The IAEA Safety Standards: from Science to Regulation

Division of Radiation, Transport and Waste Safety

Radiation Safety and Monitoring Section

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IAEA
International Atomic Energy Agency

Overview of the presentation

- IAEA’s role in the system of radiation protection
- Safety Standards - way to harmonize radiation protection approaches
- Understanding of radiation effects - one pillar of radiation protection
- Radiation protection in the view of the Daiichi NPP accident – points to address?

IAEA's Role in Radiation Safety

… to **(1) establish or adopt**, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, **standards for safety for protection of health and minimize of danger to life and property**, and to **(2) provide for the application of these standard**s…, at the request of the parties, … or at the request of a State…

from the Statute of the IAEA, Article III.A.6

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Why there is a need for International Safety Standards

While radiation protection and safety is a **national responsibility**, **international standards** and approaches:

(1) promote **consistency;**

(2) help to **provide assurance** that nuclear and radiation related technologies are used safely; and

(3) facilitate **international cooperation and trade**.

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Preparing Standards –
Road from Science to Regulations

REVISED in 2007

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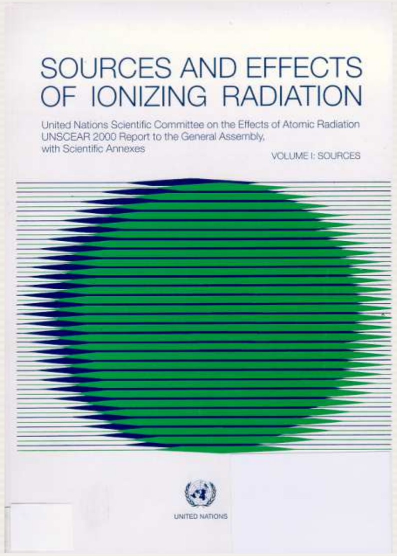
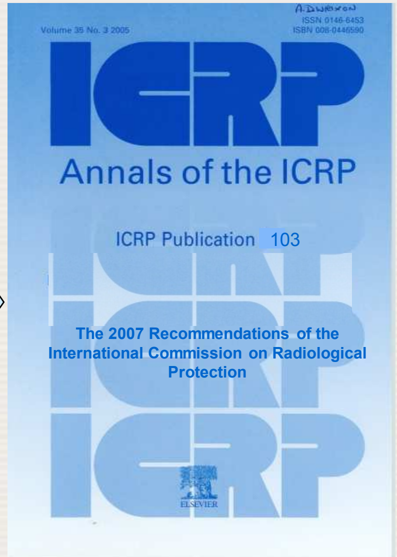
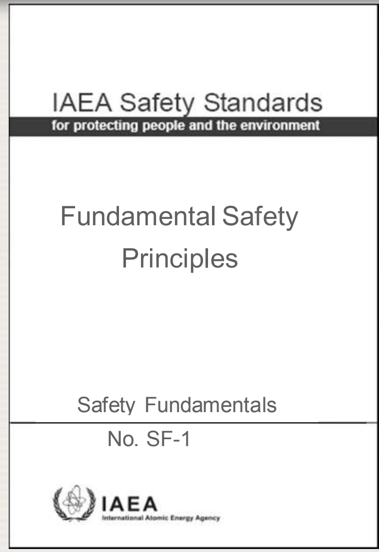
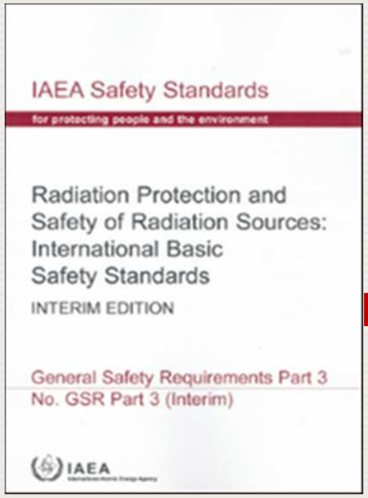








Effects of radiation

Recommendations for protection

Essential principles (*moral obligation*)

