

**AREA MONITORING :
EXTERNAL RADIATION & CONTAMINATION**

Module Objectives

- **To understand what is radiological monitoring and its purpose**
- **To become familiar with the different types of radiological monitoring equipment**
- **To understand types of record keeping methods in radiological monitoring**

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- Radiation Monitoring Record
- Data Interpretation

Introduction

- Work places where radiation sources are installed or used are required to be monitored regularly.
- Important to establish classification of the work place or to verify the validity of classification of the work area.
- Covers both radiation and contamination, and the latter usually includes surface and airborne contaminations

Introduction

Classification of Workplace Monitoring

- Routine Monitoring

Intended to show that the working environment is satisfactory for continued operations and that no change has taken place that would call for a review of the operating procedures

- Operational Monitoring

Intended to provide a check on a particular operation and to give, if necessary a basis for immediate decision on the conduct of the operation

- Special Monitoring

To obtain additional information to achieve adequate control or carried out in abnormal circumstances, include accidents or suspected accidents

Monitoring Equipment for External Radiation

Work Place Monitoring Instrumentation for External Radiation

- Measurements can be made in situ using either portable survey meters or stationary (or fixed installed) monitors.
- Latter types of instrumentation are usually equipped with alarm system that can be triggered off if the radiation level exceeds its preset limit.
- Measurements for work place monitoring can also be made using personnel dosimeters over a certain period of time e.g. one month.

Monitoring Equipment for External Radiation

Types of radiation monitoring equipment for external radiation and their operational principles

The equipment used is usually portable survey meter



Equipment Operating Procedures

- ❑ It is very important to know correct operation of the survey meter and proper techniques used in carrying out the monitoring.
- ❑ The followings are standard operating procedures in using portable survey meters:
 - ✓ Check calibration validity period of the instruments.
 - ✓ Switch the power of the instrument ON and wait for stability.
- ❑ Check the battery level of the survey meter and it should be indicated at appropriate level at the battery scale.
- ❑ Check response of the survey meter against a check source and the reading should be as expected.
- ❑ Switch the instrument's scale to the maximum range.
- ❑ Switch on audible signal.

Equipment Operating Procedures (Cont'n)

- ❑ Bring the instrument to the work place for measurement and switch to lower scale if there is no response.
- ❑ The probe protective cover should be removed when measuring beta radiation.
- ❑ Measurements should be made with the detector's position similar to its position when calibrated.
- ❑ Switch the instrument OFF once the measurement is completed.

Techniques of Monitoring

Steps in area monitoring:

- Establish layout plan by referring to the plot plan of the area to be monitored.
- Area monitoring for external radiation can be done actively or passively.
- Active monitoring: use mobile/portable radiation detector e.g. survey meter.
- Passive monitoring: use an integrated dosimeter e.g. film or TLD badges and fixed at a strategic location.

Techniques of Monitoring

Workplace Monitoring Programme should specify:

- Quantities to be measured;
- When and where the measurements;
- How frequently the measurements should be made;
- Appropriate measurement methods and procedures;
and
- Reference levels and actions to be taken if they are exceeded.

Monitoring Equipment for Contamination

Contamination

- Contamination monitoring is very important to be carried out in places where radioactive contamination is likely to occur.
- It consists of monitoring for personnel contamination, surface contamination in work places, airborne contamination in work places and environmental contamination.

Types of Monitoring Equipment Used

- The detector used depends on type of radiation involved in the contamination.
 - Alpha contamination, the detector used is usually of scintillation type (ZnS), proportional counter and solid-state detector.
 - Beta-gamma contamination, the most commonly used detector is G-M detector and scintillation detector.
- The G-M detector has an advantage in term of more sensitive compare to other detectors but it loses out in term of response time.

Types of Monitoring and Measurement Methods

There are basically two types of area monitoring and measurement methods used in radioactive contamination.

These methods depends on whether they are for:

- surface; or
- environmental contamination.

