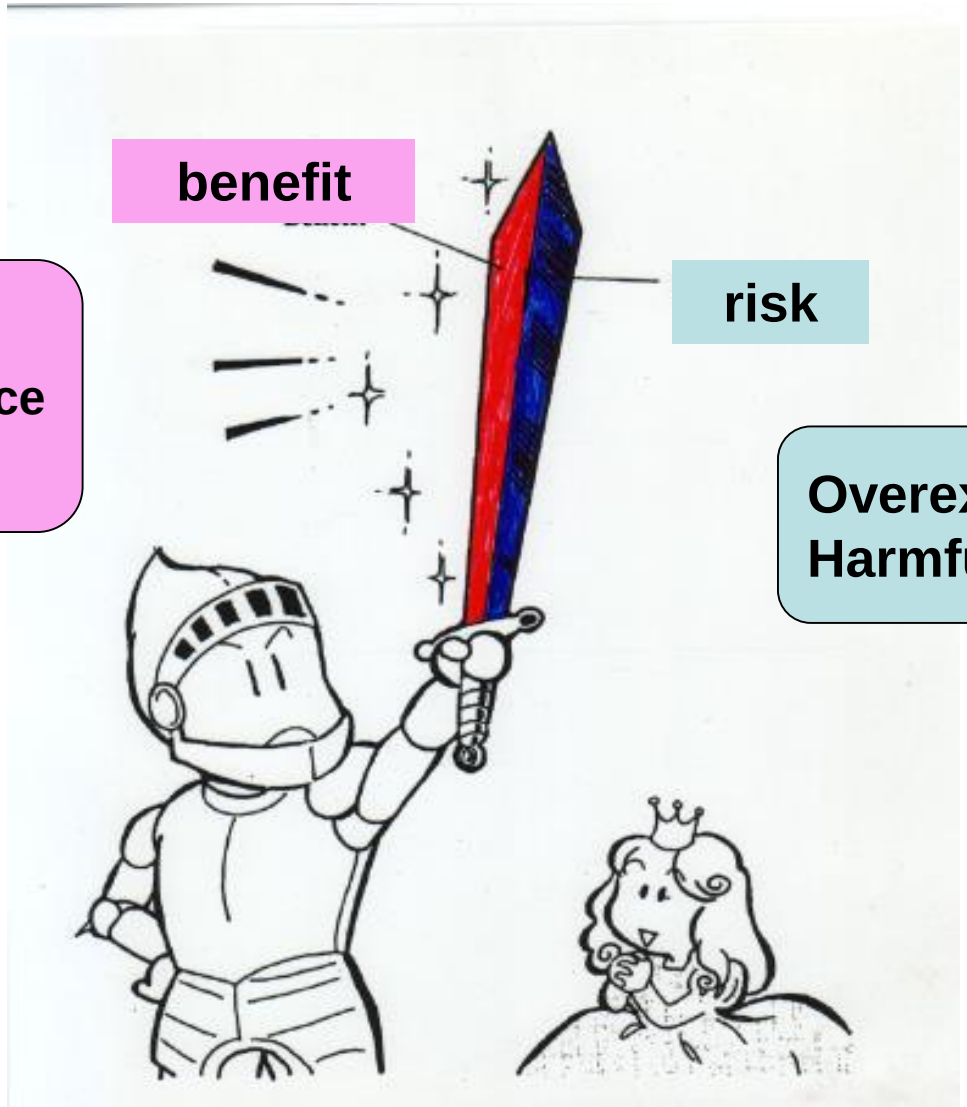
Ordinance on Prevention of Ionizing Radiation Hazards

Radiation work both ways



tracer
electric source
irradiation

Overexposure
Harmful effects

Balance of profit and loss

図 2　臨床像

ICRP

(International Commission on Radiological Protection)

