

## Dose Limits

## Comparison between ICRP Recommendations and Domestic Laws and Regulations

|   |                         | Occupational exposure   |   | Public exposure  |  |
|---|-------------------------|---|---|--|--|
|   |                         | 2007 Recommendations of the ICRP  | Laws and regulations concerning the prevention of radiation hazards (Japan), as of March 2012   | 2007 Recommendations of the ICRP   | Laws and regulations concerning the prevention of radiation hazards (Japan), as of March 2012  |
| <b>Effective dose limits</b>                    |                         | The average annual dose for the prescribed five years should not exceed 20 mSv and the annual dose for any one year should not exceed 50 mSv. | Same as the Recommendations   | 1 mSv/year<br>(Exceptionally, if the average annual dose for five years does not exceed 1 mSv, exposure exceeding the limit for a single year may be sometimes permitted.) | Dose limits are not specified, but doses at the boundaries of business establishments, including those due to exhaust gas and water, are regulated not to exceed the dose limit of 1 mSv/year. |
| <b>Equivalent dose limits</b>                   | <b>Eye lenses</b>       | 150m Sv/year  | 150 mSv/year  | 15 mSv/year  | —  |
|   | <b>Skin</b>             | 500 mSv/year  | 500 mSv/year  | 50 mSv/year  | —  |
|   | <b>Fingers and toes</b> | 500 mSv/year  | —   | —  | —  |
| <b>Dose limits for female radiation workers</b> |                         | The equivalent dose of a fetus during gestation after reporting pregnancy (exposure in utero) should not exceed 1 mSv.                        | 5 mSv/3 months<br>Equivalent dose limit for the abdominal surface after coming to know of pregnancy until delivery: 2 mSv<br>Internal exposure: 1 mSv | —  | —  |

Source: Prepared based on the 2007 Recommendations of the ICRP and Japanese laws and regulations concerning the prevention of radiation hazards (as of March 2012)

mSv: millisieverts

Present laws and regulations in Japan have not yet incorporated the 2007 Recommendations of the ICRP, but dose limits specified in the 2007 Recommendations are mostly the same as those in the 1990 Recommendations. Therefore, dose limits in Japan also mostly coincide with those specified in the 2007 Recommendations. Japan has uniquely specified dose limits for female radiation workers (5 mSv per three months).

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| Dose Limits           |   | ICRP Recommendations and Responses of the Japanese Government                             |  |
|-----------------------|---|---|--|
|                       |   | 2007 Recommendations of the ICRP  | Responses at the time of the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS  |
| Occupational exposure | Rescue activities (Volunteers who have obtained the relevant information) | When benefits for other people outweigh the rescuers' risks, dose limits are not applied. | Special Provisions of the Ordinance on Prevention of Ionizing Radiation Hazards (Ministry of Health, Labour and Welfare)<br>The emergency exposure dose limit was temporarily raised to <b>250 mSv</b> from the conventional level of <b>100 mSv</b> (from March 14 to December 16, 2011).<br>The Ordinance on Prevention of Ionizing Radiation Hazards was partially amended to raise the exceptional emergency dose limit to <b>250 mSv</b> (enforced on April 1, 2016). |
|                       | Other emergency activities  | <b>Up to 500 mSv</b>  |  |
| Public exposure       | Emergency exposure situations   | The limit is to be set within the range of <b>20 to 100 mSv/year</b> .                    | e.g.<br>Standards for evacuation in Deliberate Evacuation Areas: <b>20 mSv/year</b>  |
|                       | Reconstruction period (Existing exposure situations)                      | The limit is to be set within the range of <b>1 to 20 mSv/year</b> .                      | e.g.<br>Additional exposure dose to be achieved in the long term: <b>1 mSv/year</b>  |

Source: Prepared based on the 2007 Recommendations of the ICRP and the Special Provisions of the Ordinance on Prevention of Ionizing Radiation Hazards (Ministry of Health, Labour and Welfare: MHLW)

mSv: millisieverts

The accident at TEPCO's Fukushima Daiichi NPS occurred while deliberations were continuing over the incorporation of the 2007 Recommendations of the ICRP into domestic laws and regulations.

The accident changed exposure situations, and the idea of reference levels, which had been unfamiliar to Japanese laws and regulations, was adopted for public exposure. In exposure dose control using reference levels, an initial reference level is first set based on the standards for respective exposure situations specified in the 2007 Recommendations of the ICRP so as to ensure that no one receives an unduly high dose. Secondly, if the situation has improved and there is almost no one who receives a high dose exceeding the reference level, a new lower reference level is set as necessary to efficiently achieve exposure dose reduction.

In the meantime, regarding occupational exposure, the emergency dose limit was temporarily raised from 100 mSv to 250 mSv as an exception for an unavoidable case for the purpose of preventing the expansion of the disaster at the NPS. Later, as the work to achieve stable cold shut-down conditions of the reactors was completed, this exceptional measure was abandoned.

Considering the need to develop regulations on the prevention of radiation hazards during emergency work in preparation for any possible nuclear emergencies at nuclear facilities in the future, the Ordinance on Prevention of Ionizing Radiation Hazards was partially amended to raise the exceptional emergency dose limit to 250 mSv. The amended Ordinance was put into force on April 1, 2016.

