DISCLAIMER

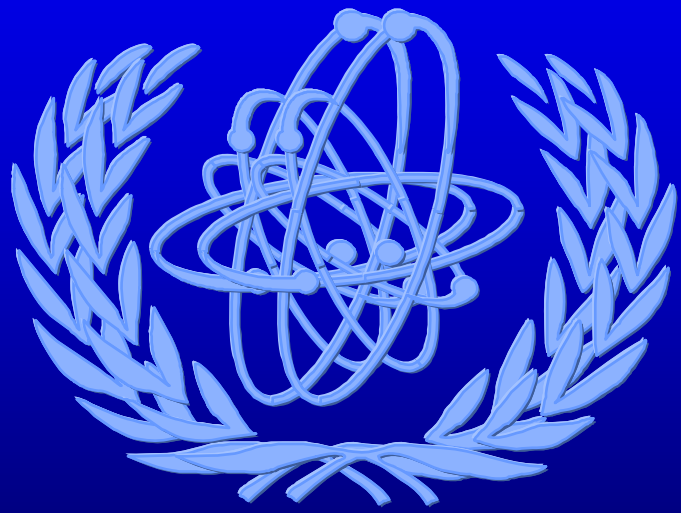
The information contained in this document cannot be changed or modified in any way and should serve only the purpose of promoting exchange of experience, knowledge dissemination and training in nuclear safety.

The information presented does not necessarily reflect the views of the IAEA or the governments of IAEA Member States and as such is not an official record.

The IAEA makes no warranties, either express or implied, concerning the accuracy, completeness, reliability, or suitability of the information. Neither does it warrant that use of the information is free of any claims of copyright infringement.

The use of particular designations of countries or territories does not imply any judgment by the IAEA as to the legal status of such countries or territories, of their authorities and institutions or of the delimitation of their boundaries. The mention of names of specific companies or products (whether or not indicated as registered) does not imply any intention to infringe proprietary rights, nor should it be construed as an endorsement or recommendation on the part of the IAEA

Emergency Monitoring



Emergency Monitoring Overview

Lecture

Introduction

- **This lecture presents an overview of the IAEA technical document *Generic procedures for monitoring in a nuclear or radiological emergency* (IAEA-TECDOC-1092)**

- **It covers strategy, manpower and equipment needed in environmental, source, personal and equipment monitoring during a nuclear or radiological emergency**

Content

- Objectives of emergency monitoring
- Generic monitoring organization
- Emergency monitoring strategy
- Emergency staff
- Instrumentation
- Basic survey methods
- Quality assurance system
- Summary

Overview

- One of the most important aspects of managing a radiation emergency is the ability to promptly and adequately assess the need for protective actions
- Protective action emergency management must make use of the key relevant information available
- Emergency monitoring is one of the main sources for obtaining the needed information

Purpose

- The primary purpose of emergency monitoring is to provide timely information on which decisions on protective actions can be confirmed or revised
- This requires detection of radioactive material, determination of its location and its nature

