious radiation monitoring program are not easily captured as an operational cost benefit or under traditional management KPIs, but are important for any operation with an interest in continuous improvement.

When monitoring programs are resourced effectively with capacity for a flexible approach, measurements can be broadly considered under two categories. Compliance monitoring provides information satisfying regulatory scrutiny, demonstrating compliance, and for quantifying occupational, community and environmental exposures. Investigative monitoring focuses on proving controls, determining whether existing controls are performing effectively, and on identifying potential risk from exposures that may not be captured by a routine compliance monitoring program.

Adequate resourcing for both monitoring streams enables an operation to optimise practices for radiation exposures rather than purely for cost.

Identification of Problems for Timely Response

To be effective and relevant and to support the principle of optimisation, a monitoring program should be cognisant of the actual risk associated with operational practices.

The breadth and depth of a monitoring program should be adequate to identify any failure of controls or trends in exposure pathways, but should not persist in monitoring at a high frequency where actual risk is continuously shown to be low and where operational practices are static, without any potential for effect on occupational dose.

This may require practitioners to revisit approved plans and engage with regulators, adapting the monitoring program to focus on new areas of concern and reduce monitoring in areas with consistently low risk of exposure.

Maintenance of Technical Capacity (in other words "Make Sure People Know What They Are Doing")

Business efficiency requirements and advances in technology can drive uptake of technology and software, or outsourcing of maintenance to specialist contractors. These advancements reduce general workload, but can lead to dependence and a loss of basic technical ability.

Uranium mining and mineral processing operations are often remote, located in areas far from specialist technical support, and the challenges of the remote environment can impede or even cripple a monitoring program that is not supported by appropriate expertise within the operation.

Retaining an understanding of basic calculation and interpretation of results allows rapid calculation and assessment of results in the field or in the event of technological outage, and enables monitoring to provide feedback to the operation promptly.

New monitoring equipment can incorporate both measurement and calculation of results, but to cover any periods when equipment is off site or unserviceable, retention of equipment and skills for simple monitoring methods ensures that a monitoring program can be maintained under any circumstances.

In house repair of equipment may not meet the requirements of a standardisation or quality framework (e.g. ISO, NATA etc), but where measurements are not used for dose assessment the requirement for accuracy may be less important than the requirement to provide prompt feedback. Field repairs to equipment may have a small effect on efficiency or calibration, but the effect is unlikely to be significant and the end goal to optimise exposures may be better executed by providing rapid assessment.

Operationally Useful, Engaged and Curious

A competent radiation monitoring program should have capacity to engage with the operation as a whole, and to respond to permanent or temporary operational changes without impacting compliance monitoring programs.
Radiation practitioners, equipped with information returned by a robust radiation monitoring program, should be actively engaged with operational decision makers to ensure that the need for controls is effectively communicated. Radiation monitoring data and the correct interpretation of legislation and of actual risk can be key to determining the need for control of any potential hazards, and in assisting in design of appropriate and effective controls.

When changing exposure situations are identified quickly, operations can respond to implement interim controls and plan for installation of permanent control measures during planned maintenance outages. A delay in identification of an exposure issue can allow the situation to spiral, causing unplanned interruptions to operations and a loss of production.

Having competent and trained staff who understand the operation and how to effectively monitor it ensures that when things go wrong (i.e. component or system failure), accurate information can be provided promptly to those needing to make decisions, thereby ensuring continued production.
Operations with proactive radiation and hygiene monitoring regimes have demonstrated an ability to positively influence operational controls, and where operational limitations (such as throughput), exist due to concern around hygiene exposure, a comprehensive understanding of a process system can ensure operators have sensitive operational responses allowing greater production levels to be achieved.

SUMMARY

Radiation monitoring programs should not be regarded as purely a requirement for regulatory compliance. Monitoring results are invaluable in achieving continuous improvement objectives, and in determining controls required to reduce occupational exposures to employees. Monitoring can assist operations to optimise production, and can intercept failures early so that unplanned interruptions to production for maintenance or repairs can be avoided.

The structure and focus of a radiation monitoring program informs and drives operational radiation management, and a monitoring program that actively engages with the operation has value both in the optimisation of radiation exposures and in supporting continuous improvement in all aspects of operation.

REFERENCES

[1] INTERNATIONAL COMISSION ON RADIOLOGICAL PROTECTION, The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4) (2007)
[2] AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY, Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)

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