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International Atomic Energy Agency
Atoms for Peace and Development

Introduction and Framework for Occupational Radiation Protection

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Objectives of this talk...

- IAEA Safety Standards
- Framework for ORP
- Radiation Protection Programme
- Monitoring programmes
- Record keeping and required arrangements

IAEA at work



Nuclear Technologies and Applications

- Sustainable development Goals
- Energy
- Health
- Addressing environmental issues
- Water
- Food and agriculture
- Industry

Safety and Security Standards

- Radiation Protection
- Nuclear installations safety
- Transport of radioactive material
- Radioactive waste management
- Emergency Preparedness and response
- Legal and regulatory aspects
- Nuclear security

Safeguards and Verification

- Basics of IAEA safeguards
- Safeguards legal framework
- Safeguards implementation
- Strengthening cooperation with states

Services

- Technical cooperation programme
- Coordinated research projects
- Collaborating centres
- Review Missions
- Laboratory services
- Education & Training

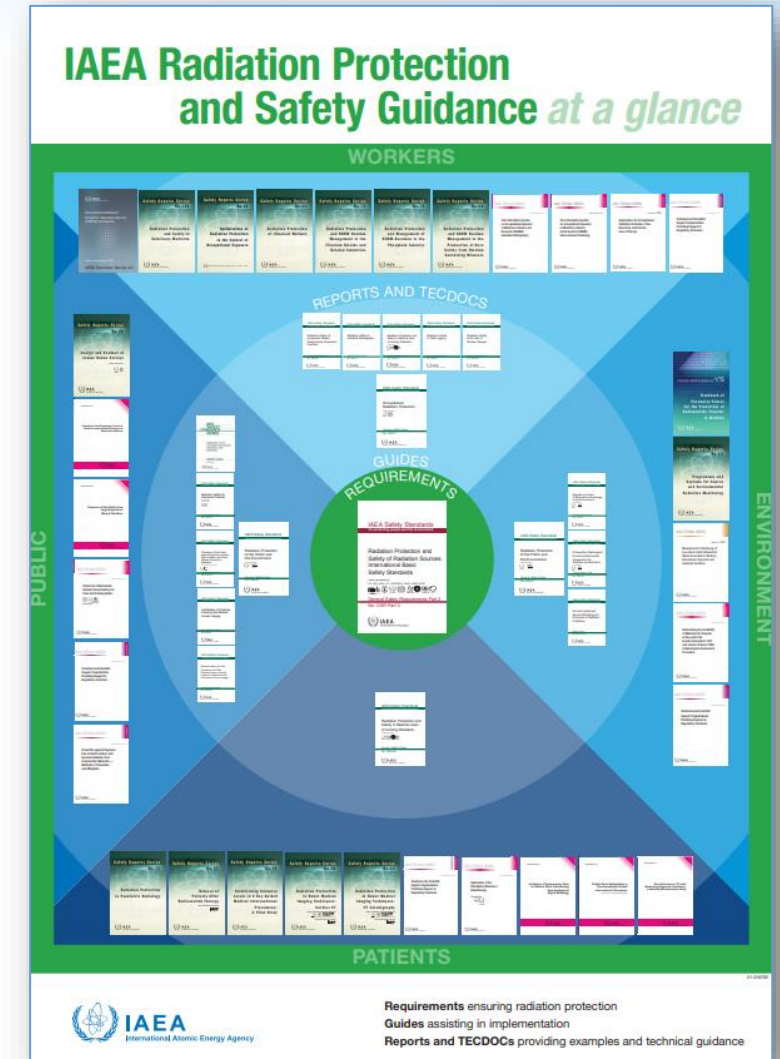
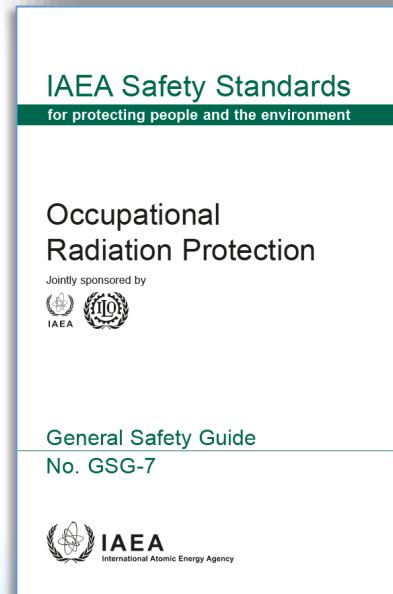
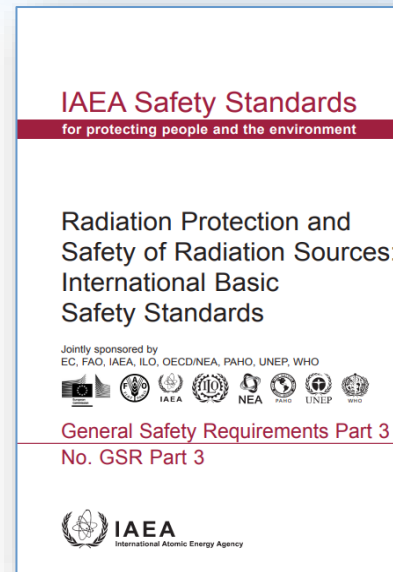
Safety Standards

- The IAEA develops safety standards and supporting technical documents that cover all areas relevant to safety related to a wide range of nuclear material and facilities.
- These standards provide a system that organizations and governments can use to protect people and the environment against harmful effects of ionizing radiation.
- The IAEA also supports countries in applying these standards by organizing technical meetings and training activities and providing advisory services.



IAEA Radiation Protection and Safety Guidance

- The protection of people and the environment from the harmful effects of ionizing radiation is at the heart of the IAEA's work.
- Development strategy : Consultations with MSs and providing technical support to leading organisations / events



IAEA - Occupational Radiation Protection Program



- **Objective:** To promote an **internationally harmonized approach** to ORP through the **development and application of Safety Standards** for optimizing protection and safety, restricting exposures and applying current radiation protection techniques in the workplace

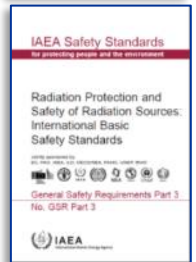
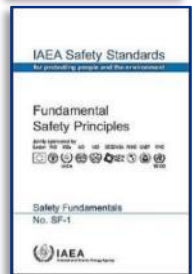
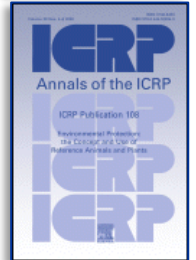
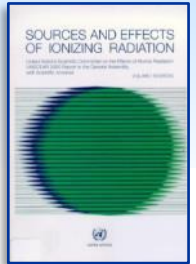
To ensure an appropriate control of occupational exposure due to external and internal irradiation from both artificial sources and natural sources of radiation



- This is achieved through provision of operational services for radiation monitoring and protection to the Agency's own operations; and through assistance to Member States in establishing, maintaining and, where necessary, improving programs for the radiation protection of workers
- Activities are targeting workers, employers, regulatory authority staff and radiation protection professionals

