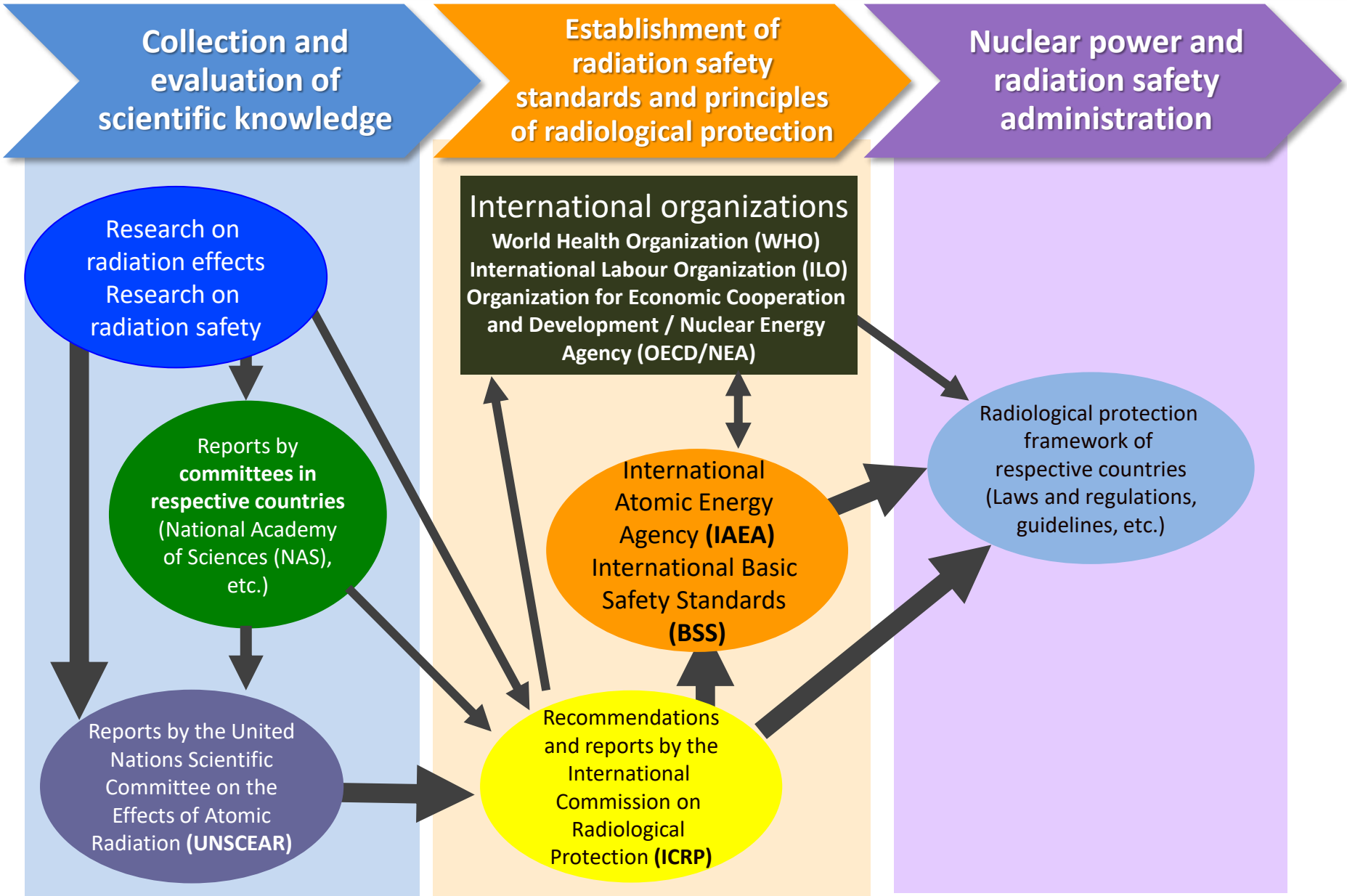
Principles of Radiological Protection

International Framework Relating to Radiological Protection



United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

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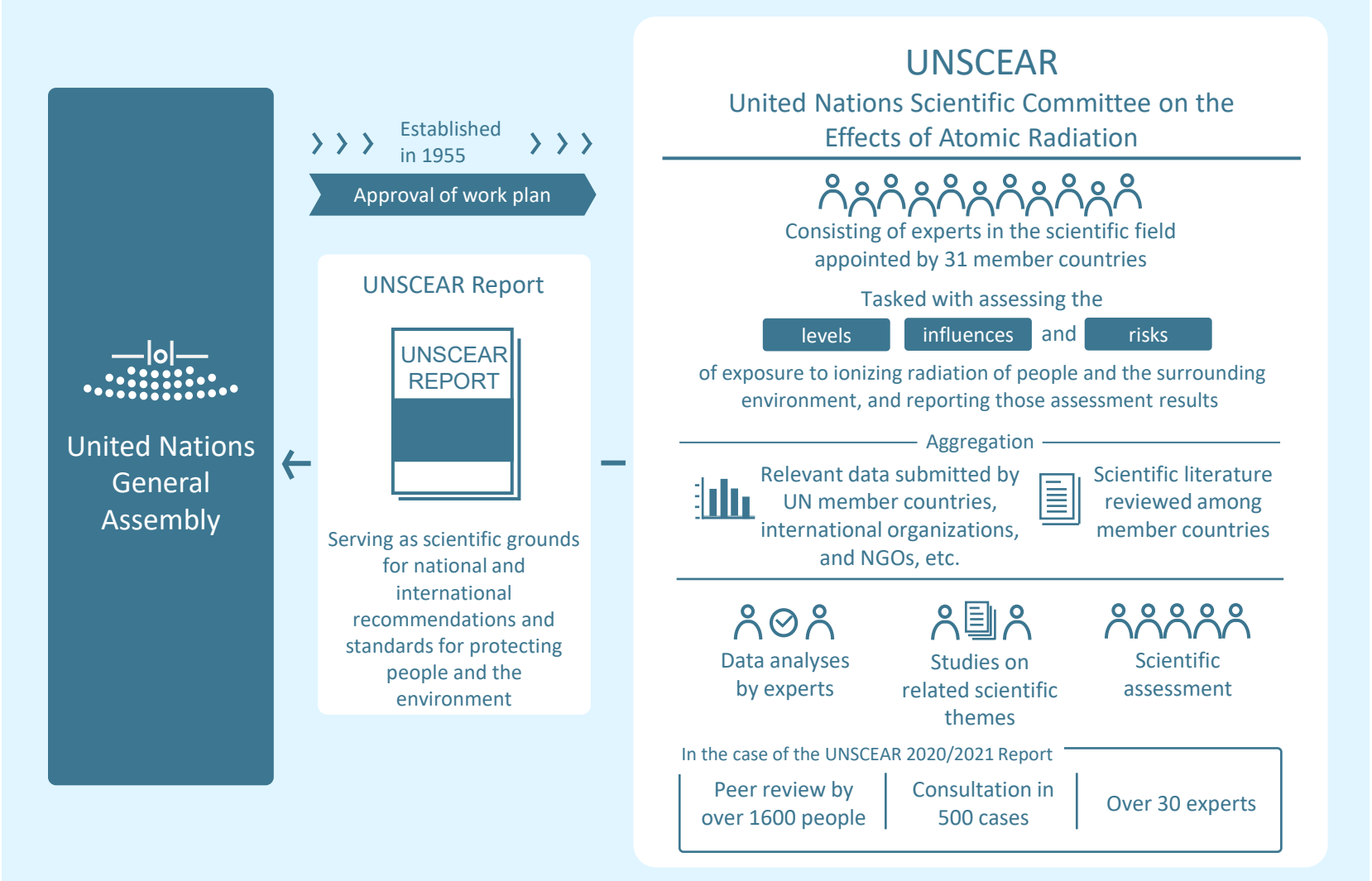


Source: Prepared based on the Fact Sheet in the UNSCEAR 2020/2021 Report, "UNSCEAR 2020 Report on Radiological Consequences from the Fukushima Accident – 10 years later –" (2022) (https://www.unscear.org/unscear/en/areas-of-work/fukushima.html)

Principles of Radiological Protection

International Atomic Energy Agency (IAEA)