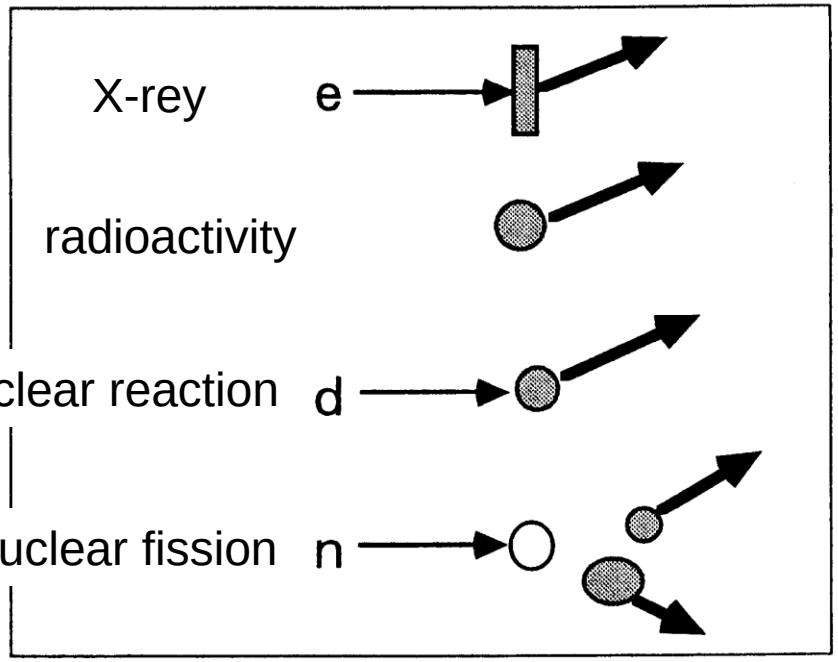
The "International Commission on Radiological Protection" is an international organization that makes recommendations on radiation protection from the standpoint of an expert. The committee was established at the 2nd Annual Meeting of the International Society of Radiology in 1928, and the 1st to 4th specialized committees were established. The basic concept of radiation protection, protection standards, radiation protection measures, etc. are examined, and the results of the examination are published in the form of recommendations or reports (Publications), which are the norms of radiation protection standards in each country.

ICRP recommendations and domestic legislation

- In 1958（publ.1）
  - The values of protection standards (determined organs / tissues, maximum permissible dose, occupational exposure: 0.3rem / week, public exposure: 1/10 of professionals) have been revised.For occupational exposure to gonads, hematopoietic organs, and crystalline lens, we recommended the maximum allowable collective dose standard (3rem / 13 weeks, supplemented by the maximum allowable dose standard) with D = 5 (N-18) rem (N: age).
  - Enactment of the Radiation Hazard Prevention Law in 1960
- In 1977（publ.26）
  - It presented a dose limiting system featuring three principles: justification of conduct, optimization of protection and dose limiting. Instead of radiation dose limits focusing on organs and tissues, we recommended dose equivalent limits based on the total risk of all irradiated tissues.
  - Partial amendment of related laws and regulations in 1988; revised to use the effective dose equivalent limit and tissue dose equivalent limit for one year as the dose standard.
- In 1990（publ.60）
  - The radiation protection system added justification and optimization of the dose limit system, and recommended a value of "5 year average of 20 mSv per year" for effective dose as the dose limit for occupational exposure.
  - Partial amendment of related laws and regulations in 2000; revised effective dose limit to 50 mSv in 1 year and 100 mSv in 5 years

