



IAEA

International Atomic Energy Agency

NORM –Environmental Monitoring

- Objectives of monitoring
- Steps in the development of the programme
- Stages of monitoring
- Key messages

Objectives of the Monitoring Programme

- Quantifies radionuclides and radiation levels in emissions and effluents.
- Quantifies radionuclides and radiation levels in the environment.
- Confirms the safety assessments.
- Demonstrates compliance with regulatory requirements.
- Demonstrates protection of the public and environment.



Stops in the development of the program

1. The identification of “radionuclides of interest”
2. Identification of releases
3. The identification of potential pathways of public exposure
4. Identify representative person and where applicable – reference plant/animal
5. Monitoring methods
6. Monitor and periodic review

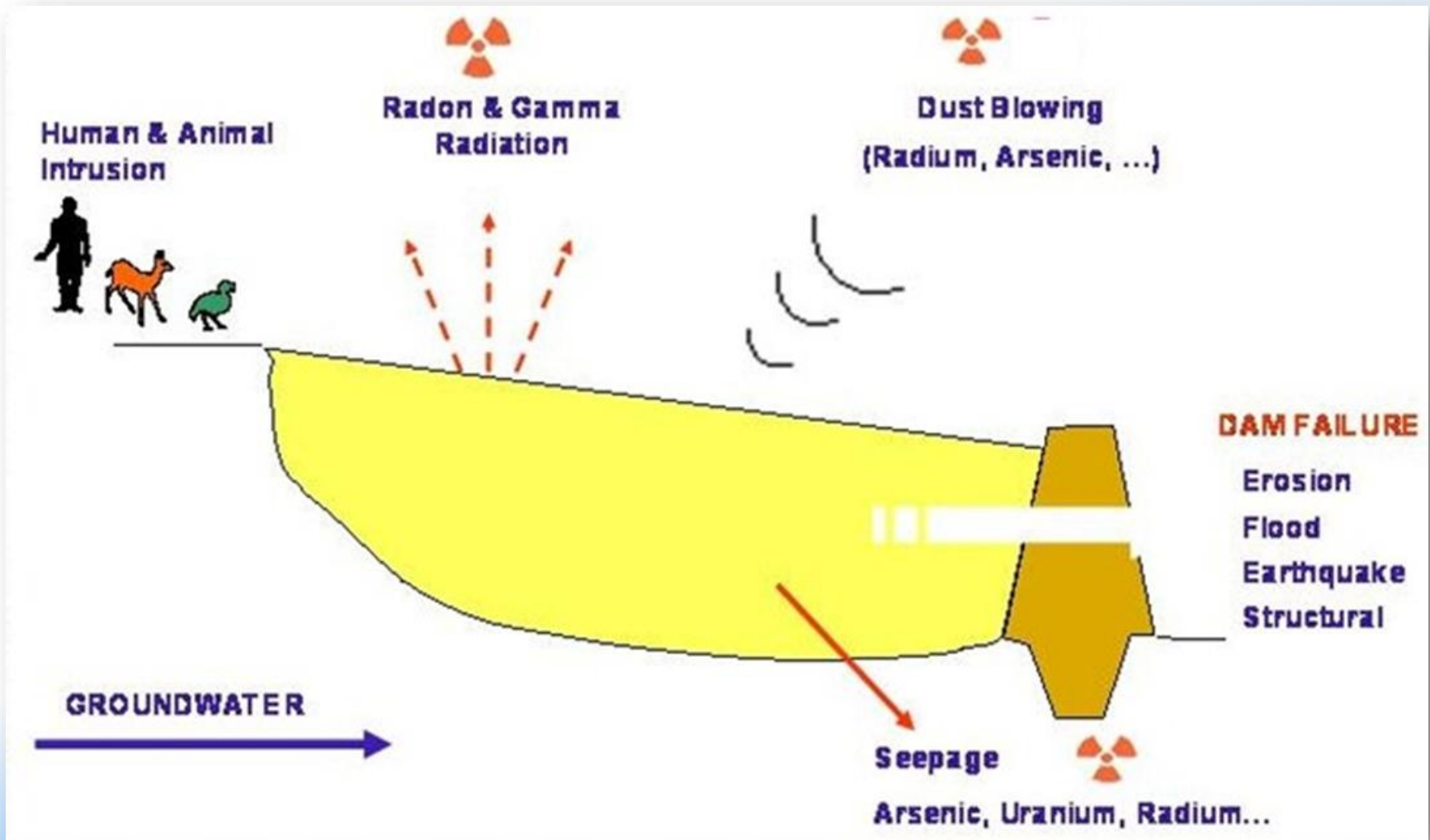
1. The identification of “radionuclides of interest”