REVISED in 2011

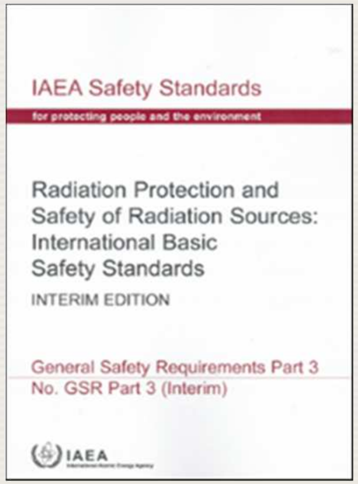
Essential requirements (*legal obligation*)

GSR Part 3: International Basic Safety Standards - holistic approach

The structure of the revised BSS follows the ICRP recommendations, ICRP Publ.103, 2007 in order to encompass all situations

- ***three exposure situations***
  - planned
  - emergency
  - existing

- ***three categories of exposure***
  - occupational
  - public
  - medical


IAEA Safety Standards
for protecting people and the environment
Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
INTERIM EDITION
General Safety Requirements Part 3
No. GSR Part 3 (Interim)
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GSR-Part 3: Clearly defined responsibility

To establish and maintain a legal, regulatory and organizational framework

→ **Government**

To establish or adopt regulations and guides

→ **Regulatory body**

Prime responsibility for protection and safety

→ **Person or organization responsible for facilities and activities**

→ **Principal parties (registrants and licensees, employers, RMP, designated persons)**

Specified responsibility for protection and safety

→ **Other parties** (suppliers, RPO, experts, workers, etc.)

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GSR-Part 3: Dose limits

Dose limits as in BSS 1996 and GS-R-Part 3, 2011*			
	Occupational exposure		Public exposure
	over 18 years of age	16 to18 years of age	
Whole body	**20** mSv averaged over 5 years max **50** mSv in a single year	**6** mSv	**1 (5 in a special circumstances) (1*)** mSv
Lens of the eyes	**150 (20*))**	**50 (20*)** mSv	**15** mSv
Skin, extremities	**500** mSv	**150** mSv	**50** mSv