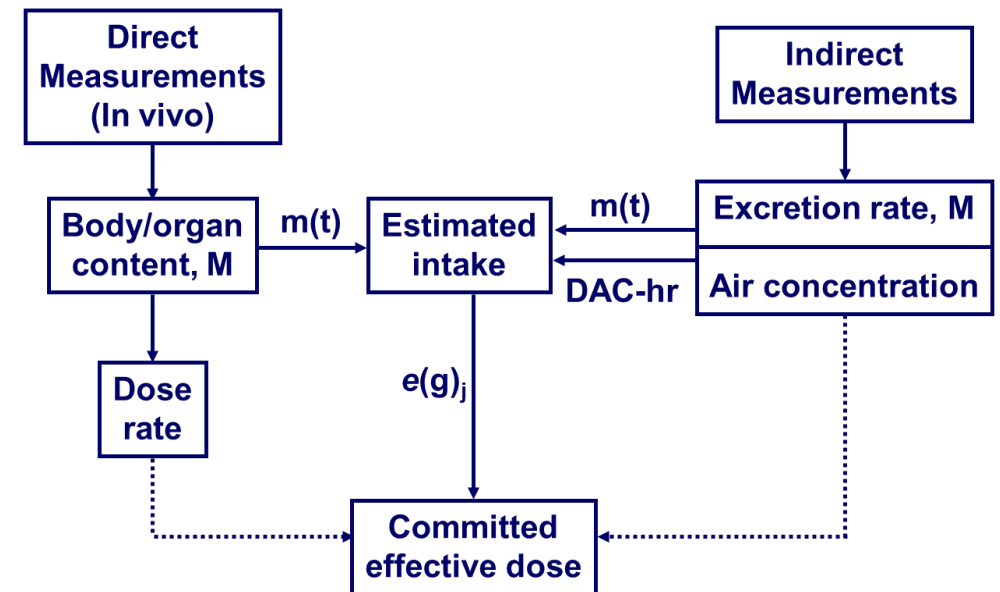
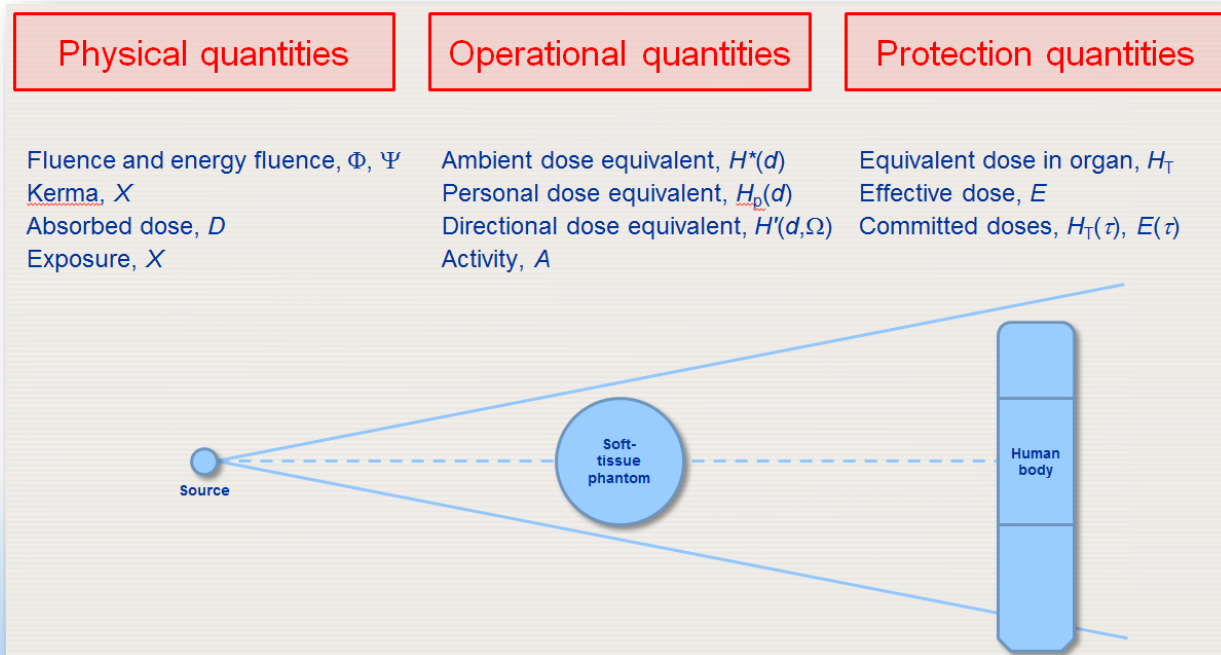
Occupational Exposure

- All exposure of workers incurred in the course of their work
 - Workers are exposed to ionizing radiation in a wide range of occupational settings (artificial & natural)
- Over 24 million monitored workers worldwide (52% - 12,6 million, exposure natural sources of radiation workers; 48% - 11,4 million, man-made source; could be as high as 41 million workers), numbers continue to increase
- Area with multiple actors (global / national level)
 - Requirements for protection of workers (IAEA - ILO)
 - Ministries, Regulators, OHS, etc.
- Safety Standards - To protect occupationally exposed workers against the risks associated with ionizing radiations - **Overall objective**