- Know your process
- Know your materials
- Refers to earlier lecture on characterisation
- For NORM – natural radionuclides

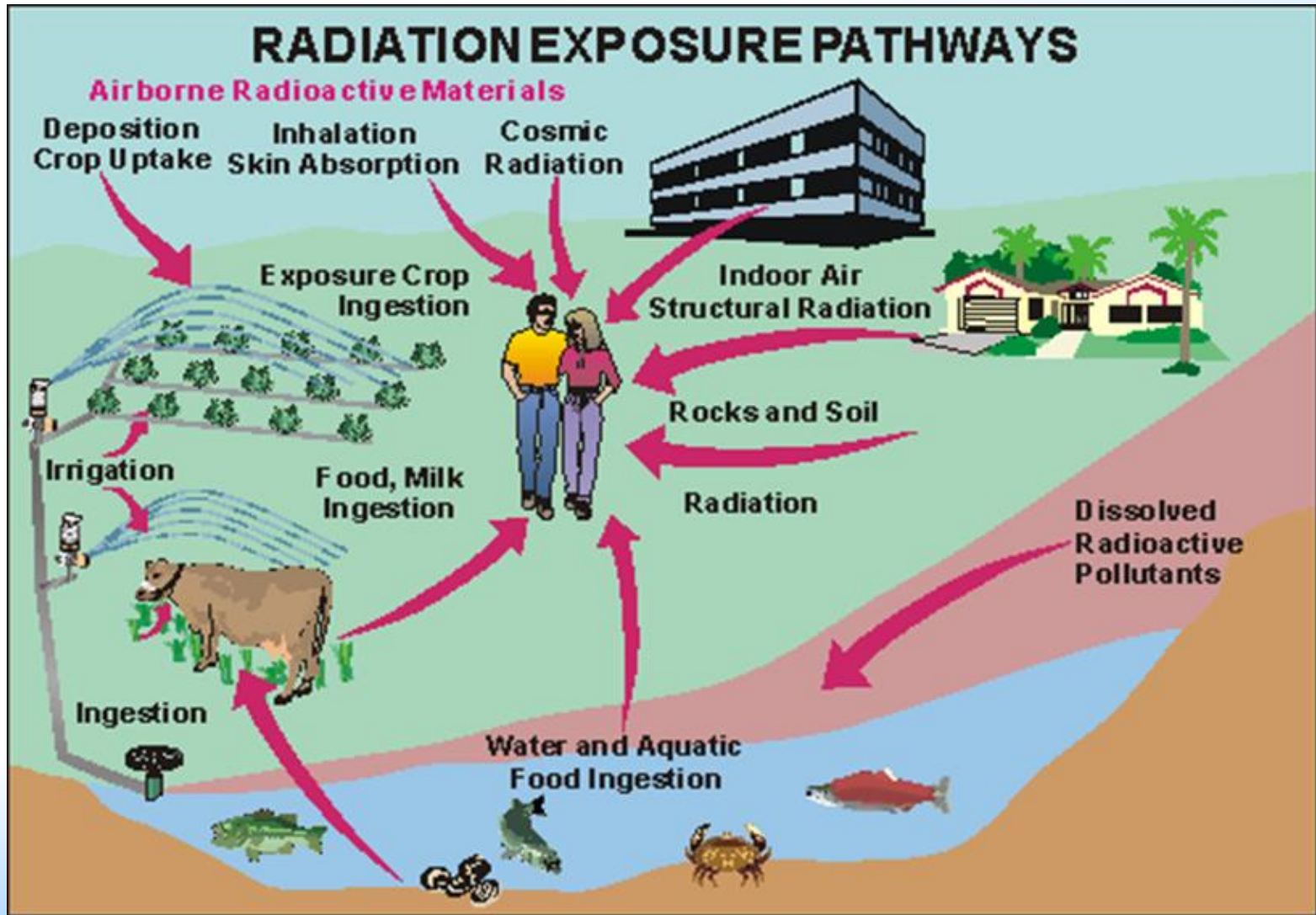
2. Identify releases



3. Identification of exposure pathways



3. The potential exposure pathways



4. Identify representative person and where applicable – reference plant/animal

- New definition (representative person – ICRP-103, 2007):
Representative Person is an individual receiving a dose that is representative of the more highly exposed individuals in the population. This term is the equivalent of, and replaces, ‘average member of the critical group’ described in previous ICRP Recommendations.
- Doses are typically trivial, so you sometimes have to model a hypothetical person

5. Monitoring Methods

- Selection of equipment
- Methods
- Frequency
- Proportionate with the risk
- Carried out by suitably trained and experienced practitioners

6. Monitoring and review

- Monitoring is a dynamic process;
- Monitoring programs should not be static;
- Revision should be justified and documented;
- The required outcome is an optimised, cost effective and focussed program;
- The extent of the program must be commensurate with the risk.
- Regulator and operator are involved in the review

Stages of Monitoring

Monitoring is required throughout the lifetime of a facility:

1. Pre-operational (e.g. baseline)
2. Operational (effluents and environment)
3. After closure (environment, integrity of the engineered structure)



Stage 1 – Pre-operational Monitoring

- Defines the baseline radiological conditions around the facility prior to operations.
- Provides data for background subtraction e.g. to separate impact of the operation from natural levels
- Provides data useful in remediation activities.
- Assists in the design of the operational monitoring program e.g. identification of sampling positions.