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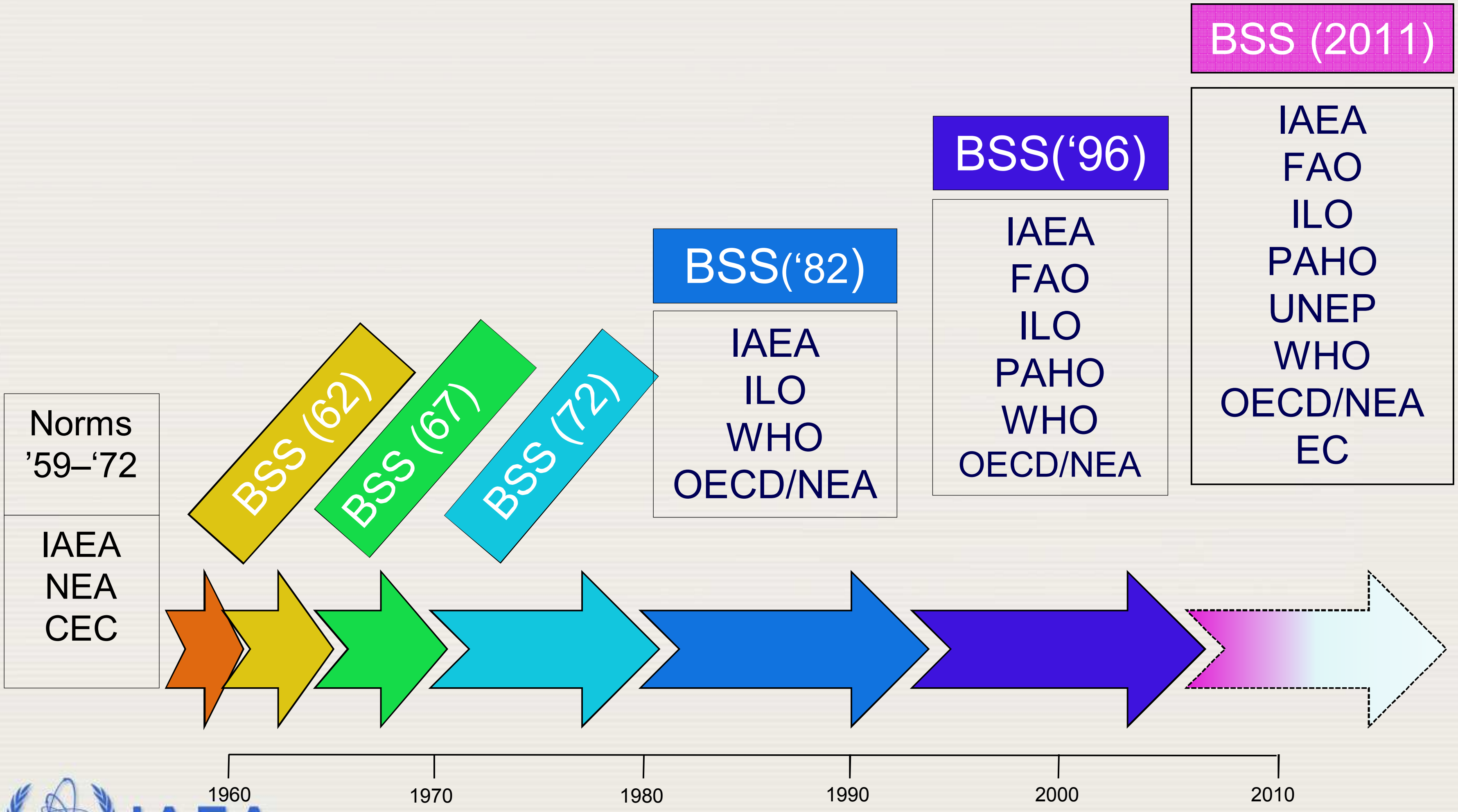
Complexity – need for involvement of a large number of intl organizations with their specific mandate



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Classification of radiation effects for radiation protection purposes

- **deterministic effect** (harmful tissue reactions)

  → it **WILL (100%)** happen to **irradiated** person

  effect is attributed to exposed individual

- **stochastic effect** (cancer or heritable effects)

  → it **MAY (?%)** happen to **some** persons

  probability of an effect to a given individual of an exposed population

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Point 1: Two main goals in radiation protection

1. to **protect** against **deterministic** effects
   i.e. to establish physical and/or medical protection measures preventing them to happen

2. to **restrict** occurrence of **stochastic** effects
   i.e. to minimize probability of their occurrence by setting radiation protection principles and standards in considering social and economical factors

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How to protect against deterministic effects ?… relatively simple task:

Science

- to research, describe and propose threshold doses (limits) under which deterministic effects are not observed

Government/Regulator

- to **establish and maintain regulatory framework** which includes limits as an guarantee that deterministic effects will not occur

Registrant and Licensee

- To **implement regulations** in its activities and facilities

Public

- to **follow information** from the Authorities
- to **apply wisdom** to avoid activities that may lead to higher exposure

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However…

how to protect against stochastic effects ?

There are certain complications:

- **no threshold** (unlike in deterministic effects), assumption: no dose level below which “nothing” happens
- **non-zero probability** of occurrence of cancer even with small doses
- occurrence of radiation induced cancer **hidden in natural occurrence** of cancer, i.e. not a simple task to detect it at an early stage

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… and then: How to set dose limits ?

if:

- for dose below 100 mSv: radiation risk is inconclusive, and in most cases can only be theoretically assumed
- even the smallest dose could cause some effect (so called liner-non-threshold model)

and also if:

- even if for dose around a few mSv there is a radiation risk, this risk is small and incidence of radiation-induced cancer cannot be distinguished from general cancer rate