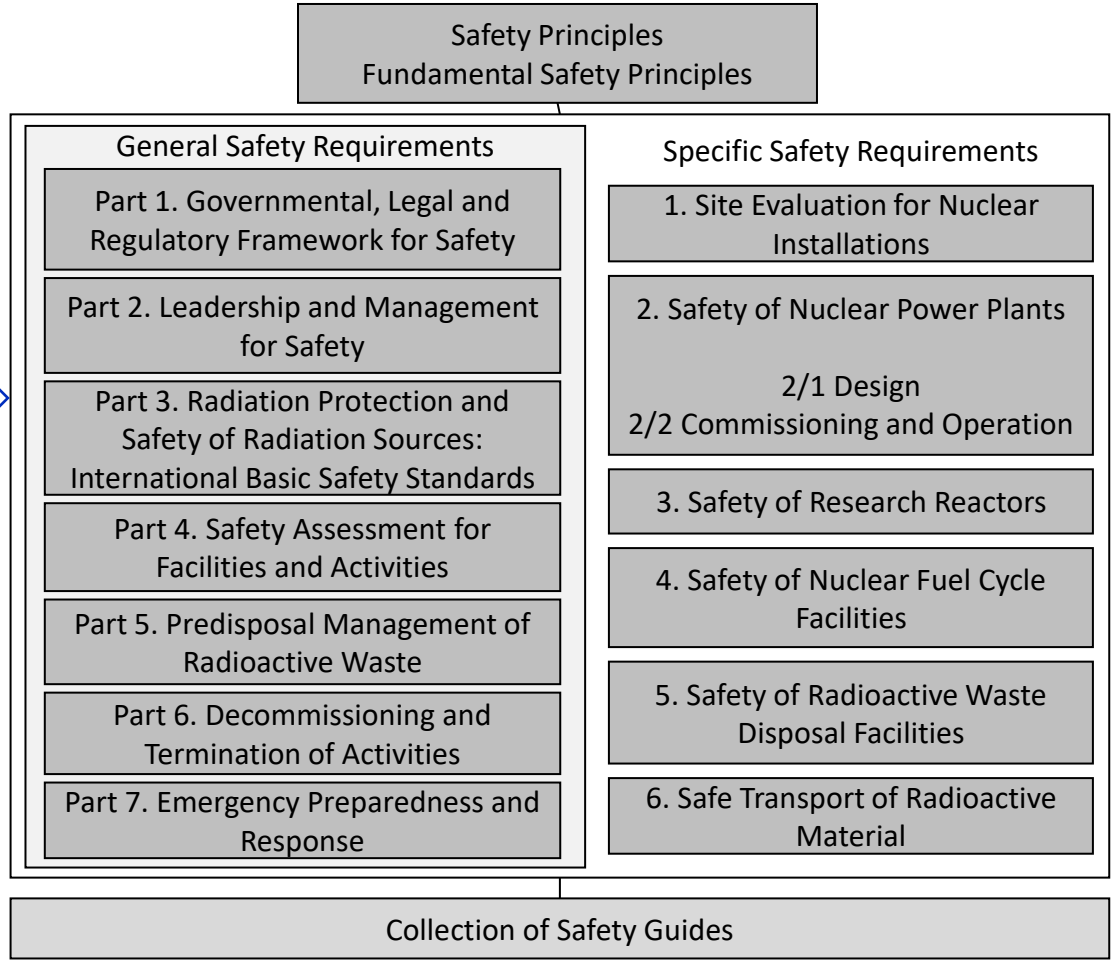
Objective: To promote peaceful use of nuclear energy and prevent nuclear energy for peaceful purposes from being used for military purposes

Outline of the IAEA's activities

(1) Peaceful use of nuclear energy	Nuclear power generation field
	Non-power generation field
	Nuclear power safety field
	Nuclear security field
	Technical cooperation
(2) Implementation of safeguards	

Establish standards

Structure of the IAEA Safety Standards Series



Source: Prepared based on "Outline of the International Atomic Energy Agency (IAEA)" on the website of the Ministry of Foreign Affairs and "GSR Part 3 Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" on the website of International Atomic Energy Agency

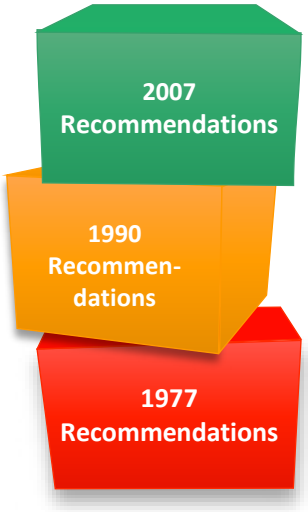
International Commission on Radiological Protection (ICRP)

International Commission on Radiological Protection (ICRP)

The Commission aims to make recommendations concerning basic frameworks for radiological protection and protection standards. The Commission consists of the Main Commission and four standing Committees (radiation effects, doses from radiation exposures, protection in medicine, and application of the Commission's recommendations).