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## Indices concerning radioactive materials in foods (Bq/kg)

| Radionuclide  | Japan         |     | Codex Alimentarius Commission |       | EU                                    |                      | US        |       |
|---|---------------|-----|-------------------------------|-------|---------------------------------------|----------------------|-----------|-------|
| Radioactive cesium  | Milk          | 50  | Infant foods<br>General foods | 1,000 | Milk<br>Infant foods<br>General foods | 1000<br>400<br>1,250 | All foods | 1,200 |
|   | Infant foods  | 50  |                               | 1,000 |                                       |                      |           |       |
|   | General foods | 100 |                               | 1,000 |                                       |                      |           |       |
| Upper limits for additional doses                             | 1mSv          |     | 1mSv                          |       | 1mSv                                  |                      | 5mSv      |       |
| Assumed percentages of foods containing radioactive materials | 50%           |     | 10%                           |       | 10%                                   |                      | 30%       |       |

\* The Codex Alimentarius Commission is an intergovernmental body created in 1963 by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) for the purpose of protecting consumers' health and ensuring fair-trade practices in the food trade, etc.; The Commission establishes international standards for foods.

\* Standard limits incorporate effects of the amount of food intake and assumed percentages of foods containing radioactive materials. Therefore, the values are not suitable for inter-comparison.

\* Indicated standard limits for drinking water are the WHO guidance levels of radioactive materials, which are referred to in respective countries, and standard limits for radioactive materials vary by country due to differences in adopted preconditions. Therefore, the values are not suitable for inter-comparison.

Source: Prepared based on "Food and Radiation Q&A," Consumer Affairs Agency

In Japan, new standard limits for radioactive materials in foods were established and were put into force on April 1, 2012. The new standard limits were set by classifying foods into four categories and the standard limit for drinking water, which is most frequently taken by people, was set at 10 Bq/kg.

The standard limit for milk, which children generally drink a lot of, was reduced to 50 Bq/kg. Additionally, a new category, "infant foods," was made for ensuring safety for infants and the standard limit thereof was set at 50 Bq/kg, the same as that for milk. The standard limit for other general foods is 100 Bq/kg.

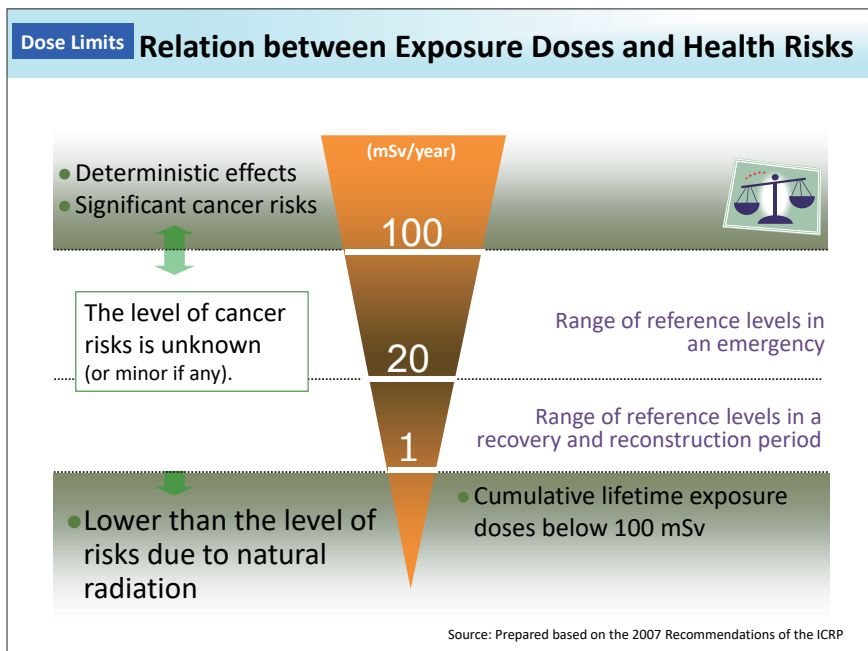
All foods other than infant foods were categorized as general foods based on the idea to minimize gaps in additional doses caused by differences in individuals' eating habits. The value was set with sufficient room to ensure safety no matter what foods people eat as long as radioactive Cs concentrations therein are within the standard limit.

Regulation values vary by country due to differences in annual exposure dose limits based on which the respective countries set their standard limits and in contamination rates in foods, etc. (In Japan, regulation values were set on the safe side based on the annual exposure dose limit of 1 mSv and on the assumption that 50% of general foods and 100% of milk and infant foods are contaminated. On the other hand, the Codex Alimentarius Commission specifies the annual exposure dose limit as 1 mSv and assumes that 10% of foods are contaminated.)

(Related to p.43 of Vol. 2, "Standard Limits Applied from April 2012")

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There is scientific evidence for the fact that radiation doses of 100 to 200 mSv or over increase cancer risks. Therefore, in an emergency due to a radiation accident, the initial reference level is set to avoid annual exposure doses of 100 mSv or over in order to prevent serious physical disorders. When the situation improves as the accident is brought under control and there is almost no one who receives a high dose exceeding the initial reference level, a new lower reference level (such as 1 to 20 mSv per year) is set to curb increases in risks of any possible cancer in the future, thereby further promoting exposure dose reduction (p.156 of Vol. 1, "Exposure Situations and Protection Measures").

As the standard limit in normal times, 1 mSv/year is adopted. As a result, some misunderstand that radiation exposure exceeding 1 mSv per year is dangerous or that they may be exposed to radiation up to that level. However, dose limits do not represent the threshold dividing the safety and the danger.

It is not that radiation exposure up to 1 mSv per year is permissible. Principally, radiation exposure should be reduced as low as practically achievable in light of various circumstances.

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