Radiation protection goals

- Radiation emission

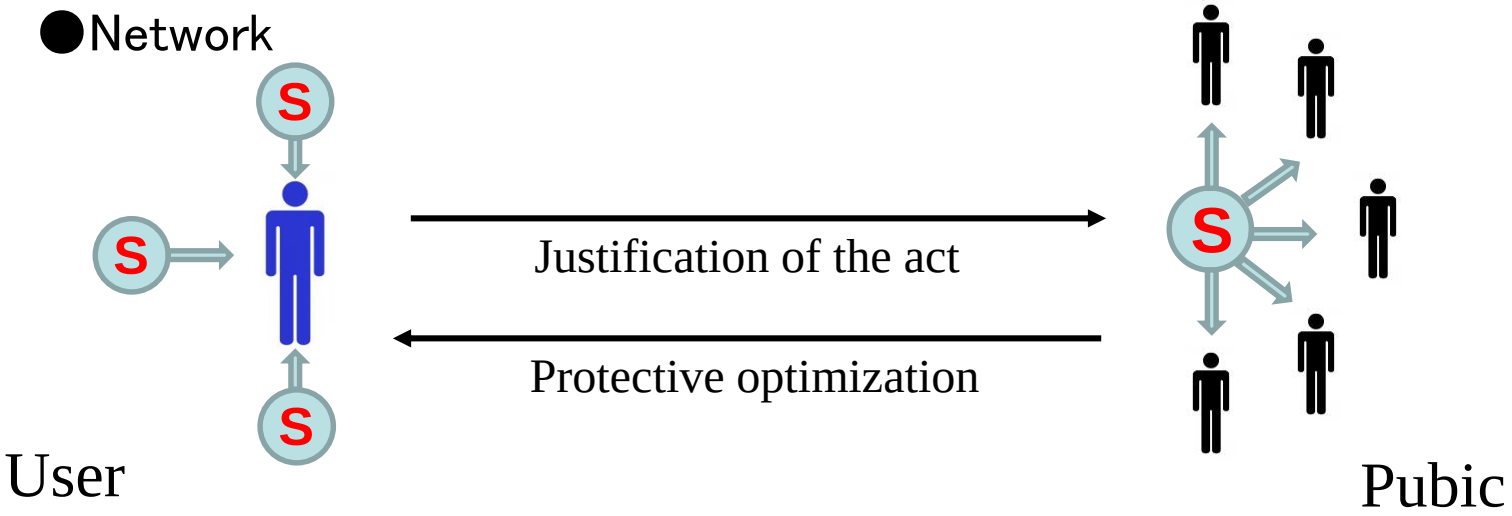


- Protection goals

	benefit	risk
Goal	Do not limit unreasonably	• Ensuring human safety • Prevents deterministic effects • Reduce the induction of deterministic effec

Radiation protection system

● Network



● Radiation protection system

action (work environment)	①Justification of the act	・Effects / results ？ ・Alternative method ？
	②Protective optimization	・ALARA
	③Individual dose limit	・Acceptable limit
intervention (public environment)	①benefit ＞ ill effect	・Bring some benefits
	②Content, scale and duration of intervention	・ Public exposure situation ・Countermeasures

Atomic Energy Basic Law (1955)

Use atomic energy only for peaceful aims through democratic administration, autonomous accomplishment and public disclosure of results.