Types of Monitoring and Measurement Methods

Surface contamination monitoring:

- Carried out either directly using a monitoring instrumentation; or
- Indirectly based on the smear sample collected from the contaminated surfaces subsequently measured using a monitoring instrumentation.

Types of Monitoring and Measurement Methods

- A direct method is measurements made in-situ using a portable contamination monitor:
 - Carried out by moving slowly the portable contamination monitor over the suspected area of contamination.
 - Probe should also be brought to as close as possible but without touching the surface being monitored.
 - Instrumentation should be properly calibrated to reflect the actual level of contamination from its direct readings.

Types of Monitoring and Measurement Methods

- Indirect method of monitoring:
 - Has an advantage over the direct method in case of high background radiation at the monitoring site but it suffers from lower collection efficiency of the contaminants.
 - Collection efficiency of the contaminant on the smear sample depends on several factors:
 - o physical condition of surface;
 - o smear material used;
 - o application of chemical; and
 - o pressure applied when taking sample.
 - Smear sample is subsequently counted for its contamination level using a suitable counter.

Types of Monitoring and Measurement Methods

Environmental contamination:

- Any release of radioactive materials into the environment will be monitored to ensure that the amount released is within the authorized limit.
- Monitoring is carried out by direct and indirect method.
- Environmental contamination may be measured in biotic and abiotic systems.

Monitoring of Airborne Contamination

Methods and Monitoring of Airborne Contamination

- Airborne contamination monitors may be divided into:
 - for radioactive particles in air;
 - for radioiodine in air; and
 - for radioactive gases in air.

Monitoring of Airborne Contamination

- Airborne contamination:
 - Monitored indirectly using air sampler together with filter system.
 - Collect the contaminants.
 - Counting instrumentation for radionuclide identification.
 - Determination of its concentration.

Radiation Monitoring Record

- Monitoring on regular basis in supervised and controlled area using equipment approved by the appropriate authority.
- Including assessment of external radiation level at work place and risk assessment in the case of accident or emergency situation.
- Retention period for area monitoring record is 2 years.
- Details to be recorded (e.g. in logbook):
 - Date and time of measurements
 - Sketch of controlled, supervised and clean areas
 - Work location
 - Type, model and date of calibration of monitoring equipment
 - Location of radiation signage and warning light
 - Radiation level during operation

Data Interpretation

- ❑ Exposure and contamination data obtained are analysed and interpreted with reference to authorized and acceptable standards.
- ❑ For individual monitoring, the limits most commonly used in the control of external radiation are Equivalent Dose and Effective Dose.
- ❑ Derived Dose Limits (e.g. ALI and DAC) are used in estimating risk from intake or radioactive materials.

ALI = dl/h ; dl =relevant annual dose limit

(Bq) h =effective dose per unit intake

DAC = $\frac{ALI}{Volume}$ (inhalation) ; refer to air inhaled volume by human working for 2000 hrs in a year at rate 1.2 m³/hr; Volume = 2400.

- ❑ For area monitoring, radiological risk are usually calculated and reported in terms of the activity concentrations of radionuclides, and external radiation.

$A = A_0 e^{-\lambda t}$; λ = decay constant = $0.693 / t_{1/2}$

A =activity at time t

A_0 = the initial activity

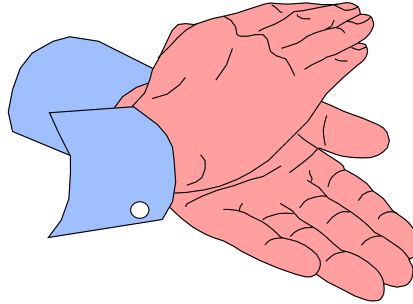
$t_{1/2}$ = half life

ALI

The derived limit for the permissible amount of radioactive material taken into the body of an adult radiation worker by inhalation or ingestion in a year. The ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in either a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue.

Summary

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Thank You
for your attention