



OCCUPATIONAL EXPOSURE AND CATEGORIZATION OF WORKERS IN A NUCLEAR FACILITY

Celso Osimani

*7th International Summer School on
Nuclear Decommissioning and Waste Management*

7th International Summer School: JRC-Ispra, Italy, 14-18 September 2015



CONTENT

- **Objective**
- **Occupational exposure**
- **Classified radiation workers**
- **Dose Limits for occupational exposure**
- **Dose Limits for apprentices and students**
- **Dose Limit for public exposure**
- **Protection of pregnant and breastfeeding workers**
- **Classification of areas and related requirements**
- **Conclusions**

7th International Summer School: JRC-Ispra, Italy, 14-18 September 2015

2



OBJECTIVE

The primary aim of radiological protection is to provide an appropriate protection of humans against ionising radiations.

The occupational exposure is one main aspect.



17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015

3



OCCUPATIONAL EXPOSURE

The occupational exposure arises as consequences of practises through the intentional use of a radiation sources in a working places.

Such exposure can be divided into two category:

- **Normal exposure**
- **Potential exposure**

- The first-one are those reasonably expected to be received
- The second-one are those unintended exposure for which there is a potential, but not certainty, of occurrence

17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015

4



OCCUPATIONAL EXPOSURE

The occupational exposure may also arise as a consequence of **interventions**, being the case where actions by workers are required to limit the consequences of an accident or emergency that has the potential for **causing harm to workers or public**. Workers may also be exposed during the process of reducing exposure of other workers arise



OCCUPATIONAL EXPOSURE

- The **occupational exposure** is normally used to indicate the exposure from a working situation under the responsibility of operating management and to which the system of protection for practises applies.

- The radiation sources like cosmic radiation at a ground level and K-40 in the body are excluded from the scope of regulatory control.



OCCUPATIONAL EXPOSURE

Any exposure at work (excluding medical exposure) as a result of artificial sources in, or associated with, the workplace should be included in occupational exposure, unless the sources have formally been excluded from regulatory control or exempted from the relevant aspects of regulatory control by the regulatory agency.

Therefore, decisions are also required regarding those sources of artificial exposure that should be excluded or exempted from regulatory control.



CLASSIFIED RADIATION WORKERS

- The radiation exposure of workers is limited by law to a set of prescribed radiation exposure levels, called **Dose Limits**.
- The dose limits for workers aged eighteen or over are shown in following slide.
- Those who are, or are likely to be, exposed to more than three-tenths of these limits are subject to additional control measures, and are known as "**Classified Workers**".



DOSE LIMITS FOR OCCUPATIONAL EXPOSURE

The ICRP recommends for occupational exposure a limit on effective dose of

- ❖ **20 mSv per year averaged over 5 years (100 mSv in 5 years),**
- ❖ **with the further provision that the effective dose should not exceed 50 mSv in any single year.**



The EU Member States recommend for occupational exposure a limit on effective dose of 20 mSv in any single year. However in special circumstances a higher effective dose of up to 50 mSv may be authorised by the competent authority in a single year, provided that the average annual dose over any five consecutive years does not exceed 20 mSv.

17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015



DOSE LIMITS FOR OCCUPATIONAL EXPOSURE

The limit on the equivalent dose for the lens of the eye is 20 mSv in a single year or 100 mSv in any five consecutive year subject to a maximum dose of 50 mSv in a single year.

The limit on the equivalent dose for the skin is 500 mSv in a year, this limit shall apply to the dose averaged over any area of 1 cm², regardless of the area exposed.

The limit on the equivalent dose for the extremities is 500 mSv in a year.

17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015

10



DOSE LIMITS FOR OCCUPATIONAL EXPOSURE

In EU Member States the expressions “Category A” and “Category B” workers are used.

- ☐ category A: those exposed workers who are liable to receive an effective dose greater than 6 mSv per year or an equivalent dose greater than 15 mSv per year for the lens of the eye or greater than 150 mSv per year for skin and extremities;
- ☐ category B: those exposed workers who are not classified as category A workers.
 - In order to keep ALARA individual radiation exposures, **additional dose constraints** lower than the above mentioned dose limits are used at the nuclear facility.



DOSE LIMITS FOR APPRENTICES AND STUDENTS

The limit on the effective dose for apprentices aged between 16 and 18 years and for students aged between 16 and 18 years who, in the course of their studies, are obliged to work with radiation sources, shall be **6 mSv in a year**.