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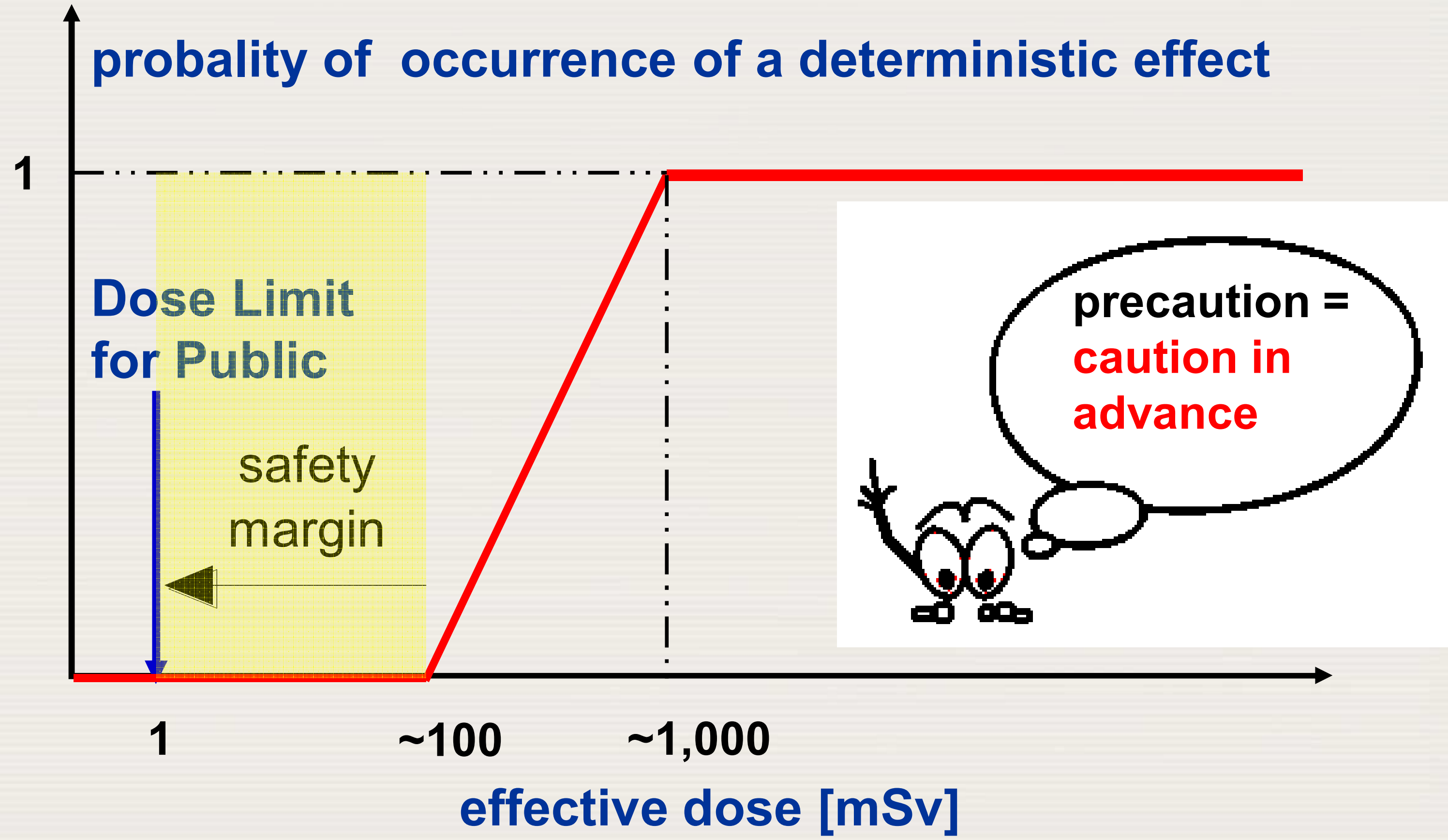
Point 2: … but there is a solution: dose limits are set on the precautionary principle