General Goal

- **To assist, confirm or revise decision-making regarding**

WHETHER
WHEN
and
WHERE

to apply protective actions

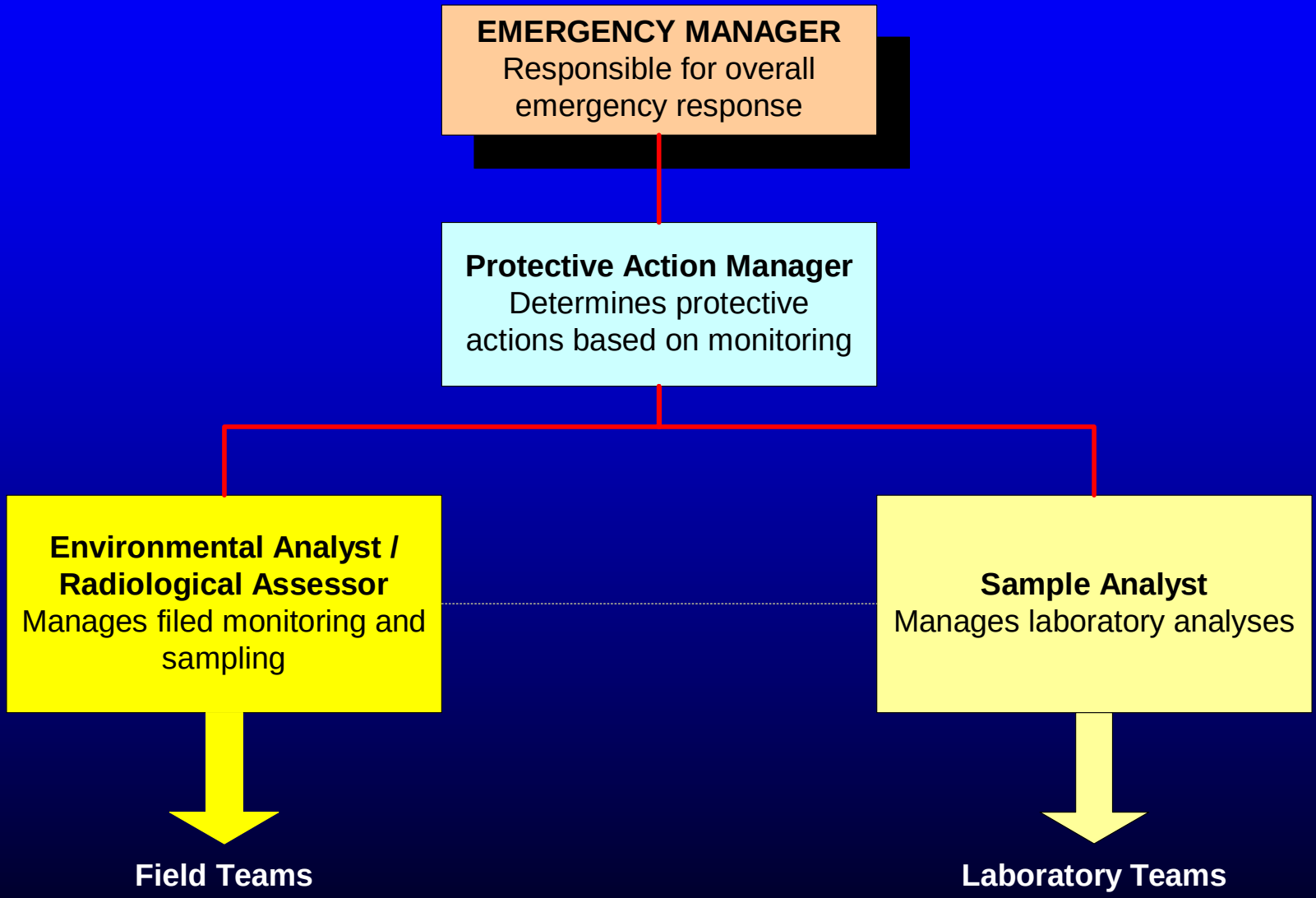
General Objectives

- The objectives of emergency monitoring in general are:
  - To provide information for accident classification
  - To help decision makers to assess the need for protective actions and interventions on the basis of operational intervention levels (OILs)
  - To assist in preventing the spread of contamination
  - To provide information for protection of emergency workers

General Objectives (1)