The annual equivalent dose in the lens of the eye shall not exceed 15 mSv, nor shall the annual equivalent dose at any point on the hands, feet or skin exceed 150 mSv.





DOSE LIMITS FOR PUBLIC EXPOSURE

The limit on the effective dose for public exposure is **1 mSv in a year**.

The limit on the equivalent dose for the lens of the eye shall be 15 mSv in a year;

The limit on the equivalent dose for the skin shall be 50 mSv in a year, averaged over any 1 cm² area of skin, regardless of the area exposed.



PROTECTION OF PREGNANT AND BREASTFEEDING WORKERS

Protection of the unborn child is comparable with that provided for members of the public. As soon as a pregnant worker informs of the **pregnancy**, the employer shall ensure that the employment conditions for the pregnant worker are such that the equivalent dose to the unborn child is as low as reasonably achievable and **below 1 mSv** during at least the remainder of the pregnancy.



As soon as workers inform the employer, that they are **breastfeeding an infant**, they shall not be employed in work involving a significant risk of intake of radionuclides or of bodily contamination.



CLASSIFICATION OF AREAS AND ZONES

Areas in which specific protective measures are required for normal working conditions shall be classified

Classification of different zones depends on dose rates or levels of contamination:

– **CONTROLLED AREAS (of different levels)**

– **SUPERVISED AREAS**



CLASSIFICATION OF AREAS AND ZONES

Demarcation of areas to be ensured possibly through existing structural boundaries


Appropriate information should be displayed at access point to controlled areas :

– Warning symbols (ISO)

– Radiations levels

– Zone category


– Enter procedures or restrictions



Area	Dose limit [year]	Ambient dose equivalent rate		Sign	
		Work place	Low occupancy		
Non-designated	1 mSv	0.5 µSv/h	2.5 µSv/h		
Radiation Area	Supervised	6 mSv	3 µSv/h	15 µSv/h	
	Simple	20 mSv	10 µSv/h	50 µSv/h	
	Limited Stay	20 mSv		2 mSv/h	
	High Radiation	20 mSv		100 mSv/h	
	Prohibited	20 mSv		> 100 mSv/h	

Controlled Area

17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015





CLASSIFICATION OF AREAS AND ZONES

Definitions

“**Controlled Area**” means an area subject to special rules for the purpose of protection against ionising radiation or preventing the spread of radioactive contamination and to which access is controlled;

“**Supervised Area**” means an area subject to supervision for the purpose of protection against ionising radiation;





17th International Summer School: JRC-Ispra, Italy, 14-18 September 2015



REQUIREMENTS FOR CONTROLLED AREA

- The controlled area shall be bounded and access to it shall be restricted to individuals who have received appropriate instruction
- Access shall be controlled in accordance with written procedures provided by the undertaking.
- Wherever there is a significant risk of the spread of radioactive contamination, specific arrangements shall be made, including for the access and exit of individuals and goods and for monitoring contamination within the controlled area and, where appropriate, in the adjacent area.
- Taking into account the nature and extent of radiological risks in the controlled area, radiological surveillance of the workplace shall be organised and ensured.



REQUIREMENTS FOR CONTROLLED AREA

- Signs indicating the type of area, the nature of the sources and their inherent risks shall be displayed.
- Working instructions appropriate to the radiological risk associated with the sources and the operations involved shall be laid down.
- The worker shall receive specific training in connection with the characteristics of the workplace and the activities.
- The worker shall be provided with the appropriate personal protective equipment.
- The licensee, under the regulatory oversight, is responsible for implementation of these duties taking into account the advice provided by the radiation protection expert.



REQUIREMENTS FOR SUPERVISED AREA

- taking into account the nature and extent of radiological risks in the supervised area, radiological surveillance of the workplace shall be organised;
- if appropriate, signs indicating the type of area, the nature of the sources and their inherent risks shall be displayed;
- if appropriate, working instructions appropriate to the radiological risk associated with the sources and the operations involved shall be laid down.
- The Licensee , under the regulatory oversight, is responsible for implementation of these duties taking into account the advice provided by the radiation protection expert.



CONCLUSION

- **Summarizing we have provided an overview of the basic concepts for occupational exposure and related dose limits**
- **The approach of the design to ensure radiation protection of works by establishing categories of workers and classification of working areas depending on the related radiological hazards**
- **Finally we have presented the requirements associated to the main classified type of areas.**



THANK YOU FOR ATTENTION