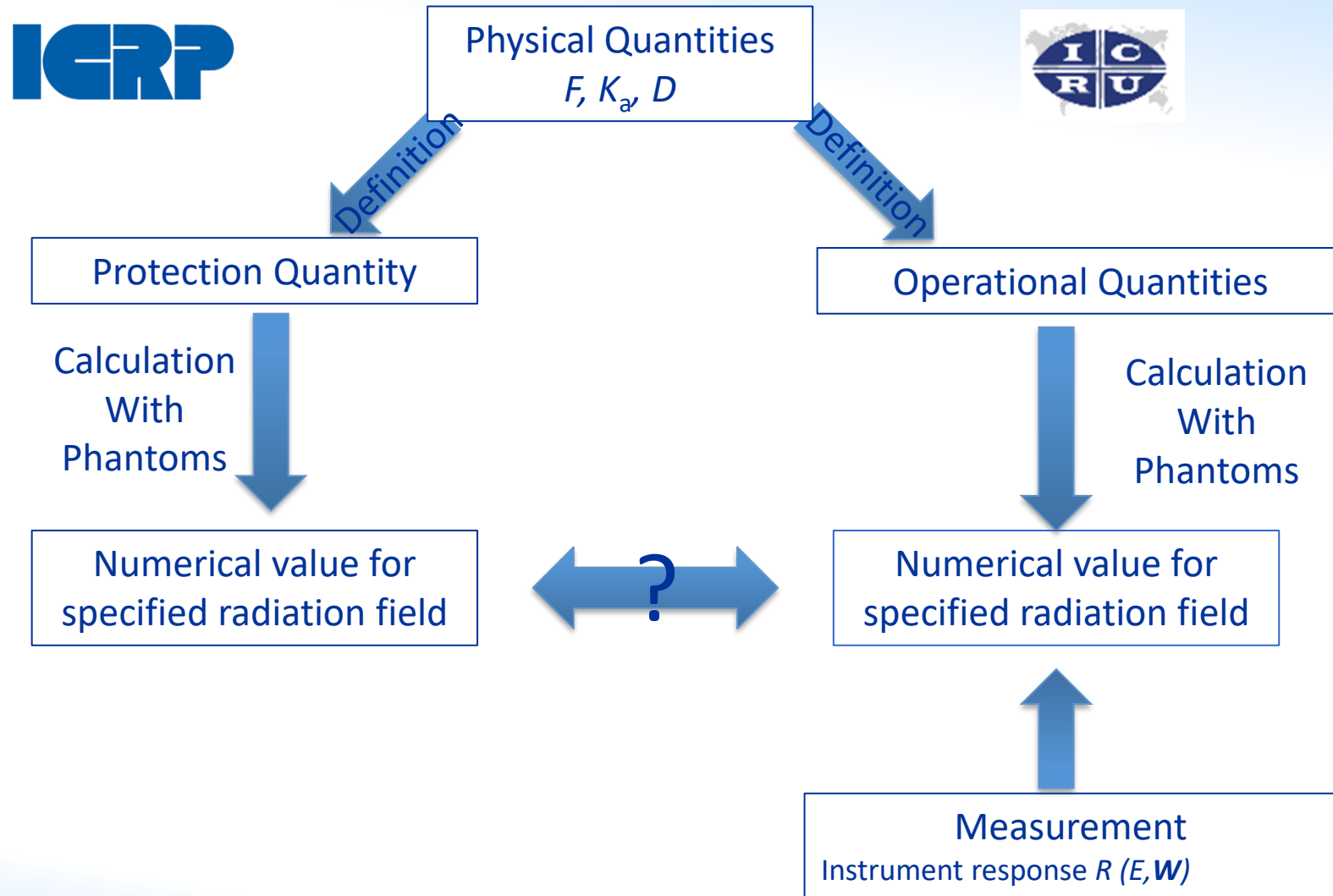


Terminology- ORP

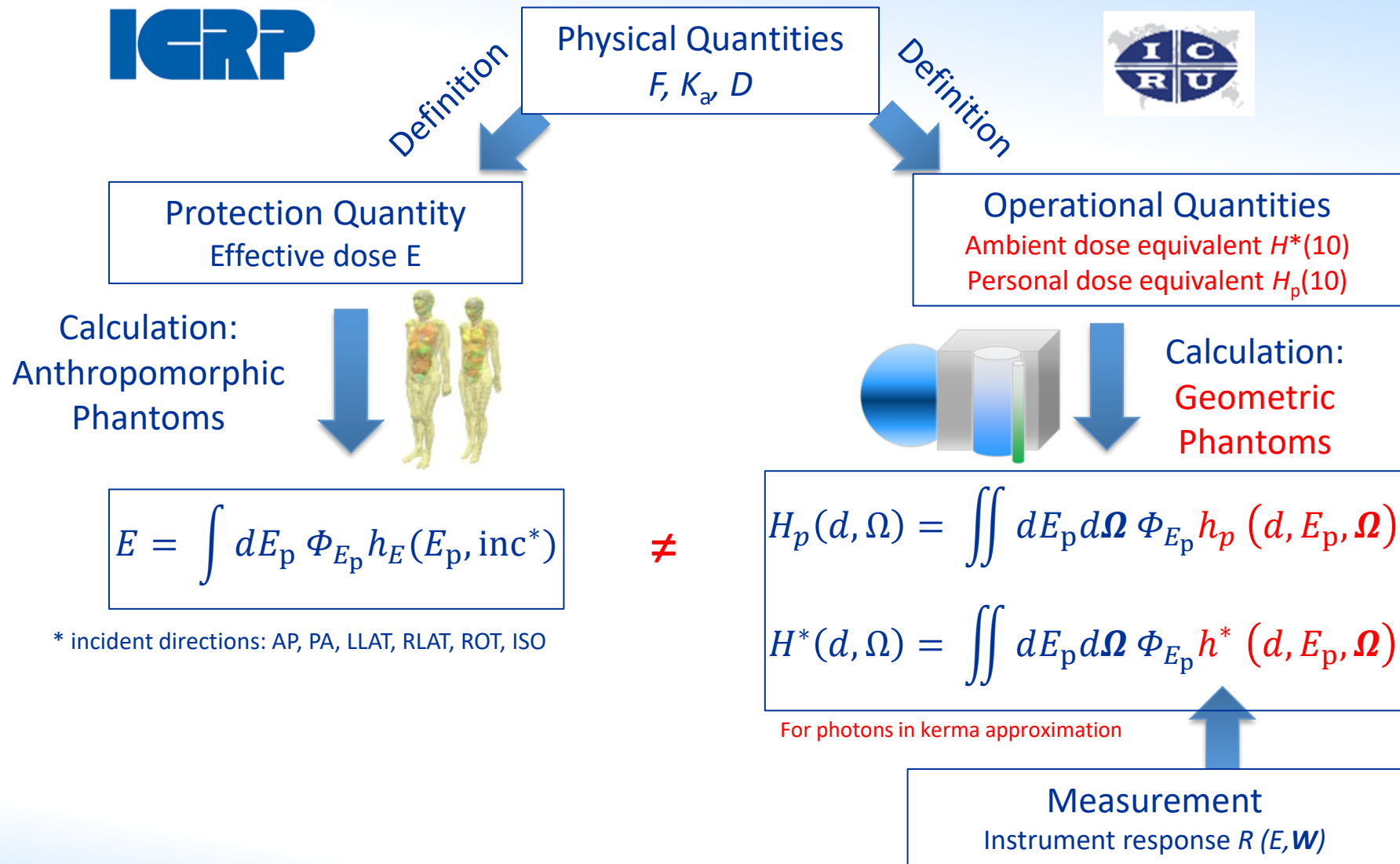
- Many different quantities and units.
- Need to be precise and careful
- Important when communicating to ensure you are talking about the same topic/item.
- There is no simple relationship between activity of a material and dose



Relation of Quantities

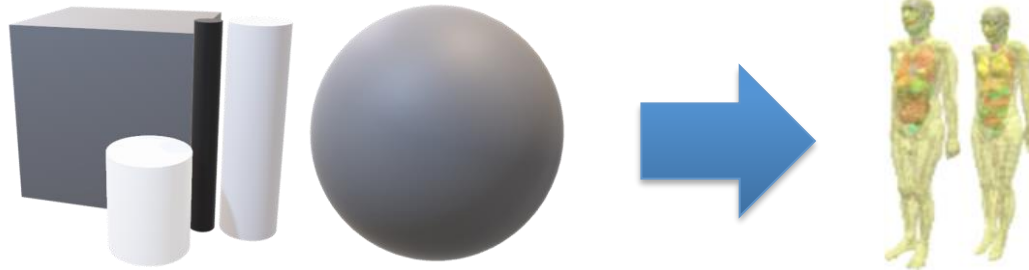


Today



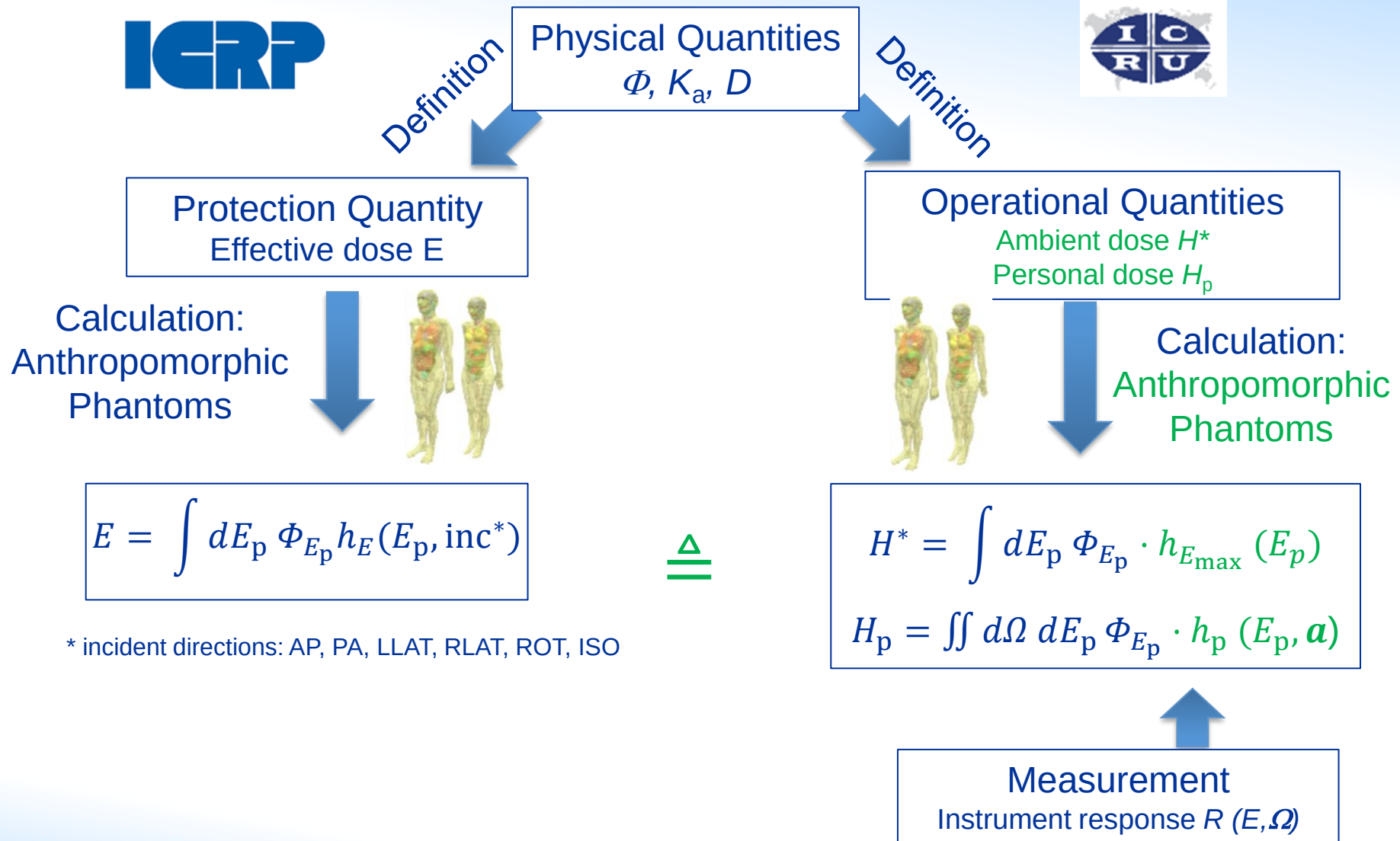
What changes ?