(Reference) Dose limits excerpted from ICRP Recommendations

	1977 Recommendations	1990 Recommendations	2007 Recommendations
Dose limits (occupational exposure)	50 mSv/year	100 mSv/5 years and 50 mSv/year	100 mSv/5 years and 50 mSv/year
Dose limits (public exposure)	5 mSv/year	1 mSv/year	1 mSv/year



mSv: millisieverts

Aims of the Recommendations

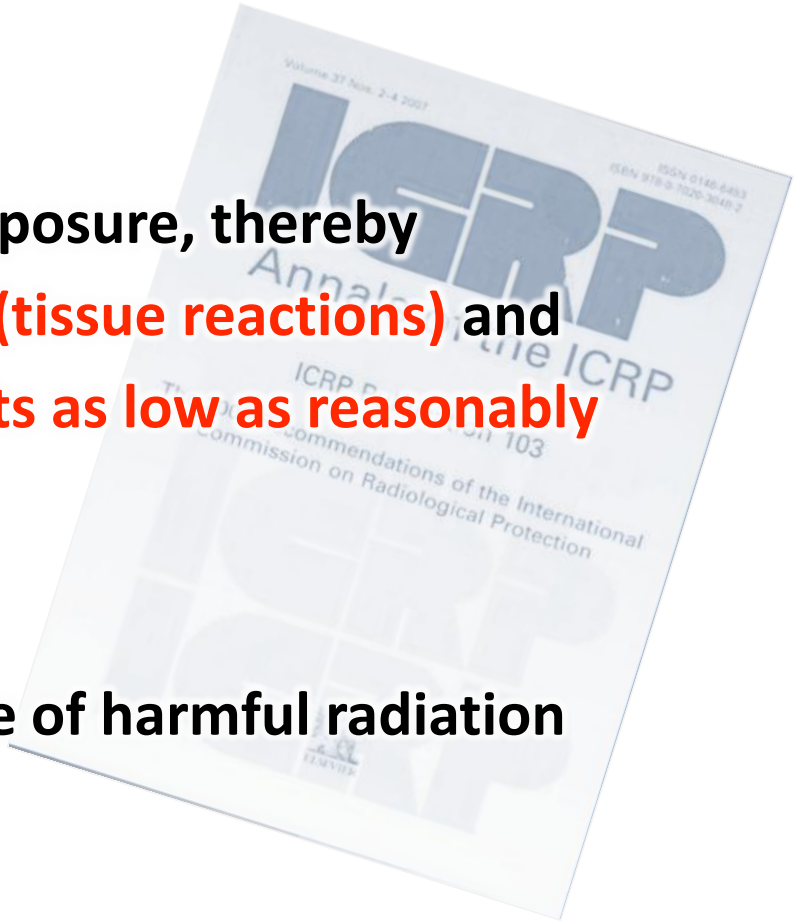
Aims of the Recommendations(2007 Recommendations of the International Commission on Radiological Protection (ICRP))

1) To protect human health

- Manage and control radiation exposure, thereby preventing deterministic effects (tissue reactions) and reducing risks of stochastic effects as low as reasonably achievable

2) To protect the environment

- Prevent or reduce the occurrence of harmful radiation effects



Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

Principles of Radiological Protection

Exposure Situations and Protection Measures

People's exposure to radiation

Planned exposure situations

Situations where protection measures can be planned in advance and the level and range of exposure can be reasonably forecast

Dose limits
(Public exposure) 1 mSv/year
(Occupational exposure)
100 mSv/5 years and
50mSv/year

Measures
Manage disposal of radioactive waste and long-lived radioactive waste

Existing exposure situations

Situations where exposure has already occurred as of the time when a decision on control is made

Reference level
A lower dose range within 1 to 20 mSv/year, with a long-term goal of 1 mSv/year

Measures
Ensure voluntary efforts for radiological protection and cultivate a culture for radiological protection

Emergency exposure situations

Contingency situations where urgent and long-term protection measures may be required

Reference level
Within 20 to 100 mSv/year

Measures
Evacuate, shelter indoors, analyze and ascertain radiological situations, prepare monitoring, conduct health examinations, manage foods, etc.