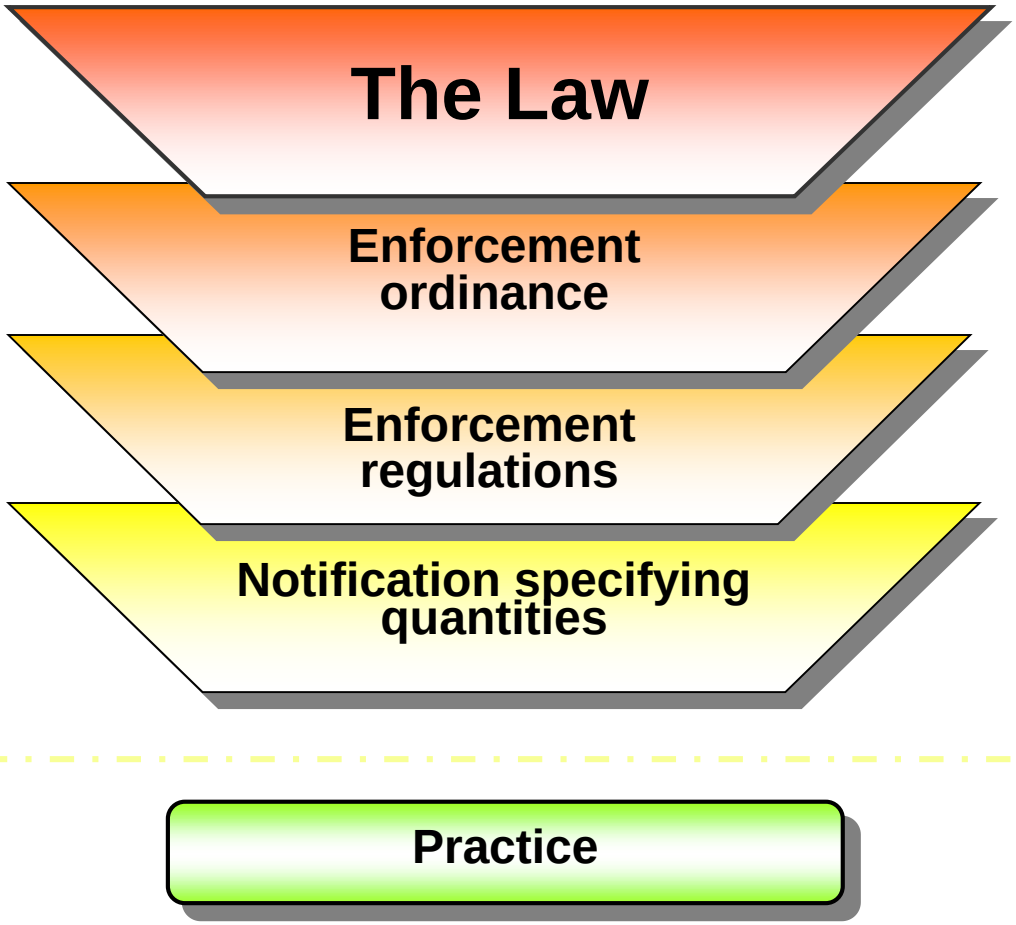
Article 12

- Regulations concerning Nuclear Fuel Materials
- Law for the Regulation of Nuclear Source Materials, Nuclear Fuel Materials and Reactors (1957)
  - Enforces the necessary regulations on manufacture, processing, storage, reprocessing and disposal activities of nuclear source materials, fuel materials and nuclear reactors.

Article 20

- Protective Measures of Radiation Hazards
- Law concerning Prevention of Radiation hazards due to Radioisotopes, etc. (1957)
  - Regulates the use, sale, lease, disposal and other handling of radioisotopes, the use of radiation generating equipment, and the disposal and other handling of the articles contaminated by radioisotopes to prevent radiation hazards.

Structure of Regulations for Prevention of Radiation Hazard due to Radioisotopes, etc



Applicable laws and regulations related to radiation

1. **Law Concerning Regulation of Radioactive Isotopes, etc.**

   Does not include X-rays and electron beams of less than 1 MeV.

2. **Industrial Safety and Health Act**

   Ionizing radiation hazard prevention rules (Ionization rule)

   Includes X-rays and electron beams of less than 1 MeV.

Contents of the ionization law

（1） **Safety management system**

Basic principle of radiation hazard prevention,

authorized chief X-ray inspection engineer

（2） **Human safety management**

Education and training, health examination,

exposure measurement and recording, emergency measures

（3） **Safety measures for X-ray equipment / X-ray work**

Technical standards for protection of external radiation,

records, measurements, alarms, Posting notes, etc.

（4） **Safety measures for γ-ray transmission photography work**

（5） **Safety measures for radioactive materials**

Prevention of pollution, measurement of working environment

Terms

X-ray : ionization radiation

X-ray equipment : radiation equipment

A device that accelerates charged particles

Radiation equipment room

Radiation work

Controlled area

Radiation equipment room

(1) The radiation device will be installed in a dedicated room (radiation device room).

- Dedicated room: A room that is not used for purposes other than the use of radiation equipment.
- Multiple radiation devices can be installed in one room.
- X-ray equipment and γ-ray equipment can be installed side by side

(2) Post a sign clearly stating that it is a radiation equipment room at the entrance of the room.

(3) Do not allow anyone other than what you need to enter the room.

Radiation work

(1) Use of X-ray equipment or inspection of equipment that generates X-rays

(2) Use of cyclotrons, betatrons and other devices that accelerate charged particles, or inspection of devices that generate ionizing radiation.

(3) These inspection work involving X-ray equipment, degassing of Kenotron or X-ray generation

(4) Handling of equipment equipped with radioactive substances

(5) Handling of radioactive substances or those contaminated with radioactive substances.