- Operational quantities from present to future:
- Change to anthropomorphic phantoms

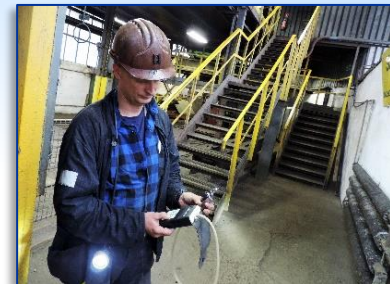


- Better approximation of E by definition
- Also:
 - Definition of quantities to limit tissue effects (local dose to skin and to eye lens) as absorbed dose
 - More radiation types, e.g., positrons, protons, pions...
 - Much wider energy range
- Adaptation of certain dosimeter types required:
 - Personal dosimeters for gamma and beta radiation at low energy

ICRU Report 95



Work environment

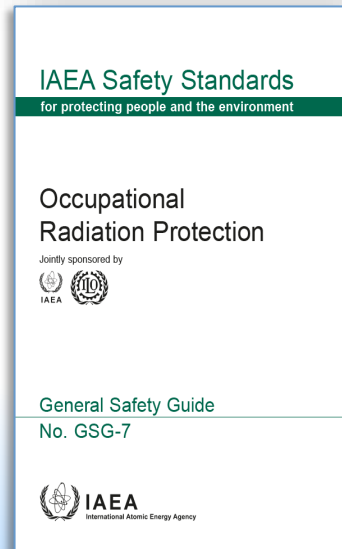
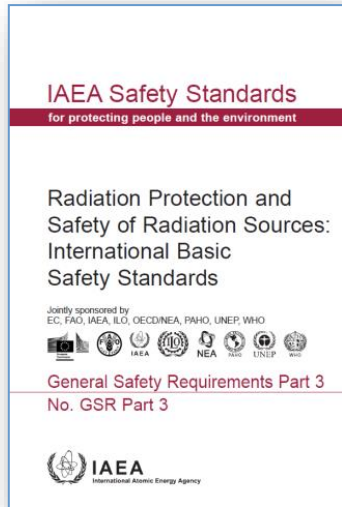


About a worker

- Any person who works, whether full time, part time or temporarily, for an employer and who has recognized rights and duties in relation to **occupational radiation protection** (*IAEA glossary, 2016*)
 - A self-employed person is regarded as having the duties of both an employer and a worker.
- Protection and safety is an integral part of a general occupational health and safety programme (*specific obligations and responsibilities*)
- The Board of Governors of the IAEA first approved health and safety measures in March 1960
- Agency worker in the 2017 IAEA Regulations (including personnel other than staff members)



International Basic Safety Standards, GSR Part 3 / GSG-7



- Protection and Safety requirements of the BSS apply to all facilities and activities
- **Planned, emergency and existing exposure situations**
- **Occupational**, public and medical exposure categories
- 52 overarching requirements – for **governments, regulatory bodies, industry, health and safety professionals, workers**, public and **service providers** such as technical support organizations
- **12 requirements for ORP**; **Control, monitoring** and **RECORDING**
- **Regulator(s), TSPs** (authorization or approval of service providers for individual monitoring and calibration services) & **Operators** (End-users)
- **GSG-7** is applicable to all areas concerning occupational exposure, including medicine, nuclear fuel cycle, industries involving NORM, radiation application industries and scientific as well as educational facilities

GSR Part 3, coverage for ORP

Planned exposure situation



Occupational exposure

- Req 19: Responsibilities of the regulatory body
- Req 20: Requirements for monitoring and recording of occupational exposure
- Req 21: Responsibilities of employers, registrants and licensees
- Req 22: Compliance by workers (*Responsibilities of workers*)
- Req 23: Cooperation between employers, registrants and licensees
- Req 24: Radiation protection programme**
- Req 25: Assessment of occupational exposure** and workers' health surveillance
- Req 26: Information, instruction and training
- Req 27: Conditions of service
- Req 28: Protection and safety for female workers and for persons under 18 years of age

Emergency exposure situation



Exposure of Emergency Workers

- Req 45: Protection of emergency workers (arrangements for controlling the exposure)

Existing exposure situation



Occupational exposure

- Req 52: Protection of workers in existing exposure situations (remedial actions, Rn in workplaces, exposure of air crew)

Radiation Protection Programme (Req 24- arrangements)



- Responsibility of employers, registrants and licensees (establish and maintain)
- **Organizational, procedural and technical arrangements** for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for **occupational exposure**

Classification: Controlled area

- Specific measures for protection & safety
- Exposure control or preventing the spread of contamination in normal operation & in anticipated operational occurrences and accident conditions

Classification: Supervised area

- Area not already designated as a controlled area but occupational exposure conditions need to be kept under review

Local rules, procedures and personal protective equipment

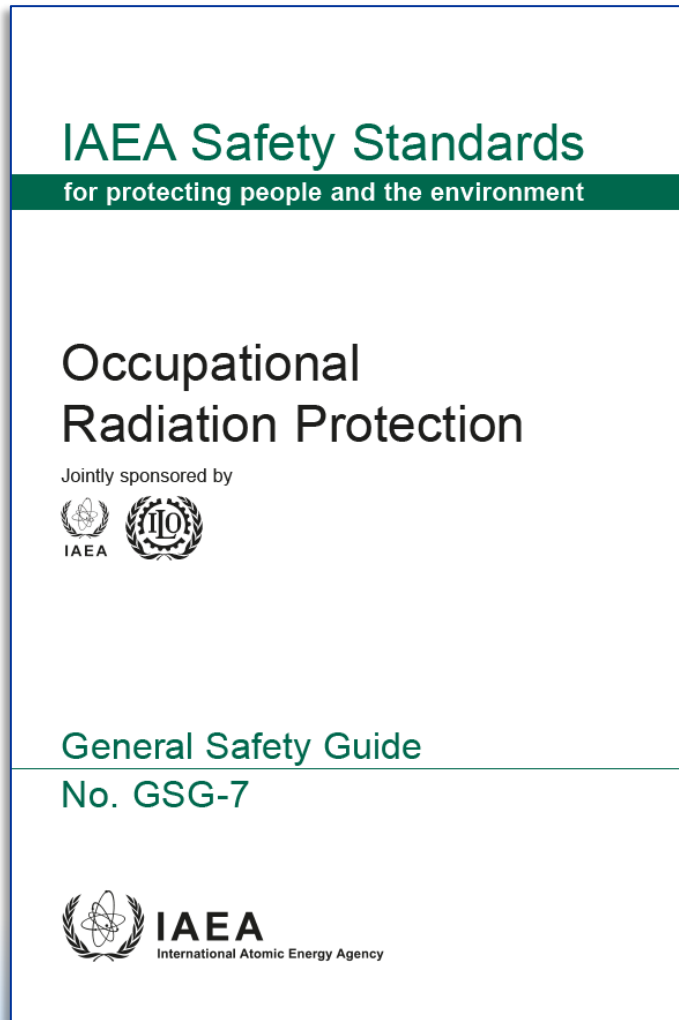
Application of control hierarchy

- Engineered controls
- Administrative controls
- Personal protective equipment

Monitoring of the workplace

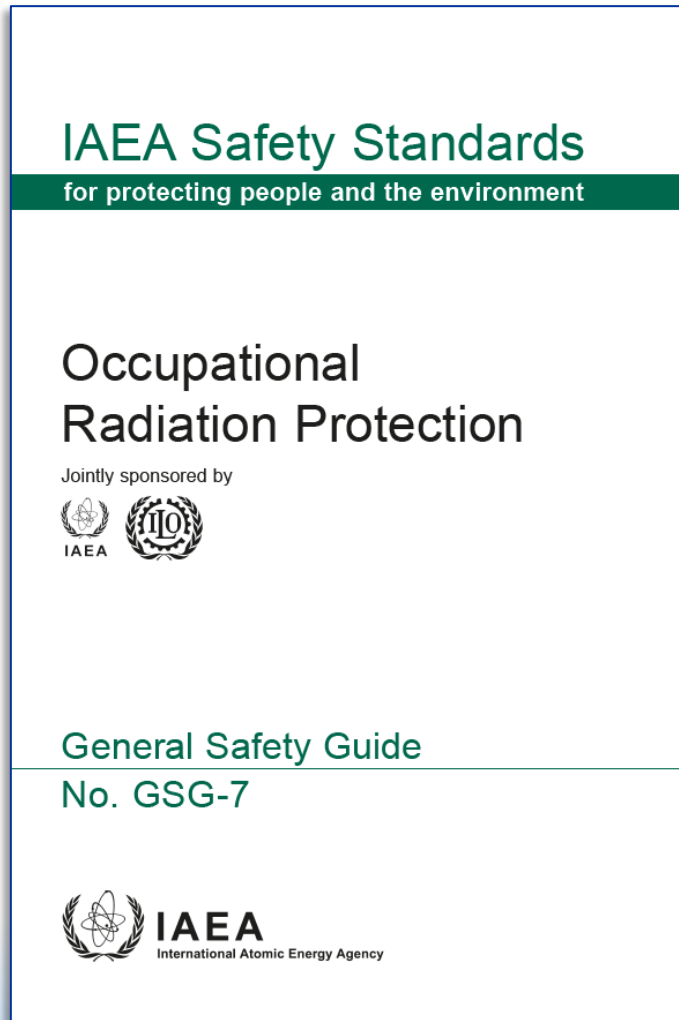
- Supervision by the RPO or qualified expert
- Type and frequency
- Evaluation of the radiological conditions, assessment of exposures, and review of the area
- Record keeping

Safety Guide on ORP



- Implementation of the Requirements on ORP in compliance with **GSR Part 3**
- Jointly developed by the IAEA and the ILO
- Updates of previous safety guides in the field of ORP
 - Occupational Radiation Protection, RS-G-1.1
 - Assessment of Occupational Exposure Due to Intakes of Radionuclides, RS-G-1.2
 - Assessment of Occupational Exposure Due to External Sources of Radiation, RS-G-1.3
 - Occupational Radiation Protection in the Mining and Processing of Raw Materials, RS-G-1.6
 - Management System for Technical Services in Radiation Safety, GS-G-3.2
- It is applicable to all areas concerning occupational exposure, including medicine, nuclear fuel cycle, industries involving NORM, radiation application industries and scientific as well as educational facilities.