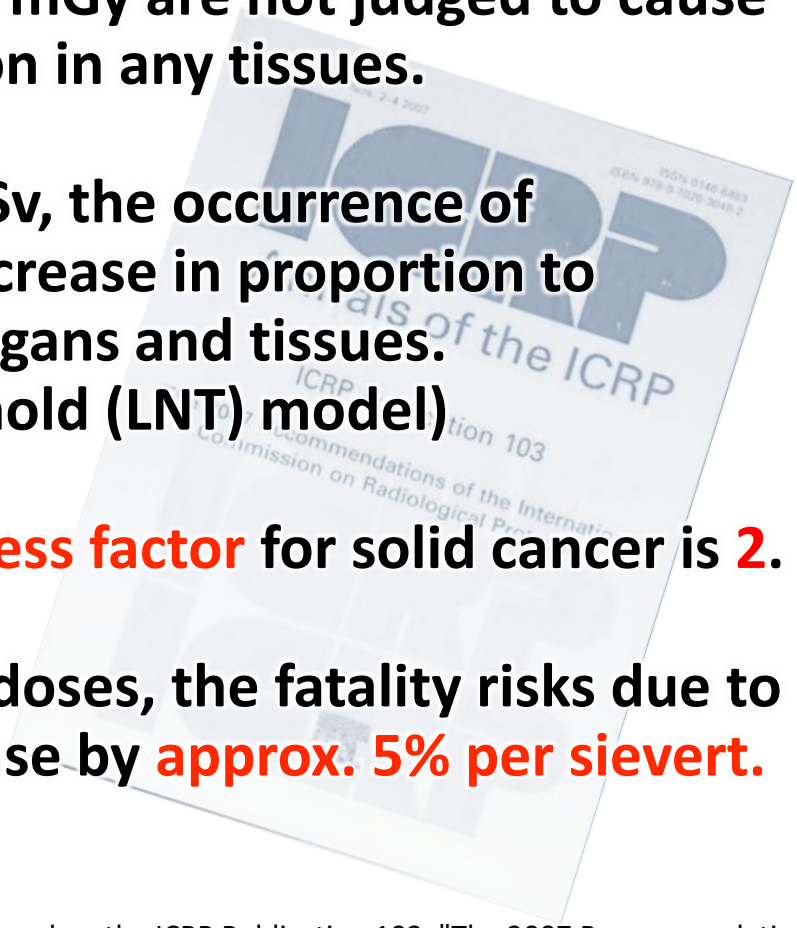
mSv: millisieverts

Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

Biological Aspect

Health effects of radiation have deterministic effects (tissue reactions) and stochastic effects.

- **Absorbed doses up to approx. 100 mGy are not judged to cause any clinically significant dysfunction in any tissues.**
- **In the range below approx. 100 mSv, the occurrence of stochastic effects is assumed to increase in proportion to increases in equivalent doses in organs and tissues. (Adoption of the linear non-threshold (LNT) model)**
- **The dose and dose-rate effectiveness factor for solid cancer is 2.**
- **Assuming a linear reaction at low doses, the fatality risks due to cancer and heritable effects increase by approx. 5% per sievert.**

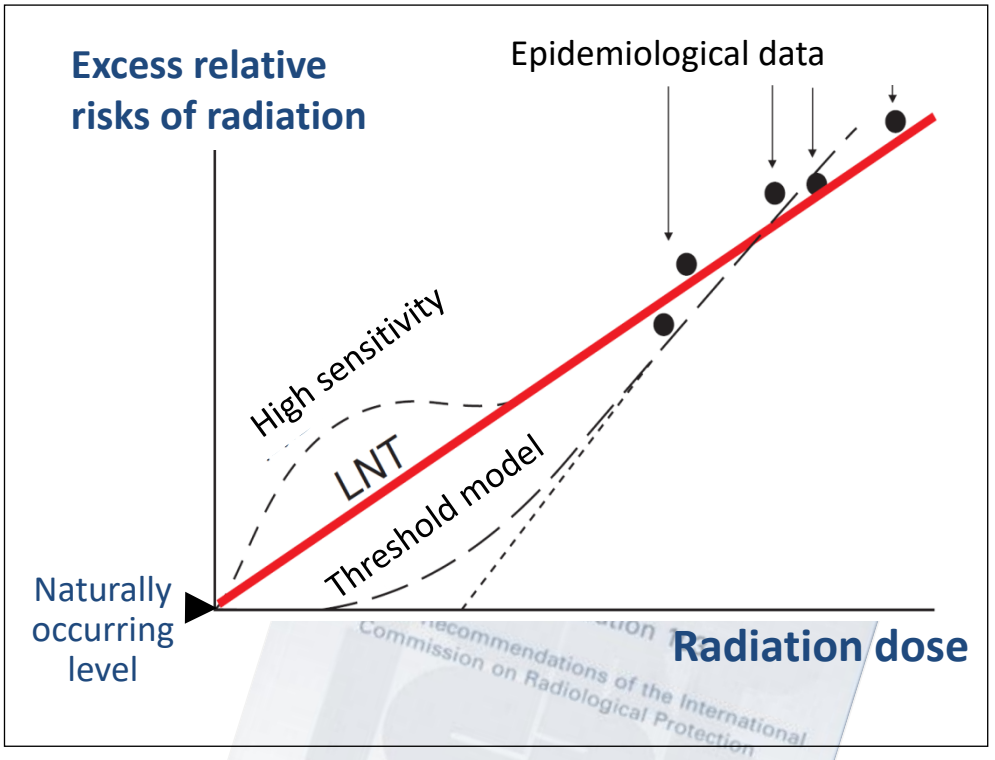


Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

Disputes over the LNT Model

◎ Affirmative positions:
National Academy of Sciences (2006)
There is no specific safety dose for radiation exposure.