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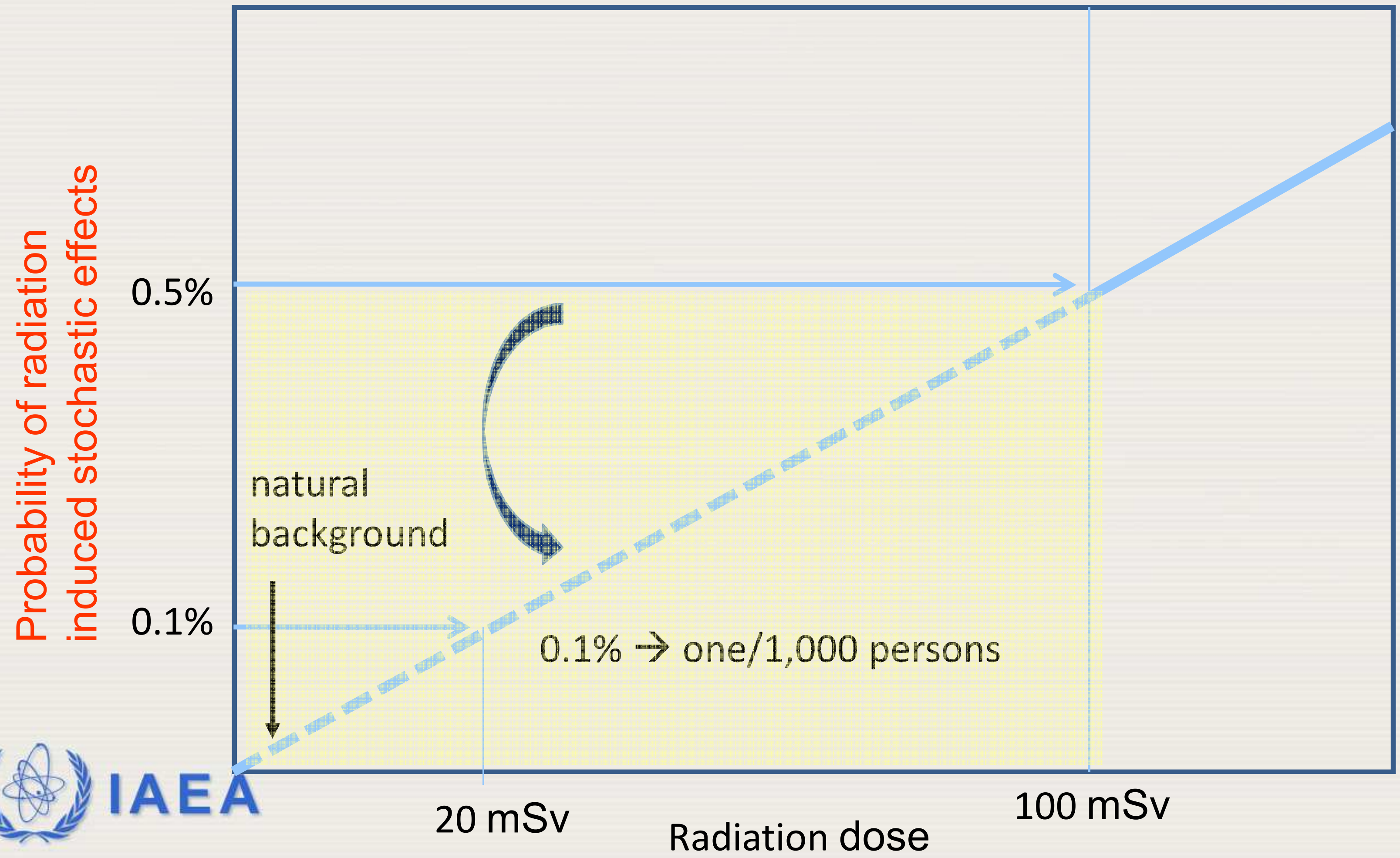
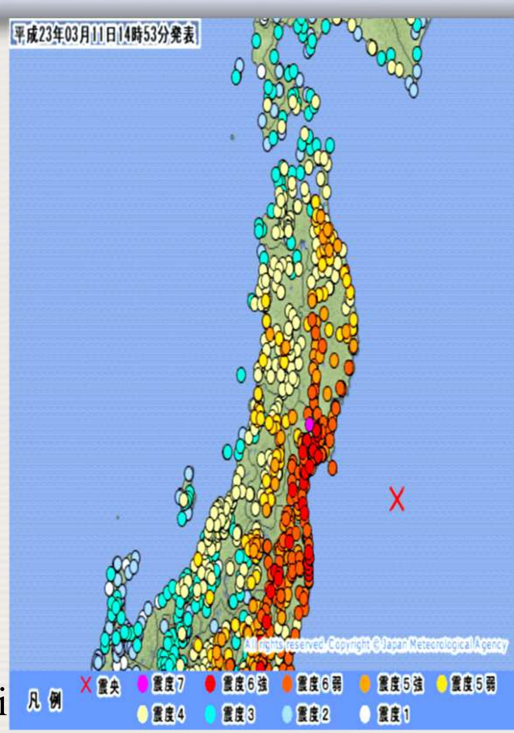
Point 3: Below 100 mSv - no immediate effects - and delayed ones?