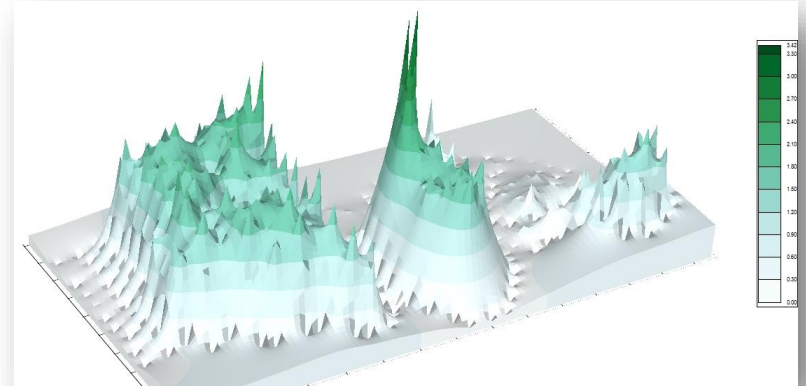
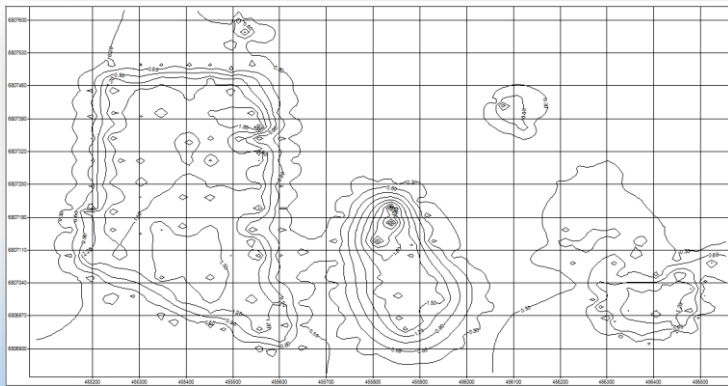
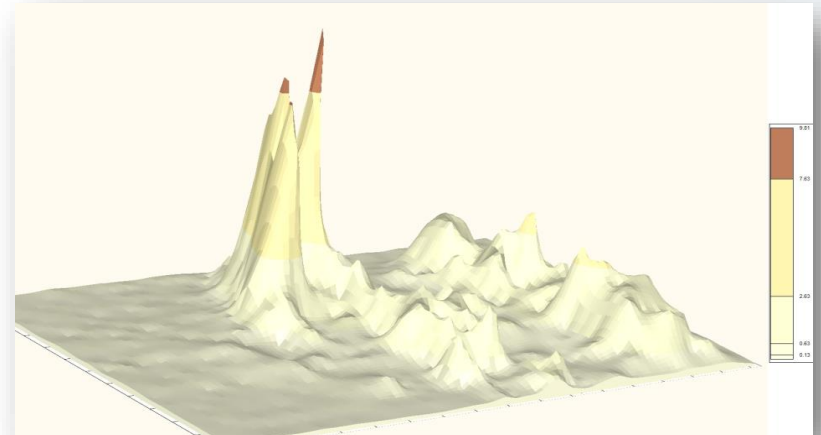
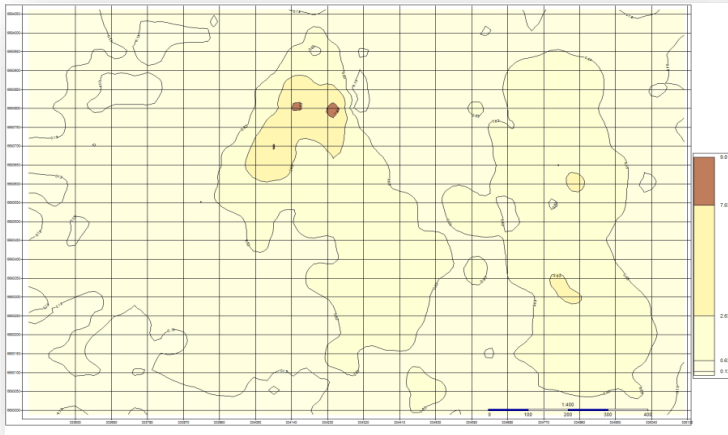


Stage 1 – Pre-operational Monitoring

- Measure for 1-2 years across the whole site and surrounding environment
- Gamma radiation across the proposed site and surrounding environment
- Concentration of radionuclides in soil, groundwater, surface water and dust
- Radon gas concentrations (and variability)
- Dust mass concentrations and dust deposition

Stage 1 – Pre-operational Monitoring

Assessment of gamma dose rate



Stage 2 – Operational Monitoring

- Need to be proportional to the exposure pathways and the material characteristics
- Measure effluent discharges at the emission point e.g. dust, gas and water (to define the source term and for modelling)
- Could include;
 - Environmental gamma
 - Activity concentrations in soil, water and biota
 - Activity concentrations in airborne dust and deposited dust
 - Radon and radon decay product concentrations
 - Foodstuffs
- Model the results to determine doses to the public

Stage 3 – Decommissioning and post closure

- When decommissioning, review monitoring to verify the exposure pathways
- At post closure reassurance monitoring may be required.
- Final monitoring prior to relinquishment (compare to pre operational measurements)
- (Note that later lecture on decommissioning and closure of facilities L12)



Non radiological aspects

- Changes in the structural stability of a disposal site may occur and monitoring of the surrounding area is needed to assess its stability.
- The state of the disposal facility cover and engineered barriers after closure is determined through the monitoring program.



- Identify source terms
- Concentrate on the most critical pathways.
- Data interpretation is as important as data collection.
- Document and report the results.
- Keep the monitoring relevant - review the program and amend it in the light of data collected.

- Monitoring is required throughout the life of the facility.
- The monitoring of NORM facilities is complicated by the presence of natural background radiation.
- Monitoring is essential to provide assurance that the NORM facility is operating in a safe manner in accordance with the regulatory requirements.
- Obtaining the right compromise between monitoring and resource requirements is crucial.