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Ingestion, wound contamination & absorption

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

Ingestion, wound contamination & absorption

- Introduction to Ingestion, wound contamination & absorption
- Control measures
- Monitoring & dosimetry
- Key messages & facilitating questions (2 questions & answers for discussion)

Introduction to Ingestion, wounds contamination & absorption

- Characteristics of Ingestion, wounds & absorption
- Sources of Exposure to Ingestion, wounds & absorption

Ingestion, wound contamination & absorption

- The mining and milling of uranium ores involves the handling and processing of large amounts of ores, process materials and uranium product.
- Potential for internal exposure through inhalation and ingestion is present at all stages of mining and processing where ores and process concentrates are handled. However, the highest potential for internal exposure is associated for work within the final product packing area.

Ingestion, wound contamination & absorption

- There are several ways that inadvertent intake of radionuclides, especially alpha emitting radionuclides, could occur at a uranium mine and processing complex
  - Direct inhalation of LLRD (as discussed in another module)
  - Ingestion of surface LLRD contamination via transfer of non-fixed contamination from a contaminated surface to hand to mouth or through the inhalation of non-fixed contamination through a resuspension process.
- Wound contamination represents another route for radioactive materials to enter the body.

Ingestion, wound contamination & absorption

- This module discusses the potential for intake of radionuclides via ingestion, wound contamination and absorption.
- The potential magnitude of these hazards depend on
  - The amount of contamination taken into the body via ingestion, wound contamination or absorption,
  - The specific chemical and radiological characteristics of the contamination;
  - uranium ore contains all elements of the ^{238}U and ^{235}U decay chains and the long-lived alpha-emitting nuclides, ^{238}U, ^{234}U, ^{230}Th, ^{226}Ra and ^{210}Po are the most significant radionuclides.

Control Measures for ingestion, wound contamination & absorption

- Engineering controls
- Administrative controls

Control Measures

- Potential for internal exposures arise during normal operations through exposure to airborne LLRD, surface contamination and additionally, there is potential for internal exposure in the event of a spill or an accident.
  – The potential for exposure to airborne LLRD and surface contamination and their controls are discussed in a separate modules.
- The most effective way to prevent internal exposure is to prevent direct contact with radioactive material.
- All preventative measures used to protect workers from elevated LLRD are applicable to preventing other internal exposures
  – Containment at source, dust suppression, ventilation & other measures

Control Measures

- The design of the facility needs to limit the spread of radioactive material and systems for contamination control are an important control measure
- Good hygiene practices are the best methods to ensure that these pathways do not cause significant exposures
  - A general cleaning programme for offices, workshops, amenities and meal rooms needs to be in place to reduce contamination as a source of exposure;
  - Workers need to be trained and supervised to ensure that they wash their hands and face prior to eating, drinking or smoking;
  - It is also common for workers to have to shower and change at the end of a working shift to reduce the risk of exposure from these pathways.
- Cleaning equipment and tools prior to and after maintenance activities can help limit the potential for workers being injured with contaminated equipment.

Control Measures

- The prevention of all types of wounds, whether involving radioactive materials or not, is the primary control mechanism;
- Wounds involving potentially radioactive materials need some additional follow-up measures.
- Wound contamination is an unlikely exposure pathway, but care needs to be taken in a manner similar to standard infection controls to ensure that “sharps” (sharp metal and other objects) are managed appropriately and any wounds are dressed and managed prior to work.

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Monitoring and Dosimetry

- **Monitoring**
- **Exposure Control**

Monitoring and Dosimetry

- A wound caused by material or equipment that is contaminated has the potential to place radioactive material directly into the body
  - prompt and thorough cleaning of the wound is important to remove as much radioactive material as possible
  - radiation monitoring of the wound is important to determine if there is any detectable radiation present but the absence of measurable radiation from the wound may not always indicate that all residual contamination has been removed;
  - the need for urgent medical treatment may limit the practicality of conducting detailed radiation monitoring of the wound
- The medical treatment of a wound can be complicated by the potential presence of radioactive material and thus, to the extent practical, it is advisable to work with medical facilities to train staff and establish treatment protocols that incorporate radiation protection measures.