Yes, stochastic effects may occur with a small probability, and in proportion to the increase in dose over the background dose (ICRP Publ.103)



THE Earthquake

- Date of occurrence: 14:46 on Friday, March 11, 2011
- Epicenter: Offshore Sanriku (38ºN, 142.9ºE), Depth of hypocenter: 24 km
- **Magnitude: 9.0** (The largest in recorded history (130 years) in Japan. The U.S. Geological Survey Office placed the quake as the 4th largest in the world since 1900.)
- Seismic intensity:
  - 7: Kurihara city, Miyagi prefecture
  - **Upper 6:** Hitachi city, Ibaraki prefecture, Naraha- cho, Tomioka-cho, Okuma-machi, Futaba-cho, **Fukushima prefecture**, Natori city, Miyagi prefecture, etc.
  - Lower 6: Ofunato city, Ishinomaki city, Onagawa-cho, Miyagi prefecture, Tokai village, Ibaraki prefecture, etc.
  - Upper 5: Miyako city, Iwate prefecture, Fukushima city, Fukushima prefecture, Taihaku ward, Sendai city, Miyagi prefecture
  - Lower 5: Kuji city, Iwate prefecture, Kariiwa village, Niigata prefecture
  - 4: Rokkasho village and Higashidori village, Aomori prefecture, Kashiwazaki city, Niigata prefecture, Tadamicho, Fukushima prefecture



THE Tsunami

Max (estimated) Tsunami height is **39 m** at Aneyoshi, Miyako City)

Minami Sanriku:
city literally "swept-out from the surface of the earth"
(photos taken in August 2011)

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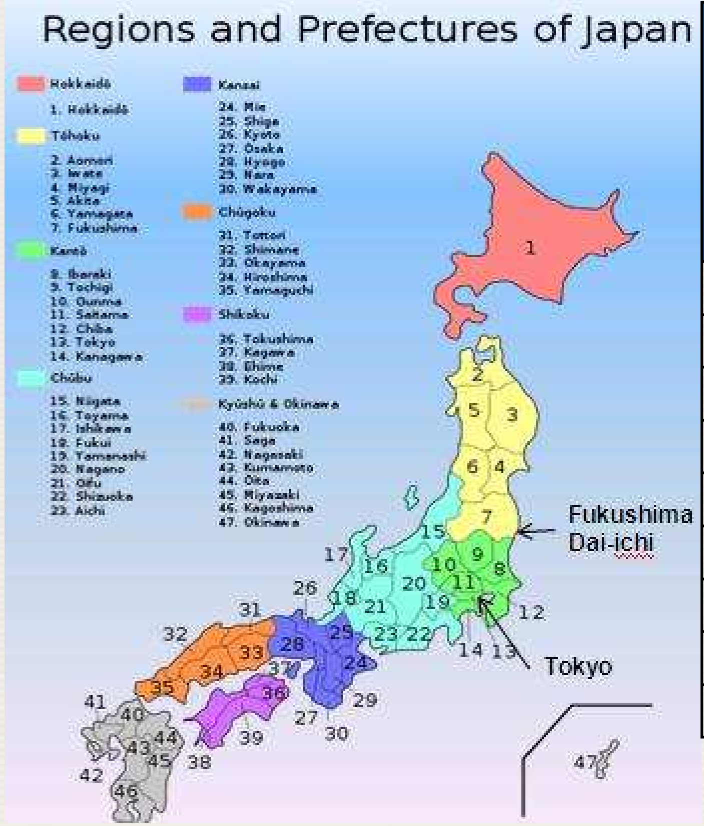
THE nuclear accident and radiological consequences