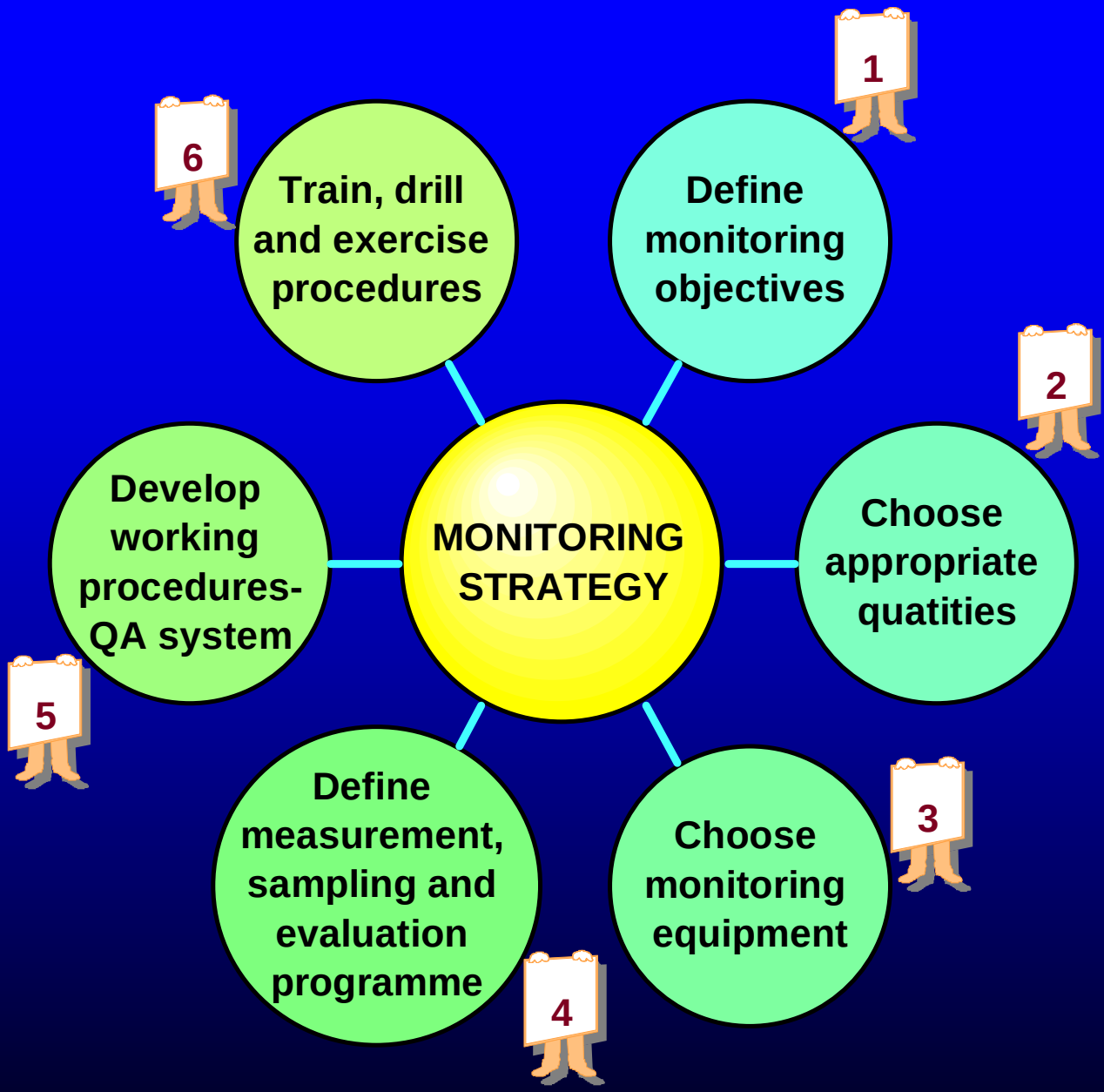
- To provide accurate and timely data on the level and degree of hazards resulting from a radiological emergency
- To determine the extent and duration of the hazard
- To provide detail on the physical and chemical characteristics of the hazard and
- To confirm the efficiency of remedial measures such as decontamination procedures etc.

Generic Monitoring Organization



Emergency Monitoring Teams

AST:	Aerial Survey Team
RMT:	Radiation Monitoring Team
RIT:	Radionuclide Identification Team
SRT:	Source Recovery Team
AAT:	Assessment and Advisory Team
EST:	Emergency Sampling Team
DET:	Decontamination Team
PST:	In Plant Survey Team
LAB:	Laboratory Facility - Team
BIT:	Bioassay Team
BDT:	Biodosimetry Team
MST:	Medical Support Team
RPT:	Radiopathology Team


MONITORING STRATEGY
1
Define monitoring objectives
2
Choose appropriate quatities
3
Choose monitoring equipment
4
Define measurement, sampling and evaluation programme
5
Develop working procedures-QA system
6
Train, drill and exercise procedures