Safety Guide on ORP



- Provides information on ORP framework, exposures of workers in different exposure situations, protection of workers in special cases, dose assessment, management system for service providers, control measures & health surveillance
- Offers an itemized step-by-step guidance on how to be vigilant in enhancing safety standards for **workers across a range of industries**
- New approaches for;
 - Itinerant workers
 - Female workers during and after pregnancy
 - Monitoring of lens of the eye exposure
 - Cosmic ray exposure
 - NORM
 - Radon at workplaces

Radiation Protection Programme (Section 3)

What is the objective?

To fulfil the **management's responsibility for protection and safety**

Effective radiation protection is a combination of

- good design,
- high quality construction, and
- proper operation

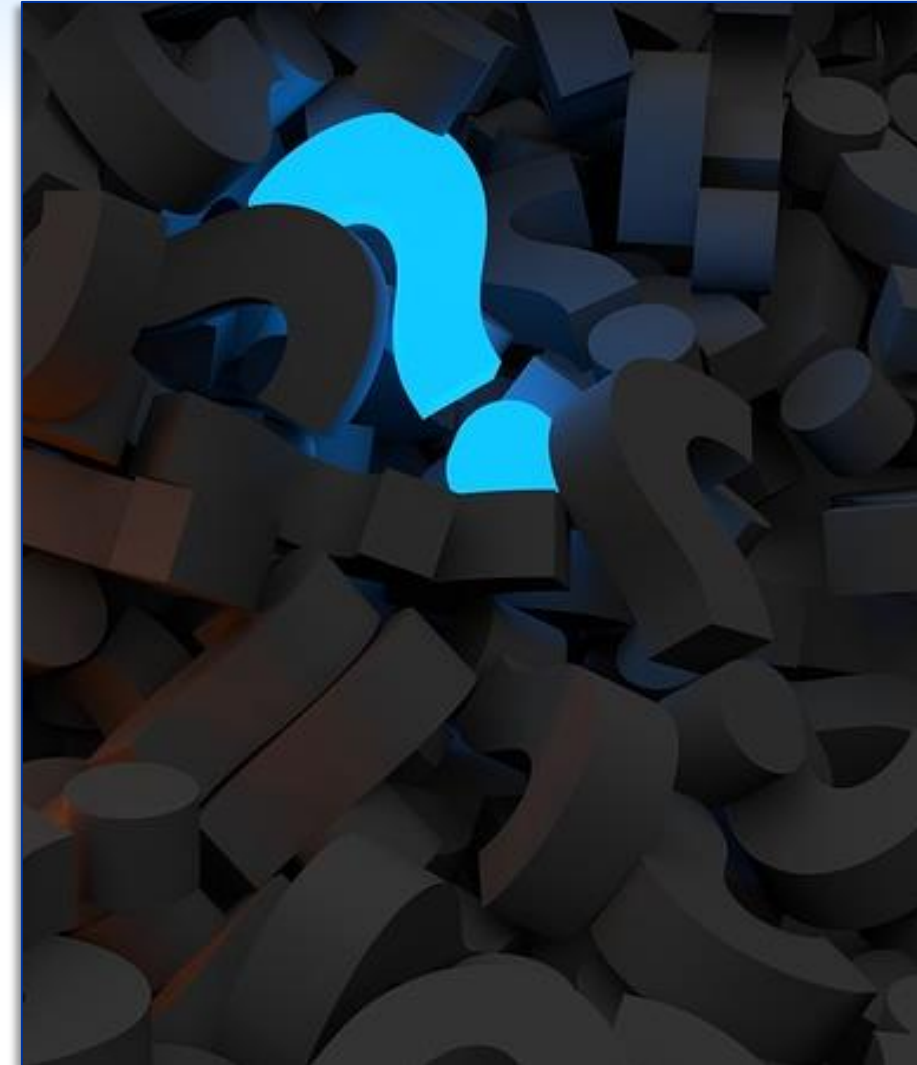
Radiation Protection Programme (Section 3)



- **Systematic arrangements** which are aimed at providing adequate consideration of radiation protection measures.
- Radiation Protection Organisation (manager and personnel)
- Radiation dose and medical surveillance of exposed workers (radiation work categories & surveillance)
- Area and zoning based on radiation exposure conditions
- Radiation work permit
- Radiation protection training
- Radiation protection procedures
- Control

Radiation Protection Programme (Section 3)

- Adoption of **management structures, policies, procedures and organizational arrangements** that are commensurate with the nature and extent of the risks
- Relates to all phases of a practice or to the lifetime of a facility (i.e. from design through commissioning and operation or process control to decommissioning)
- Only **one element** in ensuring the overall health and safety of workers (established and managed in close cooperation with those responsible for other areas of health and safety such as industrial hygiene, industrial safety and fire safety)
- To **minimize the need to rely on administrative controls and personal protective equipment**



Prior radiological evaluation and safety assessment

- **The first step towards the definition of a RPP**
(situation involving occupational exposures)
 - Graded approach
 - Level of effort
 - Formality and detail of the evaluation
 - Links to the magnitude of the exposures in normal operation, and to the magnitude and probability of potential exposures



Prior radiological evaluation and safety assessment

- **Aspects of operation**

- Sources of **routine exposure** and reasonably foreseeable **potential exposure** (*surface contamination, airborne contamination and sources of external radiation*)
- The **nature and magnitude of exposures** in normal operations & potential exposures (*Structures, Systems and Components*) & appropriate monitoring systems
- Assessment of potential public exposure due to radioactive effluents from the facility



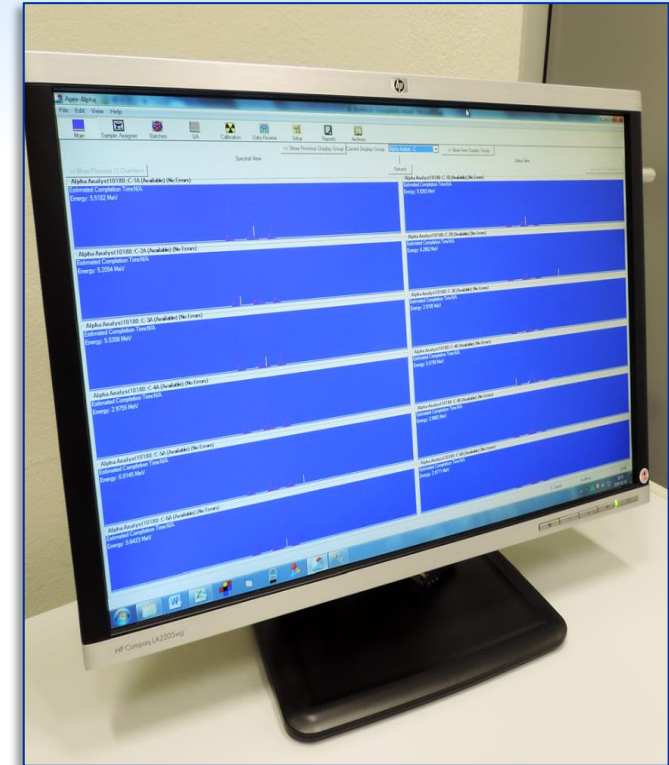
Prior radiological evaluation and safety assessment

- **Assessment of occupational exposure**

- Use of workplace monitoring
- Use of data from the scientific literature and information from comparable facilities
- Use of simulations
- Use of confirmatory measurements (with personal dosimeters can help to determine whether individual monitoring is needed)

- **Safety assessment**

- Conducted at different stages
- Siting, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning (or closure)



RPP (Scope & Content)

Documentation

- ✓ **Assignment of responsibilities** (decision making, corresponding organizational arrangements, including itinerant workers, advisory committee)
- ✓ **Designation and functions of qualified experts** (RP, internal and external dosimetry, workplace monitoring, ventilation, occupational health, radioactive waste management)
- ✓ Integration of ORP with other areas of **OHS** (industrial hygiene, industrial safety and fire safety)
- ✓ System for the accountability for radiation generators and radioactive sources (**inventory** – location, description of each radiation generator or radioactive source, activity, physical & chemical form)