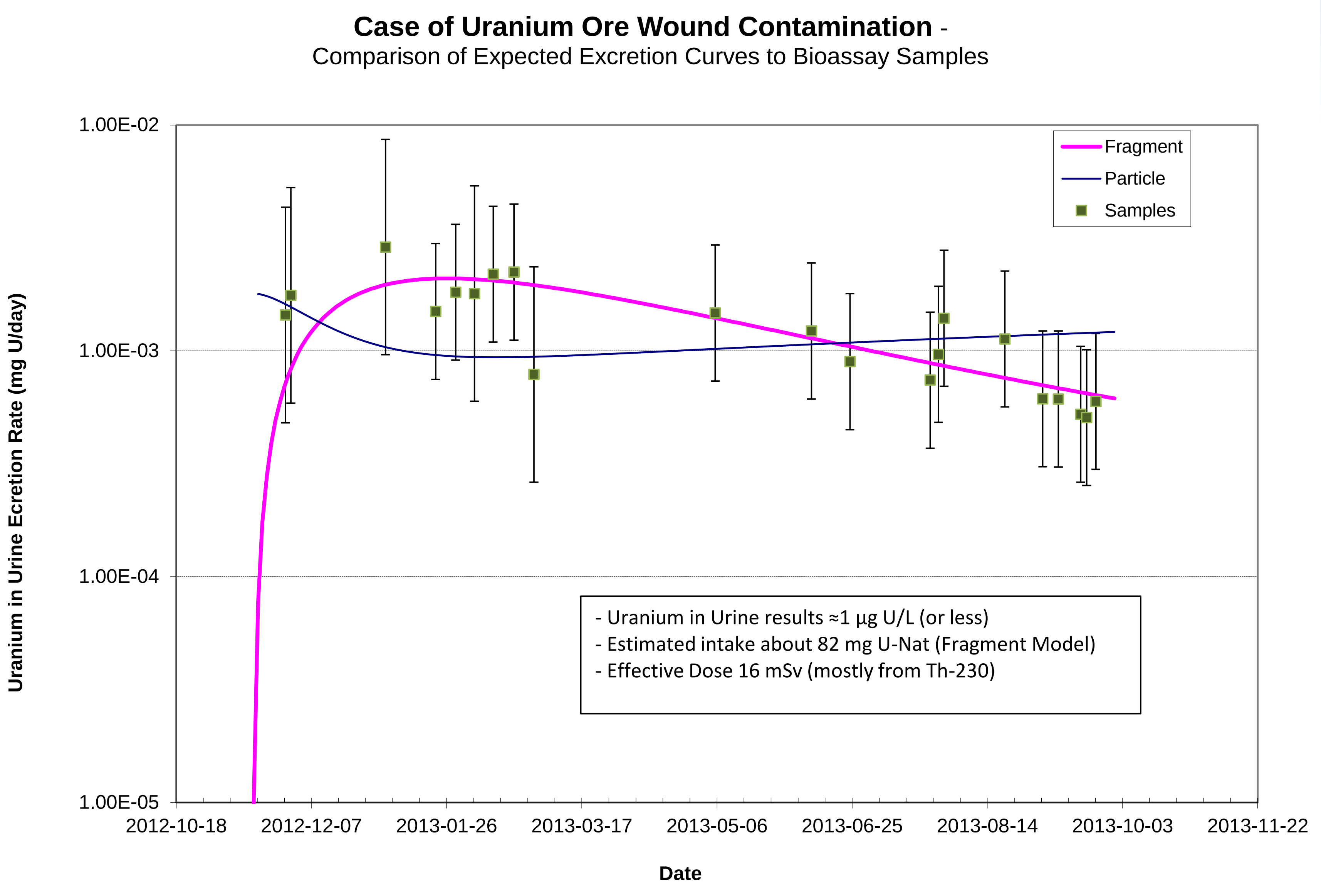
Monitoring and Dosimetry

- Follow-up bioassay measurements are important to assess the dosimetric implications
  - to provide assessment of potential intakes by workers in the event of a suspected elevated exposure to LLRD, and
  - To provide an assessment of potential intake from a wound involving radioactive contamination.
- Baseline sampling may be conducted on workers before they commence work in the final product area and may also be conducted on workers who are not exposed to uranium at work as a quality control measure;