Design of EM Programme

- The design of the emergency monitoring and sampling programme will be determined:
  - By the primary objectives for which it has been established
  - By the scale of the accident envisaged and
  - The availability of qualified teams to respond to radiological emergency

General Priorities in Designing EM Response

- In the initial response, the determination of affected areas which are truly “dirty” and where people can be affected should be the first priority

- The priority for monitoring and sampling should then take into account the composition of the affected area: residential, agricultural, rural, commercial, and industrial activities, public services and infrastructure elements

In a Radiation Emergency

Accident phase	Type of measurements and sampling
Initial environmental assessment	➢ Ambient dose rates
During a release	➢ Ambient dose rates ➢ Air sampling ➢ Radionuclide concentrations in air
After a release	➢ Ambient dose rates from deposition ➢ Ground deposition concentrations ➢ Environmental sampling ➢ Radiomuclide concentrations

Emergency Staff - General Guidance

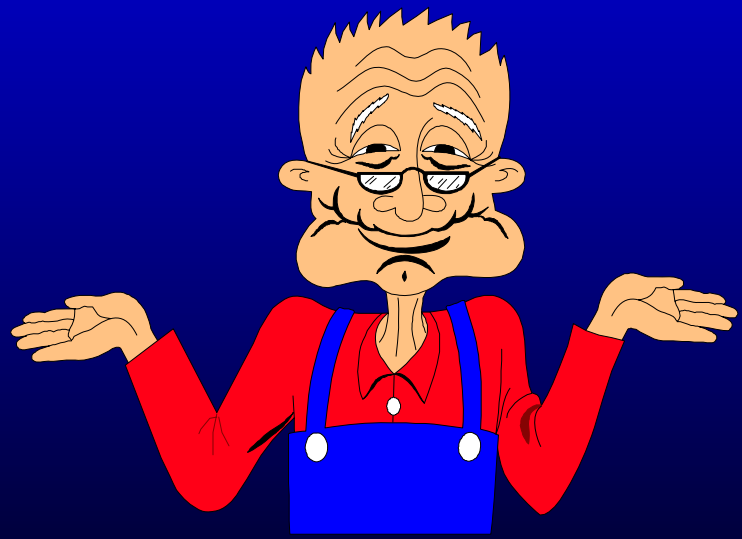
- Use persons who are skilled and experienced
- Persons performing routine monitoring and sampling should receive specific training for non-routine and emergency monitoring and sampling
- Teams should be well trained and properly equipped with personal protective equipment and be acquainted with turn back guidance

Emergency Manager

- Emergency manager is the person who will be in overall charge of an emergency and carry the ultimate responsibility for the emergency response
- He might simply be
  - The most senior member of staff of the premises where an accident has occurred
  - A senior police officer, or
  - A local or senior government official

Protective Action Manager

- **The Protective Action Manager is the officer responsible for determining protective actions based on accident classification and environmental monitoring and is normally a professional health physicist**

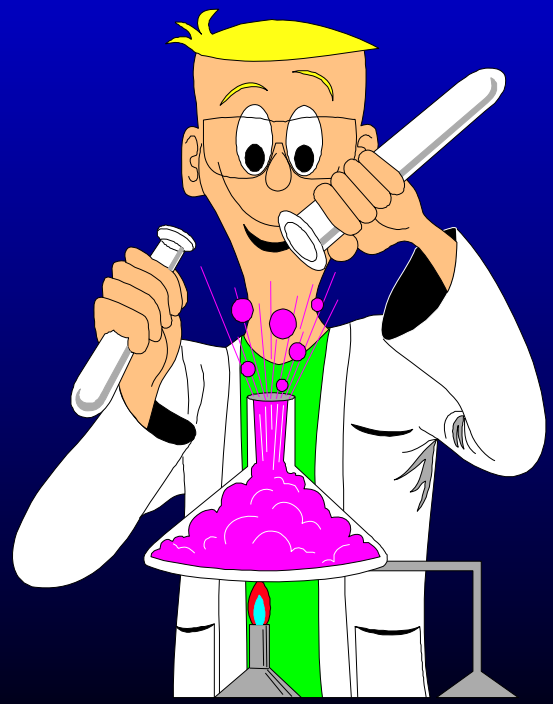


Environmental Analyst / Radiological Assessor

- **Most likely a professional operational or environmental health physicist knowledgeable and experienced in monitoring techniques and in the use of OILs but not necessarily highly skilled in specific analytical laboratory techniques**