- ✓ Designation of **controlled and supervised areas**
- ✓ **Local rules** (to follow and the supervision of work)
- ✓ Provision of **PPE**
- ✓ **Arrangements for monitoring** workers and the workplace
- ✓ System for **recording and reporting**
- ✓ **Education and training** programme
- ✓ **Methods for reviewing and auditing**
- ✓ **Emergency plan**
- ✓ Programme for workers' **health surveillance**
- ✓ Requirements for the **assurance of quality** and process improvement

Classification of areas

- Classifying working areas whenever there is occupational exposure to radiation
- Should be clearly defined in the RPP, and their classification should result from the prior radiological evaluation

Controlled area

- Defining the boundaries (magnitude of the exposures expected in normal operation, accident conditions, type and extent of the procedures), dose rate (fraction of dose limit), physical means
- Exposure times
- Radiation warning symbol
- Physical measures (to control the spread of contamination)
- Access control (entrance & exit)
- PPE, individual & workplace monitoring, contamination control, decontamination
- Information, instruction and training
- Operational experience and judgement

Supervised area

- Appropriate means (Defining the boundaries , 1mSv public –outer bound)
- Display approved signs, as appropriate, at access points to supervised areas
- Periodic review

Local rules and supervision

- Correspond to the **design and objectives** of the **facility** concerned
- **Any relevant investigation level or authorized level, and the procedures to be followed in the event that any such level is exceeded**

How to do documents

- Monitoring of exposures and contamination
 - Engineered controls (e.g., ventilation systems)
 - Use of PPE
 - Personal hygiene
 - Workers' health surveillance
 - Management of radioactive waste
- Environmental monitoring
 - Management system
 - Training
 - Development of a safety culture
 - Keeping of records
 - Reporting
 - Emergency preparedness and response

Work planning and work permits

- **Complex work conditions** (involving several groups of workers and numerous activities)
- **Nuclear industry, and also non-nuclear industries** (e.g., in the maintenance or dismantling of accelerators)
- Significant radiation levels or contamination levels
- RPO to take part in the planning of the work (written procedures) and should advise on the conditions under which work can be undertaken in controlled areas

Basis of the assessment

- Estimated duration of the work and the human resources
- Maps of estimated dose rates
- Operational state of the plant (e.g. for a NPP; cold or hot shutdown, operation at full or reduced power)
- Other activities in the same area which could interfere with the work
- Preparation and assistance in operations (e.g. isolation of the process, scaffolding and insulation work)
- Protective clothing and tools to be used
- Communication necessary to ensure supervisory control and coordination
- Management of any radioactive waste arising from the work
- Coordination with protective measures for conventional safety

Work permit

- A detailed dose rate map of the working area and possible hot spots, produced from a survey made prior to the work or otherwise estimated
- An estimate of contamination levels and how they could change during the course of the work
- Specification of any additional workplace monitoring of radiation levels to be carried out before or during the work
- An estimate of individual exposure and collective exposure for each work step
- Specification of any additional dosimeters to be used by workers
- Specification of personal protective equipment to be used in different phases of the work
- Details of any time restrictions or dose restrictions
- Instructions on when to contact the RPO



Monitoring and assessment of exposures

- Making of **measurements** in relation to the assessment or control of exposure (requires **interpretation** and **assessment**)

- Assessing the exposure and demonstrating compliance with regulatory requirements
- Effectiveness of working practices
- Radiological conditions in the workplace
- Operating procedures (individuals & groups)
- Informing workers
- Evaluation of doses in the event of accidental exposures



Types of monitoring based on objectives

- Routine monitoring
- Special monitoring
- Confirmatory monitoring
- Task related (specific operation)



Subdivision on the basis of the location of the monitoring

- Individual monitoring
- Workplace monitoring



Approved
dosimetry
services

- External exposure
- Internal exposure
- Skin contamination
- External radiation
- Air contamination
- Surface contamination

Individual monitoring

- **The need for individual monitoring is likely to be greater in the early stages of an operation**

- Type and energy of the radiation and the radionuclides involved
- Amount of radioactive material present and the radionuclides involved
- Physical and chemical form of the radioactive material
- Type of containment used
- Operations
- Expected levels and likely variations in the doses or intakes
- Complexity of the measurement procedures & interpretation procedures of the measurement programme
- General working conditions

Individual monitoring

- Handling of sealed sources (or dispersible sources that are in closed containers with or without shielding)- external only
- Handling radionuclides such as ^3H , ^{125}I or ^{239}Pu - internal only
- Gaseous or volatile materials (^3H and its compounds)
- Processing of Pu & other transuranic elements
- Maintenance of reactor facilities
- Bulk production of radioisotopes
- Radiopharmaceuticals (^{18}F , ^{131}I)
- Mining and processing U ores, mineral concentrates, production of nuclear fuel
- Processing of mineral concentrates (e.g., Monazite)



Workplace monitoring

- Evaluation of the radiological conditions in all workplaces
- Assessment of exposures in controlled areas and supervised areas
- Review of the classification of controlled areas and supervised areas
- Dose rate, activity concentration in air and surface contamination (fluctuations)

- Quantities to be measured
- Locations & frequency
- Appropriate methods & procedures for measurement
- Investigation levels (and the actions)

Assessment of exposure

- Arrangements for assessment of the occupational exposure of workers
 - On the basis of **individual monitoring** (appropriate, adequate and feasible)
 - With authorized or approved dosimetry service providers that operate under a quality management system
- **Assessment for any single component of the exposure** (e.g. strongly penetrating photon irradiation, neutron irradiation or internal exposure), the corresponding annual effective dose is expected to exceed 1 mSv (possible magnitude of potential exposures)



Assessment of exposure

- Assessment of occupational radiation exposure data and evaluation of trends of these doses over time is a fundamental tool for radiation protection of workers in terms of potential optimization of protection in line with the graded approach and dose limitation.
- Maintaining of life-time dose data of the occupationally exposed workers is also necessary to ensure and review radiation protection of workers, certification and other legal purposes and epidemiological studies.

Investigation levels

- Not dose constraints
- Particular situation sometimes indicates a need to review procedures and performance
- Qualitative (observation that the frequency of occurrence of minor contamination may have increased) or quantitative (trend in the results of monitoring programmes)
- Value of a quantity such as effective dose (selected fraction of limit), intake or contamination per unit area or volume at or above (monitoring period, frequency)
- May be used in retrospective sense



- Tool for Management
- Defined in planning stage (possible revision by OPEX)
- Regulatory body- generic investigation level in terms of individual exposure

$$\text{(Bq)} \quad \text{IL}_j = \frac{0.005}{N \cdot e(g)_j} \quad \text{(mSv)}$$

Recording levels

- Routine monitoring and collection of huge amount of data (it is the reality)
- **Recording level is value to be entered into the individual exposure records** (*derived from the duration of the monitoring period and an annual effective dose of no lower than 1 mSv or an annual equivalent dose of about 10% of the relevant dose limit + uncertainty*)
- Dose, exposure or intake (at or above)



- Specified by the Regulatory body
- Radiological parameter

$$R = L \cdot \frac{\text{monitoring period (months)}}{12}$$

$$R_{UL} = 1.5 \left(1 + \frac{H_0}{2H_0 + H_1} \right) \quad R_{LL} = \begin{cases} 0 & \text{for } H_1 \leq H_0 \\ \frac{1}{1.5} \left(1 - \frac{2H_0}{H_0 + H_1} \right) & \text{for } H_1 \geq H_0 \end{cases}$$

>

$$(Bq) \quad \text{RL}_j = \frac{0.001}{N \cdot e(g)_j} \quad (mSv)$$

Derived Investigation & Recording levels

- Expressing in terms of the quantities actually measured (radionuclide activities measured in the body or in excretion samples)
- Calculated separately for each radionuclide
- Specific to the physical and chemical form of the radionuclide
- Function of the period of time between the time of intake and the time of measurement

$$\text{DIL}_j = \frac{0.005}{N \cdot e(g)_j} m(t_0)_j$$

$$\text{DRL}_j = \frac{0.001}{N \cdot e(g)_j} m(t_0)_j$$

Records of occupational exposure

Employers, registrants and licensees shall maintain records of occupational exposure³⁴ for every worker for whom assessment of occupational exposure is required

- Workers access to records of their own occupational exposure
- Supervisor of the programme for workers' health surveillance, the regulatory body and the relevant employer with access to workers' records of occupational exposure
- Provision of copies of workers' exposure records to new employers when workers change employment
- Retention of exposure records for former workers by the employer, registrant or licensee, as appropriate (core for the National Dose Registry, NDR)
- Confidentiality of records

Records of occupational exposure

- Employer responsibility to maintain records
 - Records of occupational exposure for each worker shall be maintained
 - during and after the worker's working life,
 - at least until the former worker attains or would have attained the age of **75 years**, and for **not less than 30 years** after cessation of the work in which the worker was subject to occupational exposure.