Controlled area

Definition: A place where there is a risk of exceeding 1.3 mSv per 3 months

① **Keep unnecessary people from entering the controlled area.**

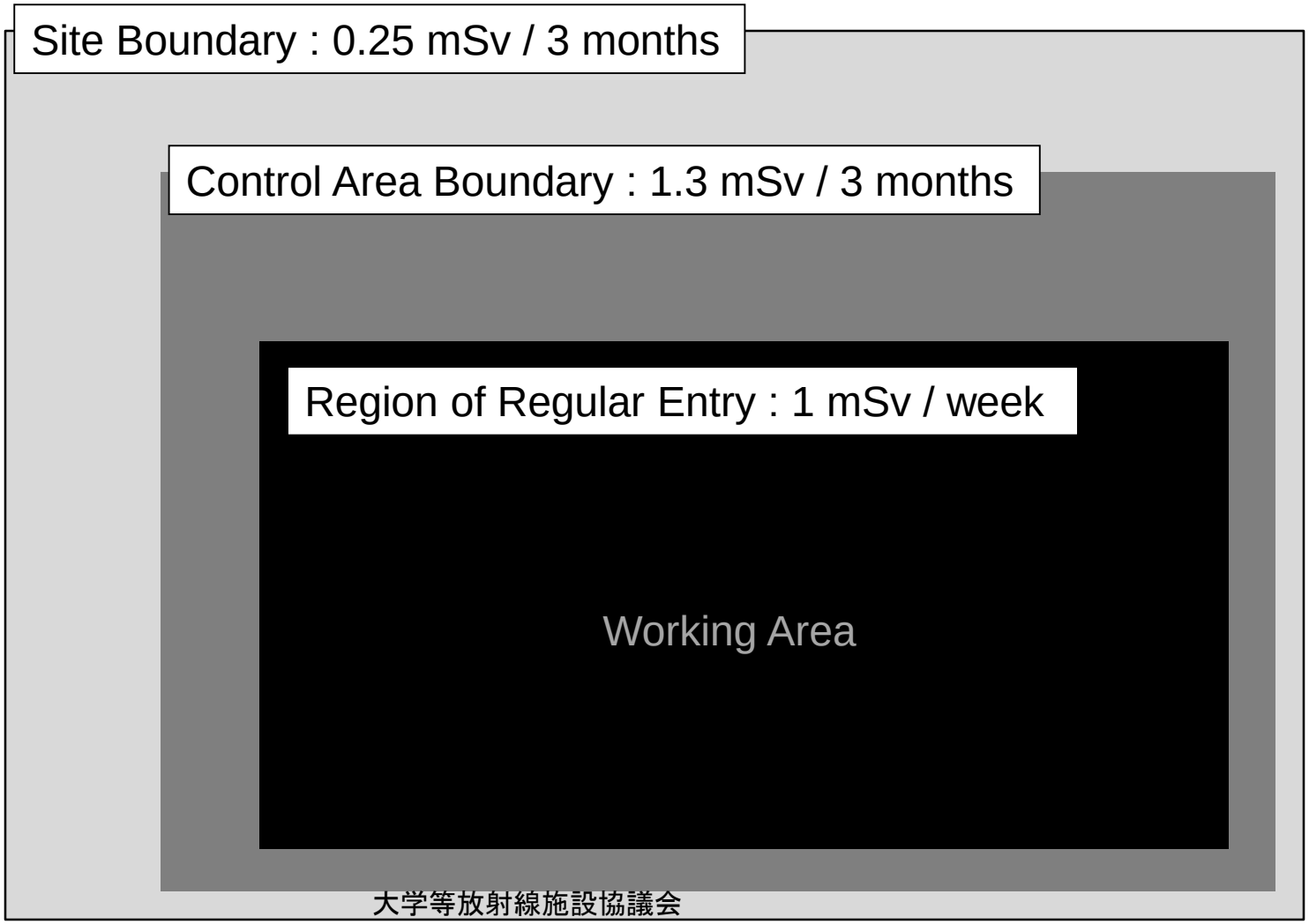
② **Post notes in an easy-to-see place in the controlled area.**

Matters necessary to prevent radiation damage

- **Precautions about wearing of personal dosimeters**
- **emergency measures in the event of an accident**

③ **Do not exceed the public annual dose limit (1msv) outside the controlled area and where the same worker stays at all times.**

Effective dose limit at each site



Exception: When the radiation device can be used other rooms

(1) A device in which the dose rate (H1 cm) outside the device is shielded to less than 20 μSv / h.

(2) When using the radiation device by moving it at any time

(3) When installing the radiation device in the radiation device room interferes with the purpose of use or is extremely difficult in terms of work.

An electron microscope is also a device that accelerates charged particles.