Sample Analyst

- He/she is a specialist in environmental monitoring data interpretation and is most likely an environmental health physicist or a specialist in sample analyses for radionuclide content



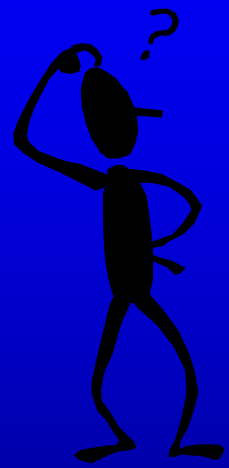
Suggested Number of Emergency Radiation Response Teams

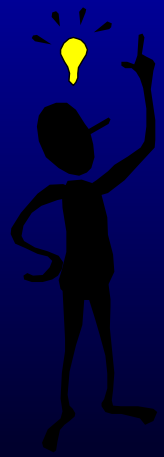
TC	AST	RMT	RIT	SRT	AAT	MST	BIT	RPT	BDT	EST	DET	PST	LAB
I	1	6	3	1	3	1	1	1	1	6	3	3	2
II	1	3	1	1	3	1	a	a	a	2	2	2	2
III	a	1	1	1	1	a	a	a	a	1	1	1	1
IV	a	1	1	1	1	a	a	a	a	1	1	nc	1
V	a	1	2	nc	1	nc	nc	nc	nc	3	nc	nc	1

a – if needed, assistance from the IAEA ERNET can be requested
nc – not recommended

Instrumentation - General Guidance

- Choose appropriate equipment
- Properly calibrate equipment
- Maintain equipment readiness





Types of instrumentation

- Radiation monitoring equipment
- Contamination monitors
- Air samplers
- Dosimeters
- Gamma spectrometers
- Gross alpha/beta counting
- Laboratory analytical equipment

Basic Survey Methods

- Ground survey
- Aerial survey
- Personal monitoring
- Sampling and sample analysis

Ground Survey

- Plume survey
- Ground deposition survey
- Environmental dosimetry
- Source monitoring
- Surface contamination survey

- Ground survey can be performed:
  - with automatic measuring stations
  - on foot with hand held instruments
  - from an adequately equipped vehicle - mobile radiological laboratory

Mobile Radiological Laboratories

- To perform rapid analyses at or near an emergency site an appropriate equipped mobile radiation laboratory can be the best solution

- Vehicles range in size from van or lorry based to commercial semi-trailer or articulated lorry


ekološki laboratorij
z mobilno enoto
z mobilno enoto

Use of the MRL

- **Mobile laboratories are set up for a specific purpose:**
  - **to provide rapid analyses following radiation accident**
  - **to provide analyses for routine environmental studies**
  - **to provide survey in**
    - **lost source events**
    - **events where the source material is not known**
    - **nuclear weapons accidents, and**
    - **incidents of nuclear terrorism**

Equipment

- Common equipment placed inside mobile laboratories:
  - gamma spectrometers
  - gross alpha/beta counters
  - liquid scintillation systems
  - other detection equipment
- The choice of equipment for a mobile laboratory is crucial to ensure that samples can pass through the laboratory quickly

Sample Preparation Capability

- Simple sample preparation is called for in an emergency
- It is recommended that sample preparation is not performed in the mobile laboratory
- Either a sample preparation capability should be built into another vehicle, or be set up in whatever space or facilities are available locally

Sample Preparation Laboratory

- Placement of the sample preparation laboratory relative to the mobile laboratory in the field is important

- The mobile laboratory should be away from sample preparation area by a good distance, and the mobile laboratory must be much further from sample control (where samples are initially received before processing starts)