Records of occupational exposure

- Employer responsibility to maintain records
 - Information on the **general nature of the work** in which the worker was subject to occupational exposure;
 - Information on **dose assessments, exposures and intakes** at or above the relevant recording levels specified by the regulatory body and the data upon which the dose assessments were based;
 - When a worker is or has been exposed while in the employ of **more than one employer**, information on the dates of employment with each employer and on the doses, exposures and intakes in each such employment;
 - Records of any assessments made of doses, exposures and intakes due to actions taken in an **emergency or due to accidents or other incidents**, which shall be distinguished from assessments of doses, exposures and intakes due to normal conditions of work and which shall include references to reports of any relevant investigations.

Records of occupational exposure

- If employers, registrants and licensees cease to conduct activities in which workers are subject to occupational exposure,
- they shall make arrangements for the retention of workers' records of occupational exposure by **the regulatory body or a State registry**, or **by a relevant employer**, registrant or licensee, as appropriate.



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Monitoring



Operational monitoring

- The range of activities involved in dose assessment, including individual and workplace monitoring
- Assessment of occupational exposure is a key element in achieving effective optimization and dose limitation
- The general objective of operational monitoring programmes is to provide the assessment of workplace conditions and individual exposures
 - Assessment of external exposure
 - Assessment of internal radiation exposure
 - Individual dose assessment

Monitoring is based on workplace area classification

Controlled Area

- “Any area in which specific protection measures and safety provisions are or could be required for:
 - ✓ controlling normal exposures or preventing the spread of contamination during normal working conditions; and
 - ✓ preventing or limiting the extent of potential exposures.”

Supervised Area

- “Any area not designated as a controlled area but for which occupational exposure conditions are kept under review even though specific protective measures and safety provisions are not normally needed.”

Occupational monitoring requirements

- Any worker normally working in a controlled area, or who occasionally works in a controlled area, and may receive significant occupational exposure,
- shall be provided individual monitoring where
 - appropriate,
 - adequate and
 - feasible

Occupational monitoring requirements

- When individual monitoring is,
 - inappropriate,
 - inadequate or
 - not feasible,
- Occupational exposure assessment should be based on,
 - workplace monitoring, and
 - information about locations and durations of worker exposure

Occupational monitoring requirements

- Individual monitoring is not required for workers regularly employed in a supervised area or who enters a controlled area only occasionally, however,
- Occupational exposure worker shall be assessed.
- Assessment is to be based on workplace or individual monitoring results.

Record keeping is used to:

- Demonstrate compliance with legal regulations
- Assist in work planning (worker allocation)
- Demonstrate the effectiveness of Optimization / ALARA
- Provide data for analysis of dose distribution
- Evaluate exposure trends
- Develop effective monitoring procedures and programmes
- Provide data for medical and/or legal purposes
- Provide data for epidemiological studies

Records

- Dosimetry records should include **details** of external and internal dose assessment using individual and workplace monitoring results
- **External Dosimetry** - The minimum level of detection should then be used as the recording level, i.e., record results below that level as zero
- **Internal Dosimetry** - Recording level applied to the measured results avoids the unnecessary effort for assessment of trivial intakes
- In making records of dose assessments, it is important to establish the recording levels of monitoring programmes
- A large amount of the data accumulated in monitoring programmes is of only transitory value



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Dose Management System

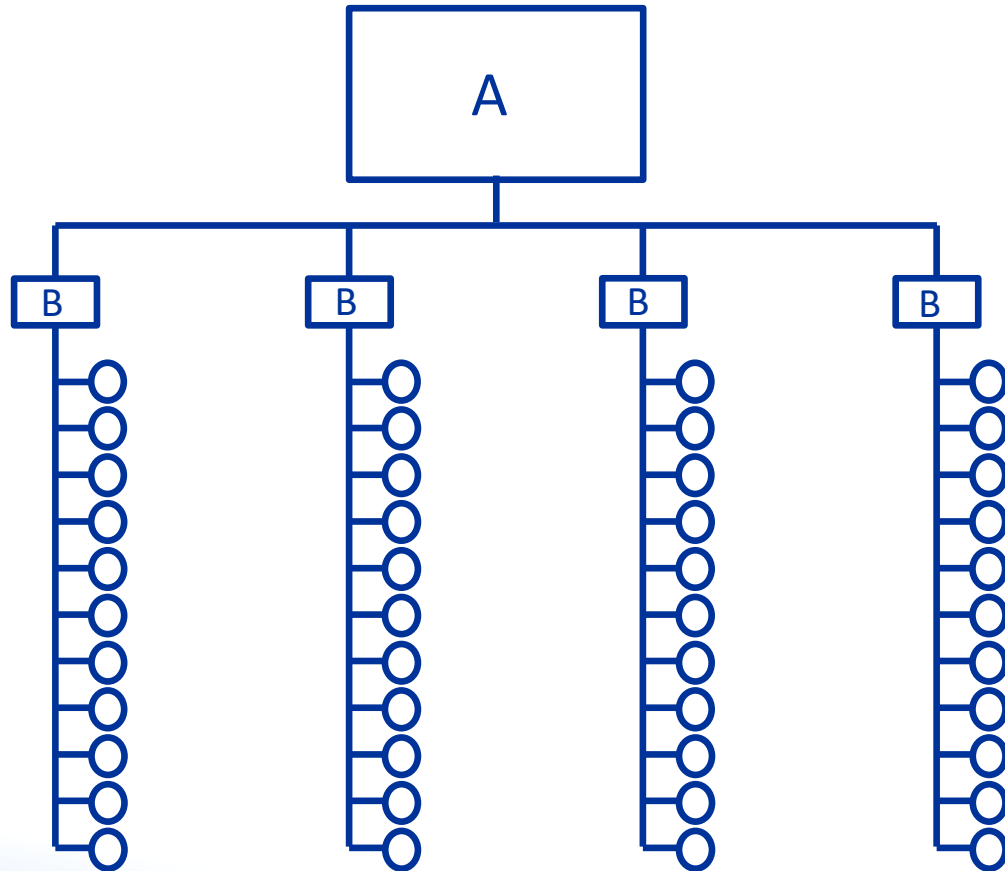
Setting up a Dose Management System

- Suggested structure if the DMS
 - is used by a large Individual Monitoring Service,
 - serving a significant number of customers

For smaller services, simpler structures may suffice

- The DMS structure assumes three levels:
 - The establishment (employer, customer)
 - The site
 - The individual

General structure of a Dose Management System



A. Establishment / Employer

B. Sites

C. Workers

Employer identification elements

- Name
- Employer code number
- Contact
- Street and number or PO Box
- Postal code
- Town
- Country
- Bank account number
- Telephone number
- Category of establishment

Employer work activity categories

- Medical
- Industry
- Nuclear
- Workplaces with natural radiation sources (NORM)
- Research
- Safety
- Transport
- Safeguards
- *Note - Within these categories, there are several practices*

Record system elements to identify the worker

- Full name
- A unique number (i.e., SSN)
- Sex
- Date of birth
- Employer (link to)
- Site (link to)
- Date of work commencement with present
- Employer
- Date of termination with present employer
- Classification: Employer work activity
- Classification: Worker occupational category

Occupational categories of individual workers

- Medical (DR, NM, ERT, IR, dental, veterinary etc.)
- Industrial (Industrial irradiation, Non-destructive testing, Isotope processing and production, Neutron sources, Process control, Industrial gauges, Well-logging, etc.)
- Non-destructive testing
- Sealed sources, nuclear gauges
- Various X-ray units
- Nuclear reactors
- Uranium ore extraction and processing
- Various activities

Occupations for Medical	Code
Physician (radiologist, nuclear medicine, radiotherapist)	S1-XX-001
Anaesthesiologist	S1-XX-002
Other Physicians (cardiologist, surgeon, etc.)	S1-XX-003
Radiation Physicist, Medical Physicist	S1-XX-004
Radiographer	S1-XX-005
Nuclear Medicine Technologist	S1-XX-006
Radiation Therapy Technician	S1-XX-007
Nurse – Anaesthetics, Operating Room Nurse with a State Diploma	S1-XX-008
Nurse	S1-XX-009
Health Care Aid, Stretcher Bearer	S1-XX-010
Radiopharmacist	S1-XX-011
Medical Laboratory Technician	S1-XX-012
Veterinarian	S1-XX-013
Veterinary Assistant	S1-XX-014
Dentist, Dental Surgeon	S1-XX-015
Dental Assistant	S1-XX-016
Occupational Health Physician	S1-XX-017
Logistics Operator (maintenance, cleaning and services)	S1-XX-018
Maintenance Operator for Ionising Radiation Devices	S1-XX-019
Student, Trainee	S1-XX-020
Researcher (director, assistant, manager), Engineer, etc.	S1-XX-021
Medical Assistant, Dietician, Physical Therapist or other medical field	S1-XX-022
Director, Head, Project/Product/Customer Application/Design Engineer, Industrial Research or Development/Test Engineer, Safety-Quality Operator, etc.	S1-XX-023
Chemist, Physicist, Biochemist, Geologist	S1-XX-024
Salesperson	S1-XX-025
Pharmacist	S1-XX-026
Laboratory Technician, Research Assistant	S1-XX-027
Teacher (middle and high school), Professor (university), Instructor, Trainer	S1-XX-028
Others (medical)	S1-XX-029