1. Devices that generate X-rays accessorily, such as electron microscopes, are not classified as X-ray devices.
2. If the effective dose from ionizing radiation generated from the charged particle accelerator may exceed 1.3 mSv / 3 months, a controlled area will be established for management. Even if it is not necessary to establish a controlled area, it must be managed so as not to exceed the annual public limit of 1 mSv.
3. The electron microscope is a device that accelerates charged particles, and X-rays may leak depending on the model and usage conditions of the electron microscope, so it must be managed so as not to exceed the annual limit of the public.

Contents related to the safe handling of X-rays in the ionization law

（1） Safety management system

Basic principle of radiation hazard prevention, authorized chief X-ray inspection engineer

（2） Human safety management

Education and training, health examination, measurement and recording of radiation exposure,
Emergency measures

（3）Safety measures for X-ray equipment and X-ray work

Technical standards, records, measurements, of external radiation protection
Warnings, notices posted, etc.

（1） Safety management system

(1) Responsibilities of the business operator and authorized chief X-ray inspection engineer

(2) Work that requires the appointment of authorized chief X-ray inspection engineer

(3) Duties of authorized chief X-ray inspection engineer

（1）Responsibilities of the business operator and authorized chief X-ray inspection engineer

1. Strive to minimize the exposure of workers to ionizing radiation
2. Appoint a chief from among those licensed as X-ray work chiefs.

★ Appoint an X-ray work chief to reduce the exposure of X-ray users as much as possible.

the appointment of authorized chief X-ray inspection engineer

1. One X-ray work chief will be assigned to each controlled area.
2. Post the name of the appointed chief and the work content in an easy-to-read place.
3. When using a device with an interlock only within the device in a controlled area, it is not necessary to appoint an X-ray work chief. However, it is desirable to appoint a person who has the necessary knowledge as the person in charge of management and have him / her perform the following matters.
4. Chief administrator

   (1) While emitting X-rays, always keep the safety device effectively so that the arms, fingers, etc. cannot enter the device.

   (2) Take necessary measures to prevent arms, fingers, etc. from entering the device in the event of an abnormality such as a malfunction.

Duties of authorized chief X-ray inspection engineer

① When using outside the radiation equipment room, clearly indicate the sign of the restricted area within 5 m from the focal point and the irradiated object.

② Take measures to properly use the irradiation tube, diaphragm, and filter plate.

③ Take the measures specified in the measures for indirect photography, fluoroscopy, and transmission photography.

④ Adjust the irradiation conditions, etc. so that the dose received by the radiation workers is as small as possible.

⑤ Check the alarm device.

⑥ Confirm that no workers are entering the exclusion zone before and during irradiation.

⑦ Check if the personal dosimeter is weared correctly.

Penalties

If you violate the provisions of the Industrial Safety and Health Act, the actor will be punished and the corporation will also be fined.

1. **Example of imprisonment for up to 6 months or a fine of up to 500,000 yen.**

- **When a work chief is appointed and the matters specified by the Ordinance of the Ministry of Health, Labor and Welfare are not performed.**
- **If you do not take the necessary steps to prevent radiation-induced health problems.**
- **If no special education did.**
- **When the work environment is not measured and the measurement results are not recorded.**

2. **Examples of fines of 500,000 yen or less**

- **When the X-ray device is used without notification or the main part is changed.**

(2) Human safety management: Education training

Industrial Safety and Health Act

When a business operator hires a worker or changes the work content, he / she must provide education for safety or hygiene regarding the work he / she engages in.

★Work is not specified.

Ionization law

Special education should be given when getting into transparent photography work or when the work content is changed.

Special education subjects, content, time

subjects	content	time
Method of transparent photography work	Work procedure, radiation measurement, radiation exposure prevention law, measures in case of accident	one and half hour
Structure and handling method of X-ray equipment	Principles of X-ray equipment, structure and function of X-ray tubes, high voltage generators and controllers, operation and inspection of equipment	one and half hour
Effect of ionizing radiation on living organisms	Types and properties of ionizing radiation, effects on living cells, tissues, organs and the whole body	half hour
Applicable laws and regulations	Related provisions in the Industrial Safety and Health Act, the Ordinance, the Regulations, and the Ionization Regulations	One hour
total		4 and half hours

Attention to education training

① Special education may be omitted if the person is recognized as having sufficient knowledge and skills in all or part of the subject.

② Record the participants and subjects of special education and keep them for 3 years.