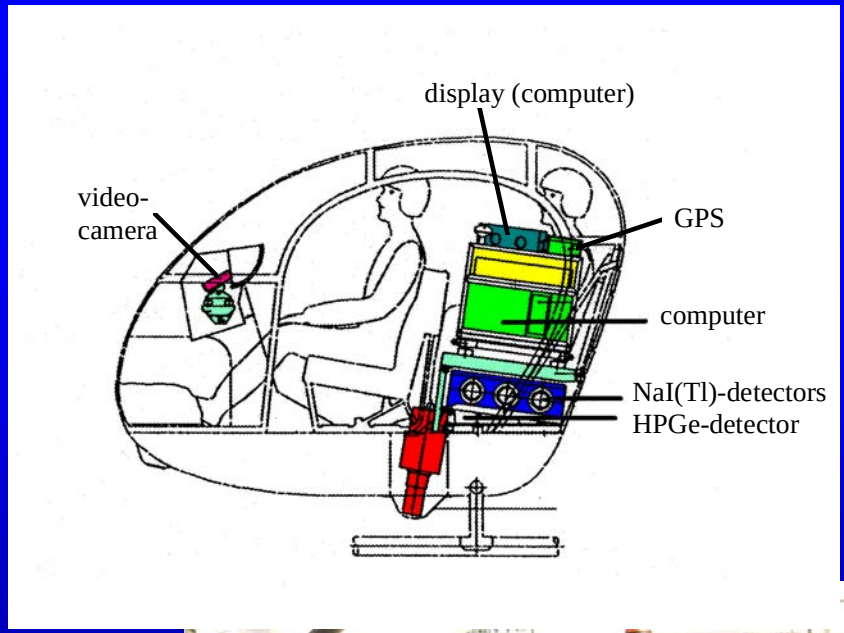
Aerial Survey

- Aerial monitoring can be regarded as an appropriate method for a rapid survey
  - To provide information on large area surface contamination (ground contamination survey) or
  - To search, detect localize and identify gamma-emitting source(s) over large areas in order to render the source safe

Equipment

- For aerial surveys high HPGe detectors or Na(I) detectors are the favorite detectors

- Systems based on pressurized ionization chambers, proportional counters, GM detectors or other suitable dose rate meters may be also used


display (computer)
video-
camera
GPS
computer
NaI(Tl)-detectors
HPGe-detector

Personal Monitoring

- To control personal exposure and contamination of response personnel and in particular field monitoring teams
- To monitor persons from the accident area for skin and clothing contamination before, during and after decontamination
- To monitor thyroid for radioiodine uptake

Sampling - General Guidance

- Take representative samples to enable the level and extent of contamination of air, ground, water, foodstuffs, vegetation etc. to be accurately and rapidly determined
- Sampling techniques should be consistent between sampling teams
- Samples should be taken at locations representative for the area and where contamination is more likely rather than at the most accessible sampling sites

Sample Analysis

- Samples can either be assessed in the field or returned to a specialist laboratory
- Standard analytical procedures may need to be replaced by rapid methods to cater for larger numbers of samples and the need for results as soon as possible
- Sample screening techniques may be employed

Confidence in the Monitoring Results

- Confidence in the monitoring results and international acceptability can be achieved only by implementing effective quality assurance system
- The system basically consists of
  - Quality assurance (QA) programme
  - Quality controls (QC) and
  - Audits / appraisals

Procedures

- Measuring procedures
- Calibration procedures
- Evaluation procedures
- QA and QC procedures

What procedures???

Field Measurements and Sampling

- Techniques
- Preparation and storage of samples
- Coding and record keeping

Instrumental Analyses

- Instruments
- Calibrations
- Background evaluations
- Checks of the stability of the instruments
- Field and laboratory records
- Data reporting

Summary

- **Monitoring organization and emergency team protective guides should be adapted to reflect country specific system in emergency response**

Where to Get More Information

- Practical lessons related to this lecture
- INTERNATIONAL ATOMIC ENERGY AGENCY, Method for the development of emergency response preparedness for nuclear or radiological accidents, IAEA-TECDOC-953, Vienna, (new addition, 2002)