◎ Critical positions:
Académie de Médecine; Académie de Science (2005)
Exposure to radiation below a certain dose does not actually cause cancer, leukemia, etc. and therefore, the LNT model represents overestimation not suited to the reality.



⇒The International Commission on Radiological Protection (ICRP) adopts the linear non-threshold (LNT) model as a simple and reasonable assumption for the purpose of radiological protection.

Principles of Radiological Protection

Three Fundamental Principles of Radiological Protection

ICRP's three fundamental principles of radiological protection

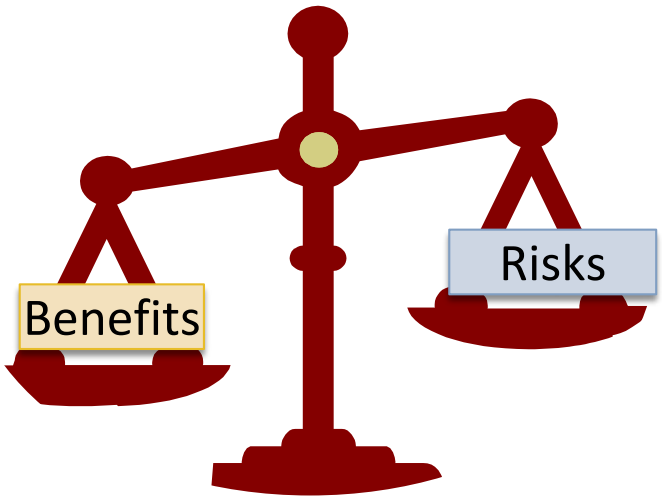
- **Justification**
- **Optimization**
- **Application of dose limits**

Source: ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

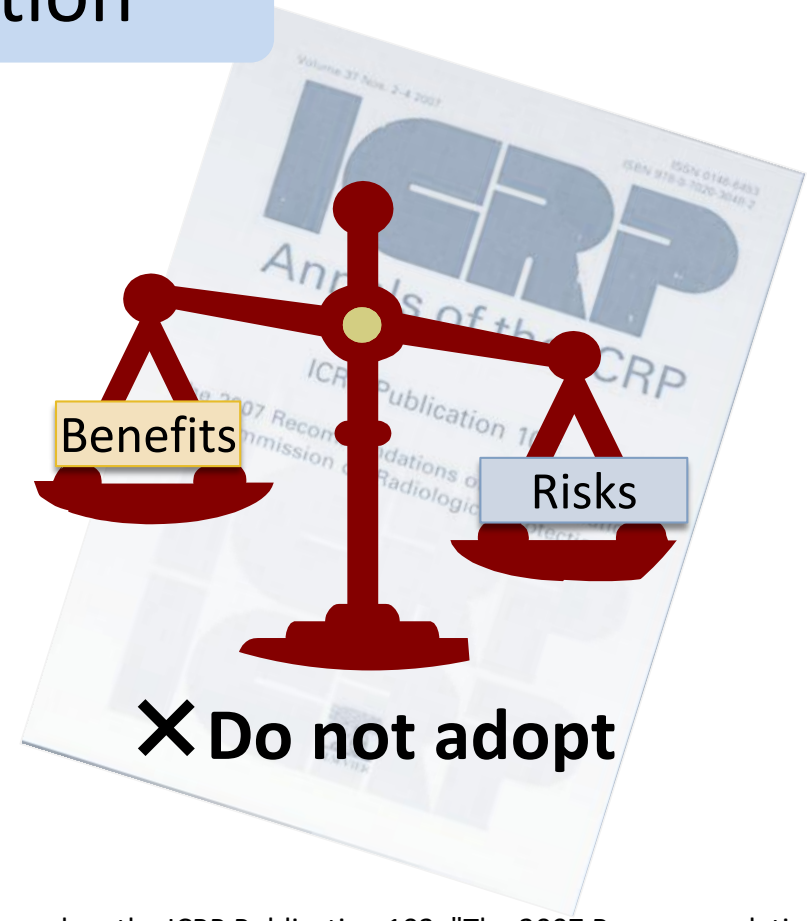
Justification of Radiological Protection