③ Education will also be provided for short-term employees such as temporary and part-time employees.

④ Shooting work includes all related work such as assembling the equipment, attaching and detaching films, and moving the equipment at the work place. However, those who are only engaged in the transportation of equipment (drivers of truck transportation) are not included.

⑤ Education is not defined for practical skills, but it is desirable to educate including actual operations.

health checkup

Business operator

① Perform initial and regular health examinations.

② Submit the report to the director of the competent labor standards inspection office without delay.

③ Create a personal slip and store it for 30 years.

④ Necessary measures when there are abnormal findings

⑤ Take necessary measures when a radiation hazard occurs.

Worker

① You must undergo a medical examination conducted by the business operator.

② If you do not accept the medical examination by the doctor designated by the business operator, you may undergo a medical examination by another doctor and submit a document certifying the result to the business operator.

health checkup

law	Ionization law
responsibility	Business operator
eligible person	Workers engaged in radiation work ordinally
time	Timing of hiring or relocation, periodic intervals
intervals	Per once within 6 months
way	Medical examination by a doctor

Contents of health checkup

1. Presence or absence of exposure history and evaluation

If exposed

① Work place

② Contents

③ Period

④ Presence or absence of radiation damage

⑤ Presence or absence of subjective symptoms

⑥ Other matters related to radiation exposure

2. Inspection items

① White blood cell count, white blood cell percentage

② Red blood cell count, blood pigment amount or Hematocrit value

③ Eyes on cataracts

④ Skin

Omission of health checkup

★Investigation and evaluation of exposure log cannot be omitted.

★Inspection can be omitted depending on the conditions

(1) Can be omitted depending on the type of radiation source

(2) If the doctor deems it unnecessary in the regular health examination, some or all of it can be omitted.

- Effective dose of the previous year: less than 5 mSv
- Effective dose for the relevant year: Expected to be less than 5 mSv
- When the doctor does not deem it necessary
- Show the previous dose to the doctor

(3) Eyes related to cataract can be omitted

Radiation dose limits for occupational exposure

Effective dose	radiation worker	men	100 mSv/5years not exceed 50 mSv in any single year
		women	5 mSv/3month
		women in pregnancy	1mSv for internal exposure until delivery
	emergency worker		100 mSv
	temporary visitor		100 μSv
Equivalent dose	lens of the eye		150 mSv/year
	skin		500 mSv/year
	abdomen of pregnant women		2 mSv until delivery

Radiation exposure management

Legal division of women

Women1	**Women of childbearing potential**
Women2	**Women diagnosed or offered to become pregnant**
Women3	**Women diagnosed as unlikely to become pregnant**

Exposure limit for each place

Place	Limit
A place where people always enter	1mSv/week
Controlled area boundary	1.3mSv/ 3 month
Establishment boundary	250μSv/ 3 month
Hospital, Clinic rooms	1.3mSv/ 3 month

Confirmation and recording of measurement results

	division	One month	Three months	One year	Five years
effective dose	Man, Women3		○	○	○
	WomenA（※1）	○	○	○	○
	WomenB（※2）		○	○	○
equivalent dose	Each organization		○	○	
	Women2	○			

※1　WomenA：Women1＋Women2

※2　Female A who does not exceed 1.7 mSv / month. Managing each 3month

Emergency procedures

Emergency example

When the shield is damaged and irradiation cannot be stopped immediately.

Evacuate immediately from the exclusion zone.

Area where effective dose may exceed 15 mSv

（3） Safety measures for X-ray equipment and X-ray work

Technical standards for protection of external radiation,

Record,

Measurement,

Alarm,

Posting notes,

other

X-ray equipment classification

1) Classification by safety standards
   (1) X-ray equipment
   (2) Specific X-ray equipment
2) Classification by interlock

Classification by safety equipment

(1) X-ray equipment

All devices that generate X-rays. There are no special restrictions on tube voltage and safety devices.

Handmade equipment for research and education

(2) Specific X-ray equipment

Among X-ray devices, X-ray devices equipped with standards and safety devices specified by the Ministry of Health, Labor and Welfare.

1. **Industrial specific X-ray equipment**
   : Non-medical specific X-ray equipment
2. **Specific X-ray equipment for medical use**

Specific X-ray equipment

Specified X-ray equipment shall not be transferred, rented, or installed unless it is equipped with the standards or safety equipment specified by the Minister of Health, Labor and Welfare.