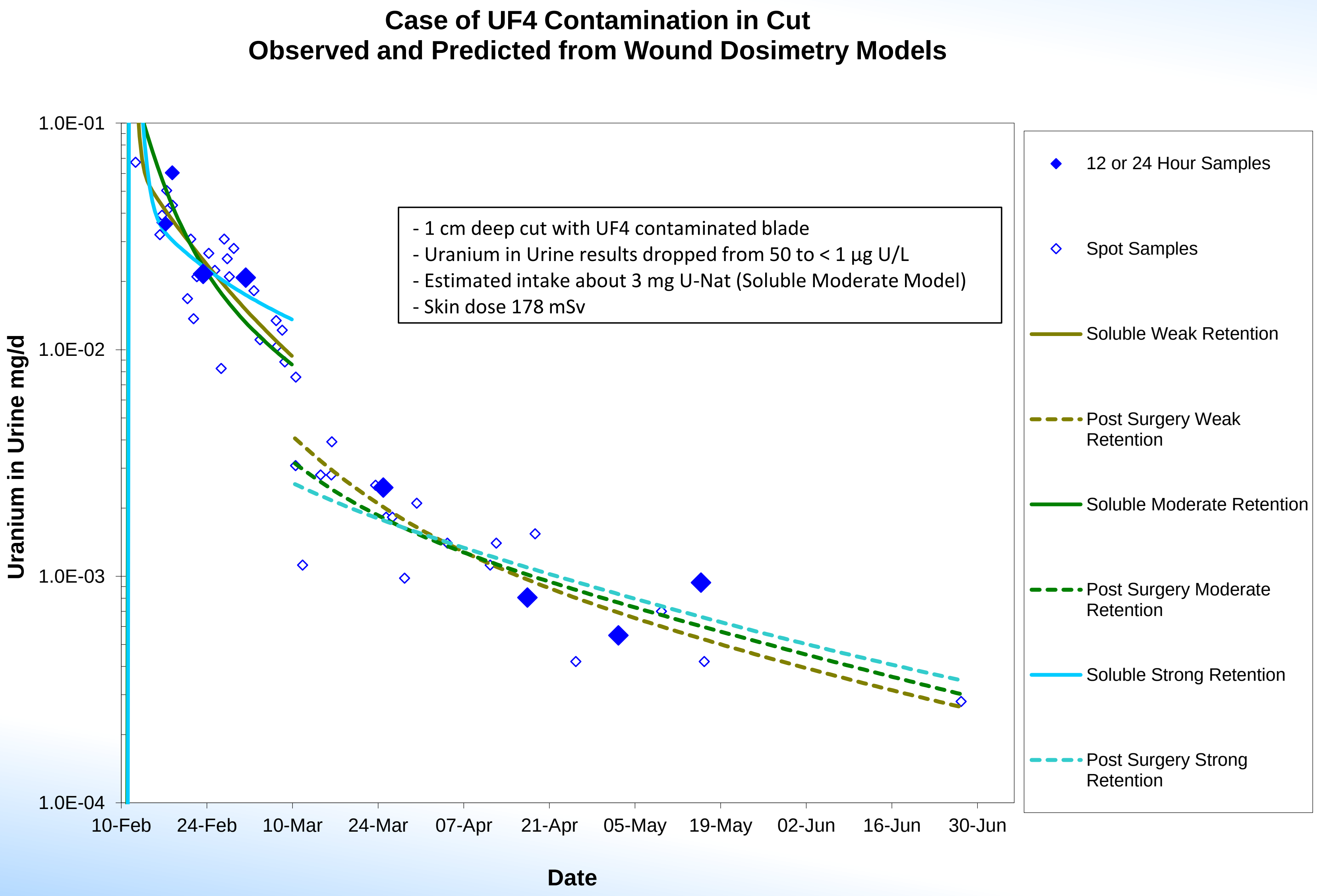
Monitoring and Dosimetry

- Urinary excretion curves based on biokinetic models such as those developed by the ICRP and NCRP provide tools to support the “backward” calculation of possible uranium intake based on measured urine excretion data.
- In practice distinguishing between the different models is not simple and advice from an expert in the field may be required.

Uranium Ore Wound Case



Uranium Wound Case



Key messages & facilitating questions

- Key messages
- Facilitating questions
  - 2 questions & answers for discussion

Key Messages

- Potential for internal exposure through inhalation and ingestion is present at all stages of mining and processing where ores and process concentrates are handled. However, the highest potential for internal exposure is associated for work within the final product packing area.
- The most effective way to prevent internal exposure is to prevent direct contact with radioactive material
- The design of the facility needs to limit the spread of radioactive material and systems for contamination control are an important control measure
- Good hygiene practices are the best methods to ensure that these pathways do not cause significant exposures
- the potential for wound contamination is normally not a significant pathway providing normal hygiene practices are in place.

Guidance Questions

Q1: What area of the process plant presents the greatest potential for internal exposure?

Q2: What are two important considerations in minimizing the potential for inadvertent internal exposure?

Q3: How can biokinetic excretion models be useful?

Answers

- A1: The final product packing area has the greatest potential for internal exposure
- A2: (1) The design of the facility needs to limit the spread of radioactive material and systems for contamination control are important control measures

  (2) Good hygiene practices are the best methods to ensure that these pathways do not cause significant exposures
- A3: Biokinetic excretion models can be used to help estimate an intake of a radionuclide following an accidental exposure.

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Thank you!