Justification of Radiological Protection

Justification



○ Adopt



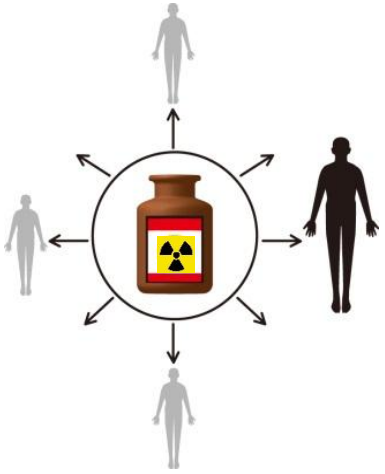
✕Do not adopt

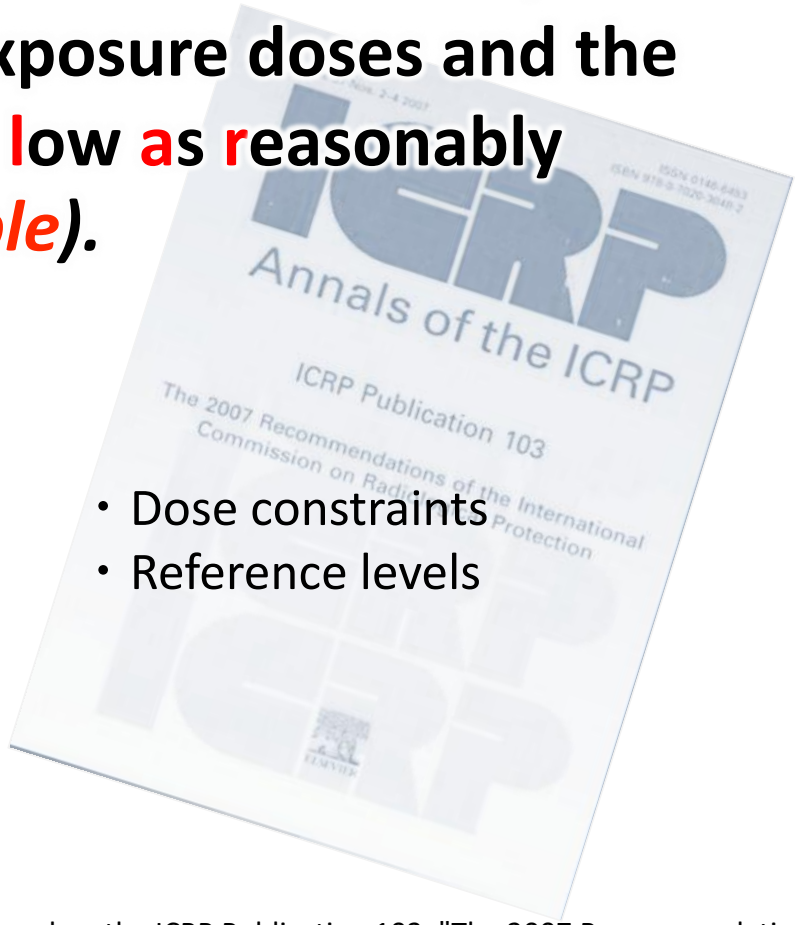
Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

Optimization of Radiological Protection

Optimization of Radiological Protection

In consideration of economic and social factors, strive to reduce individuals' exposure doses and the number of exposed people as low as reasonably achievable *(the ALARA principle)*.





