

Risk estimation of radiation

Tokushi Shibata

Professor Emeritus, University of Tokyo
Senior Scientist Oarai Research Center, Chiyoda Technol Corp.

1. Risk for low-level radiation exposure
2. Future effort toward recovery
-Related radiation-
3. To gain understanding of residents for radiation risk

1. Risk for low-level radiation exposure

• Risk estimation by ICRP

For the low-level exposure, risk is cancer and hereditary effect.

Cancer : $5.5 \times 10^{-2} \text{ Sv}^{-1}$

Hereditary : $2 \times 10^{-3} \text{ Sv}^{-1}$ (much lower than cancer)

In the case of dose limit for public 1mSv/y

Cancer : $5.5 \times 10^{-5} \text{ y}^{-1}$

• Risk other than radiation

Cancer	$2.7 \times 10^{-3}/y$
Cardiac disease	$1.3 \times 10^{-3}/y$
Cerebrovascular disease	$1.1 \times 10^{-3}/y$
Pneumonia	$7.0 \times 10^{-4}/y$
Freak accident	$3.2 \times 10^{-4}/y$
Traffic accident	$7.0 \times 10^{-5}/y$
Falling	$5.0 \times 10^{-5}/y$
Smoking	$1.6 \times 10^{-3}/y$
Second-hand smoking	$3.0 \times 10^{-4}/y$
Primary industry (Agriculture, Forestry, Fishery)	$1.0 \times 10^{-3}/y$
Secondary industry, tertiary industry	$1.0 \times 10^{-4}/y$
Obesity (5 unit increase of BMI)	$6.0 \times 10^{-4}/y$

• External exposure and internal exposure

The difference between external and internal exposure is due to β -ray and internal conversion electrons in case of ^{137}Cs .

Since ^{137}Cs accumulates in muscular, and the maximum range of electron is about 2mm, the effects of the electrons are small

Annual Dose

- <20mSv : Area preparing lift the evacuation order
- 20~50mSv : Restricted residential area
- >50mSv : Area unfit for returning for many years

Risk for 50 years living in the area 20mSv at present

Half life: 2.07y (^{134}Cs), 30.0y (^{137}Cs)

Effect for child (0~20) 3 times of adult

Adult 650mSv, Risk 3.6% (50y) $7.2 \times 10^{-4}/y$

Child 1400mSv, Risk 7.8% (50y) $1.6 \times 10^{-3}/y$

Necessity of decontamination

2. . Future effort toward recovery **-Related radiation-**

- **Decontamination work**

Removal of contaminated soil, cutting of contaminated tree

- **Storage of contaminated soil**

Installation of temporary storage and interim storage facility

- **Distribution of deposited cesium in soil**

Distribution of cesium is less than 5 cm from the surface

- **Migration of cesium in soil**

The study after the Chernobyl accident reported that the speed of migration of cesium for vertical direction is less than 1 cm/y and 78–99% of cesium exists within 10 cm from the surface after 7 years from the accident

3. To gain understanding of residents for radiation risk

- **Experimental proof of safety for the storage facility**

Confirmation of safety by measuring radiation level and transfer rate to underground water of radio-cesium for the installed pilot storage facility

- **Understanding of radiation risk**

Repeat the clear explanation of radiation risk and answer the the question for resident

- **Involving for decontamination work by resident**

To return to the residential area, they must be convinced for safety about radiation. To convince themselves, it may be necessary to involve in the radiation measurement and decontamination work