Occupations for Industry	Code
Logistics Operator (maintenance, cleaning and services)	S3-XX-018
Maintenance Operator for Ionising Radiation Devices	S3-XX-019
Student, Trainee	S3-XX-020
Researcher (director, assistant, manager), Engineer, etc.	S3-XX-021
Driver (only hauling)	S3-XX-030
Director, Head, Project/Product/Customer Application/Design Engineer, Industrial Research or Development/Test Engineer, Safety-Quality Operator, etc.	S3-XX-023
Chemist, Physicist, Biochemist, Geologist	S3-XX-024
Salesperson	S3-XX-025
Stationary X-ray Inspection Device Operator (Gamma Ray Technician, etc.),	S3-XX-031
Mobile X-ray Inspection Device Operator	S3-XX-032
Welder	S3-XX-033
Construction Worker (painter, mason, etc.)	S3-XX-034
Laboratory Technician, Research Assistant	S3-XX-027
Manufacturing Operator	S3-XX-035
Control Operator (I&C, reactor control, field operator)	S2-XX-036
Control Technician (liquid penetrant testing, ultrasound, etc.)	S3-XX-037
Decontaminator	S3-XX-038
Diver	S3-XX-039
Pipe Fitter, Boilermaker	S3-XX-040
Cableman	S3-XX-041
Foreman	S3-XX-047
Packer, Store Clerk, Bus Driver, Crane Operator, Bridge Operator, Longshoreman	S3-XX-048
Driver also responsible for handling	S3-XX-049
Others (industry)	S3-XX-029

Occupations for natural sources	Code
Logistics Operator (maintenance, cleaning and services)	S4-XX-018
Maintenance Operator for Ionising Radiation Devices	S4-XX-019
Student, Trainee	S4-XX-020
Researcher (director, assistant, manager), Engineer, etc.	S4-XX-021
Driver (only hauling)	S4-XX-030
Director, Head, Project/Product/Customer Application/Design Engineer, Industrial Research or Development/Test Engineer, Safety-Quality Operator, etc.	S4-XX-023
Chemist, Physicist, Biochemist, Geologist	S4-XX-024
Salesperson	S4-XX-025
Laboratory Technician, Research Assistant	S4-XX-027
Navigation Personnel Pilot	S4-XX-050
Navigation Personnel Steward	S4-XX-051
Navigation Personnel Other	S4-XX-052
Astronaut	S4-XX-053
Miner	S4-XX-054
Driller	S4-XX-055
Excavation Personnel	S4-XX-056
Spa Personnel	S4-XX-057
Others (Natural)	S4-XX-029

Computer based systems are widely used for record keeping

- Computer based data processing has shown tremendous improvement
- Hard- and software are available at very moderate prices
- Except when small numbers are involved, computer-based systems offer a great advantage over manual processing
- Either a PC or central computer system can be used
- "Ready-to-go" software packages are readily available
- However, setting up a records system may not be simple



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Recommended Record Content

Dosimetry records contain various kinds of information:

- Information to identify the worker.
- Measurements of external dose
 - $H_p(10)$ from X and gamma radiations;
 - $H_p(10)$ from neutron radiations;
 - $H_p(0.07)$ from X, gamma and beta radiations;
 - $H_p(3)$ from X, gamma and beta radiations;
- Measurements of internal dose, such as Committed Effective Dose.

Measurement techniques

- Date of measurement
- Dosimeters used
- Calibration
- Method of the data analysis
- Detection limits

Measurement results

- $H_p(10)$
- $H_p(0.07)$
- Extremity monitoring
- Estimate of radiation quality
- Quantities used

Supporting documentation should be maintained

- Working procedures and practices
- Training records and qualifications of analysts
- Quality assurance procedures
- Quality control data such as background trends and estimates of MDA
- Equipment calibration procedures and records
- Traceability of standard sources

Records include:

- Evaluations of anomalous dose;
- Doses allocated for lost or damaged dosimeters or samples;
- Any special dose limits imposed on the worker;
- Records of formal declarations of pregnancy, any revocations of such declarations, and notifications of the conclusion of a pregnancy

Records may also include

- Historical data
- Dates relating to personal and exposure information
- Text relating to personal and exposure information
- Lifetime dose to date, only if required by national regulation

A gap in the dose record?

- If a dose assessment is not available for a period when a worker should have been monitored, such as when,
 - a dosimeter has been damaged or lost, or
 - a recorded dose that, on investigation, is declared invalid
- The record keeping system should allow the introduction of doses estimated or assessed by an authorized person
- These doses may need to be flagged so that they can be distinguished from official dose measurements

Extremity monitoring records

- Separate records of the exposure of each extremity should be kept
- Assessment of the total exposure of the extremities should be the sum of the readings of,
 - extremity dosimeters in the periods when they were worn, and
 - $H_p(0.07)$ assessed by whole body dosimeters during periods when extremity dosimeters were not used

Record keeping for workplace monitoring

- Workplace monitoring results are unlikely to be useful in dose assessment, unless assessment is made at the time as part of the monitoring programme
- Substantial information will be required about the worker location, and the type of work during the monitoring period

Record keeping for workplace monitoring

- Proper interpretations of workplace monitoring results in terms of individual exposures may not be possible merely by later review of records
- Routine records of workplace monitoring will usually be used more to demonstrate good housekeeping than for assessment of the individual exposure

Workplace records should include a variety of information

- Records should include the designation and location of controlled and supervised areas
- Records should also include identification of instruments used and the individual performing the survey

Workplace records should include a variety of information

- Records should also be kept of radiation surveys, including,
 - date
 - time
 - location
 - radiation levels measured, and
 - any comments relevant to measurements made



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Record Access and Retention

The employer should:

- Provide workers access to information in their own exposure records;
- Provide access to the exposure records by the supervisor of the health surveillance programme, the Regulatory Authority and the relevant employer; and
- Facilitate the provision of copies of workers' exposure records to new employers

When a worker asks for his/her record,

- Usually through his employer
- A simplified version of the full dose record is appropriate
- Partly because the transcript may contain unrecognizable
- “computer terminology”
- On termination of employment, a summary of the dose record may be given to the worker
- Covers the period of last employment and dose information transferred from previous employment

Retention and use of records depend on local and national situation

- Used by management in
 - maintaining and improving design and operation, and
 - in achieving and demonstrating compliance
- Records may also be used in litigation or for other medical or legal reasons
 - this influences the retention period
- Records need not include the dosimeters, monitoring films, etc

Record retention

- Workplace monitoring, calibration of survey instrument;
 - 5 years
- Occupational exposure of worker, calibration of personal monitoring equipment;
 - Until the worker is or would be 75 years of age and 30 years after cessation of work

Record retention

The employer should:

- When employment stops, make arrangements for retention of exposure records by the Regulatory Authority, or a State registry, etc, as appropriate; and
- Maintain the appropriate confidentiality of records



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Thank you

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Occupational Radiation Protection Networks (ORPNET) | IAEA

Whole body Dosimeters	Threshold * (mSv)	Eye Lens Dosimeters	Threshold * (mSv)	Wrist Dosimeters	Threshold * (mSv)	Finger Dosimeters	Threshold * (mSv)
X, β , γ : TLD	0.1	X, β , γ : TLD	0.1	X, β , γ : TLD	0.1	X, β , γ : TLD	0.1
X, β , γ : RPL	0.05	-	-	X, β , γ : RPL	0.1	-	-
X, β , γ : OSL	0.05	-	-	X, β , γ and neutrons: TLD	0.1	-	-
Neutrons: solid track detector	0.1	-	-	Neutrons: solid track detector	0.1	-	-
Neutrons: solid track detector (standard ^(**) or equipped with a Teflon radiator ^(***))	0.1	-	-	X, β , γ : OSL	0.1	-	-
X, β , γ and neutrons (albedo): TLD	0.1	-	-	-	-	-	-

(*) This threshold corresponds to the minimum recorded dose value.

(**) Intermediate and fast neutron measurement.

(***) Allowing additional measurement of thermal neutrons.