- Dose constraints
- Reference levels

Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

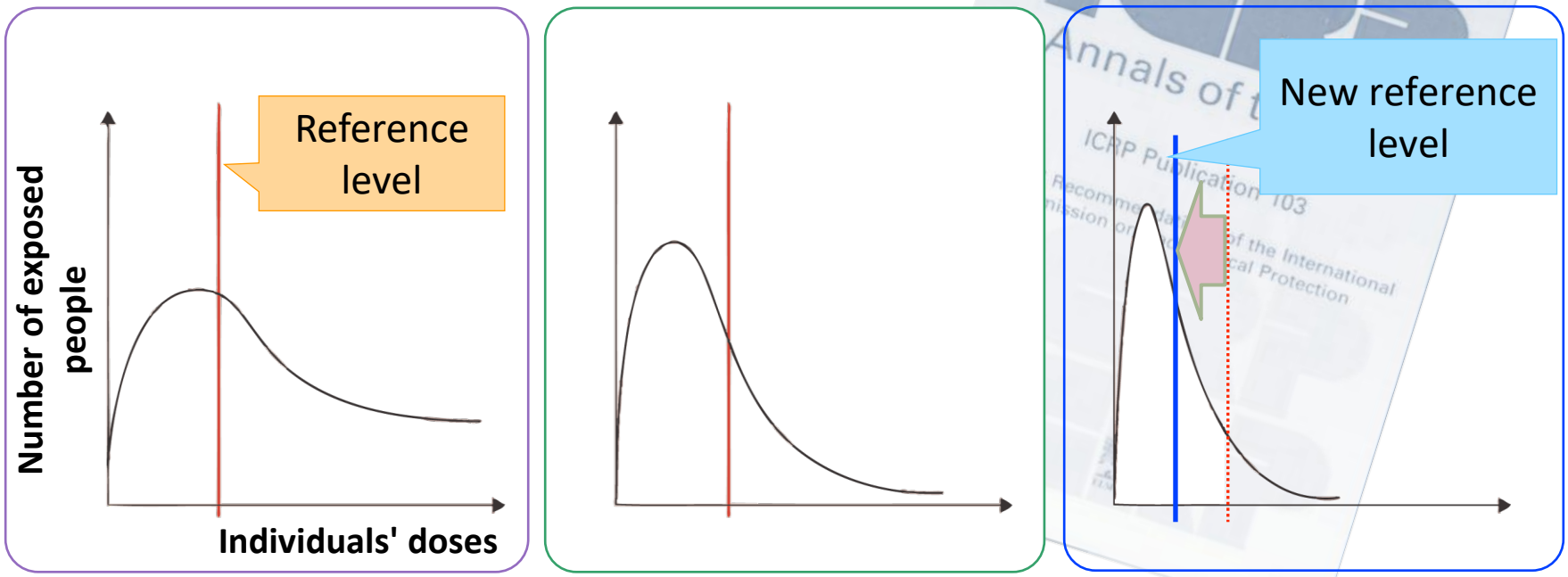
Principles of Radiological Protection

Optimization of Radiological Protection Using Reference Levels

Flow of optimization using reference levels

Initial situation

Setting of a reference level → **When doses have decreased** → **Setting of a new reference level**



Source: Prepared based on the ICRP Publication 103, "The 2007 Recommendations of the International Commission on Radiological Protection" (ICRP, 2007)

Application of Dose Limits

Dose limits are applied under planned exposure situations.

- ◯ **Occupational exposure (effective dose)**

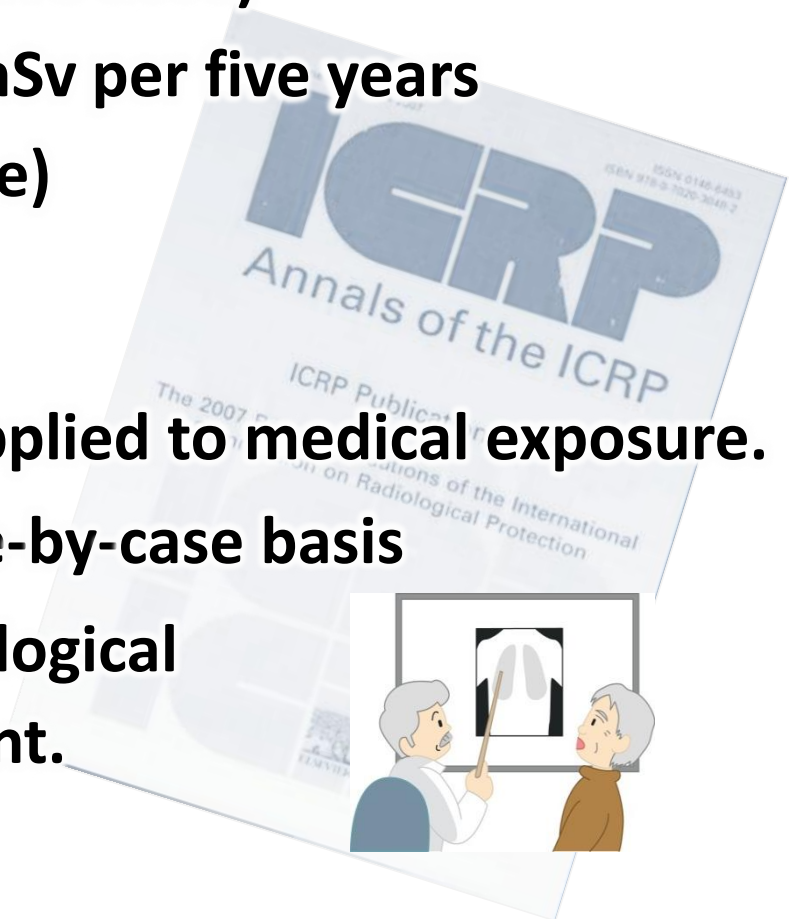
  50 mSv per year and 100 mSv per five years

- ◯ **Public exposure (effective dose)**

  1 mSv per year

(Exception) Dose limits are not applied to medical exposure.

- **Justification on a case-by-case basis**
- **Optimization of radiological protection is important.**



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