When installing, relocating, or changing major parts, notify the Chief of Labor Standards Inspection Office with documents and drawings.

Interlock function

① The X-ray device must have an irradiation box.

②All or part of the body of the worker engaged in the work during irradiation must be shielded so that it does not enter the inside.

③ The structure should be such that X-rays are not emitted unless the irradiation box door is closed.

④ The structure must not allow the interlock to be easily released.

Conditions for specific X-ray equipment

① X-ray equipment with a rated tube voltage of 10 kilovolts or more based on the crest value.

② Excludes those that are assembled each time they are used for research or education of X-rays or X-ray equipment.

③ Excludes medical devices specified by the Pharmaceutical Affairs Law, which are specified by the Minister of Health, Labor and Welfare. Equipment and machinery under the Pharmaceutical Affairs Law refer to medical X-ray equipment and X-ray tubes for medical X-ray equipment.

④ Use an irradiation tube or diaphragm so that the radiation angle of the used line cone does not exceed the angle required to achieve the purpose of use. However, this does not apply if the purpose of use is hindered.

⑤ The irradiation cylinder or diaphragm meets the standards set by the Minister of Health, Labor and Welfare.

Clarification by Interlock

(1) Interlock type

Can be used in general laboratories

(2) Non-interlock type

Cannot be used in general laboratories

① Fixed use: Inside the radiation room (X-ray equipment room)

② Mobile use: Establish an off-limits area.


緊急時の対応
「X線回折装置」
注 意
名古屋大学 工学部
X線回折装置使用者各位
Rigaku
X-RAY DIFFRACTOMETER
EMERGENCY


FS RELEASE
SHUTTER
1
2
OPEN
CLOSE
EXT.
Rigaku
X-RAY
READY
ON
OFF
TUBE VOLTAGE/CURRENT
ALARM
OLL
HVL
LVL
LCL
CW
RESET
POWER
ON
OFF
kV
mA
LOAD
kW
CAUTION
Rigaku

Procedure: Notification of X-ray equipment

Notify the Labor Standards Inspection Office.

1. When installing, relocating, or changing major structural parts

2. X-ray equipment, radiation equipment room

3. Document:

① Drawing of the controlled area,

② Radiation equipment summary

③ Radiation equipment room summary

Safety measures for specific industrial X-ray equipment

(1) Irradiation cylinder, aperture, filter plate

(2) Measures for indirect shooting

(3) Measures for fluoroscopy

(4) Measures for mobile use

(5) Posting of precautions, etc., such as alarm devices

（4）Measures for mobile use

① Use in the exclusion area.

Exclusion area: Within 5m from the focal point or subject

② Indicate the restricted area with a sign.

③ Keep people out of the direction of radiation.

（5）Posting precautions such as alarm devices

① Alarm device: When energized

1. Automatic alarm device: red rotating light, electric bell, buzzer
2. Non-automatic alarm device: manual buzzer, display

② Posting of precautions

1. Use of personal dosimeter
2. First aid in the event of an accident

Measurement of working environment

Measurement of dose equivalent rate

(1) When using fixedly: 1 time / 6 months

(2) When not fixed: Once a day

(3) Record the results and store for 5 years

(4) Calculation when measurement is difficult

(5) Post the measurement results and make them known

The end.

Enter 0 for correct questions and x for missing questions in parentheses.

( ) 1. The electron microscope is not an X-ray device, so you can use it freely.
( ) 2. If you have a medical examination once at the beginning, you do not need to have a medical examination from the next year.
( ) 3. A friend visited me, so I thought I would get permission from the administrator, but I was absent, so I conducted an experiment together using an X-ray device without obtaining permission from the administrator.
( ) 4. I lost my personal dosimeter, so I borrowed a friend's dosimeter.
( ) 5. Since the regular inspection was troublesome, I copied the previous record as it was.
( ) 6. Since it was difficult to obtain the data, the collimator of the X-ray device was removed for measurement.
( ) 7. For the convenience of the experiment, the interlock of the X-ray device was released and used.
( ) 8. Since the type of collimator of the X-ray device was changed, the leakage dose was remeasured.

[Answer]
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