Dose rates in prefectures near Fukushima plants as of 24 March at 8:00



Prefecture/ Map reference	Dose Rate 24 March At 8:00-9:00 (µSv/h)	Normal Natural Radiation Dose Rate (µSv/h)	Surface Contamination (kBq/m^2)	
			I-131	Cs-137
Yamagata (6)	0.083	0.025- 0.082	2.1	1.9
Ibaraki (8)	0.306	0.036 – 0.056	27	0.42
Tochigi (9)	0.135	0.030 – 0.067	23	0.099
Gunma (10)	0.092	0.017 – 0.045	0.31	ND
Saitama (11)	0.118	0.031 – 0.060	22	0.32
Chiba (12)	0.097	0.022 – 0.044	22	0.36
Tokyo (13)	0.139	0.028 – 0.079	36	0.34
Kanagawa (14)	0.094	0.035 – 0.069	1.3	0.064
Niigata (15)	0.047	0.031 – 0.153	ND	ND

Source: Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)

public dose limit 1 mSv/y - ~ 0.1 µSv/h

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Point 4: Actions based on reference levels

Definition as in the revised BSS:

In an **emergency exposure situation** or an **existing exposure situation**, the level of **dose, risk or activity concentration** above which it is not appropriate to plan to allow exposures to occur and below which optimization of protection and safety would continue to be implemented.

- The chosen value for a reference level will depend upon the prevailing circumstances for the exposure under consideration.

Reference levels are typically expressed as an **annual effective dose to the representative person**.

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Point 5: Transition from Emergency to Existing Exposure Situation

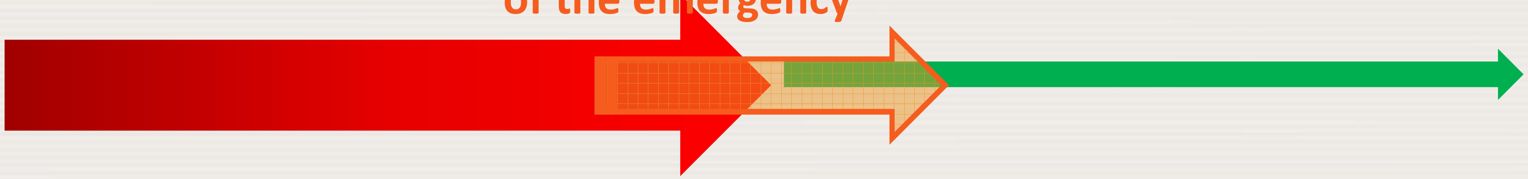
By whom and at which values are reference levels set?

(an example for situation after accident)

emergency

Transition/termination of the emergency

existing



100-20 mSv/year → 20-1 mSv/year

[recommended values (ICRP Publ.103)]

Government, regulatory body or another relevant authority

⬇

selects an **appropriate values** to <u>secure necessary activities be undertaken</u>

or

(**adopts** necessary **amendments** to existing laws (regulations) to <u>secure it)</u>

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Radiation protection – examples of points to address this week?

Point 1: *two main goals in radiation protection*

Point 2: *precautionary principle*

Point 3: *effects below 100 mSv*

Point 4: *actions based on reference levels*

Point 5: *transition from emergency to existing exposure situation*

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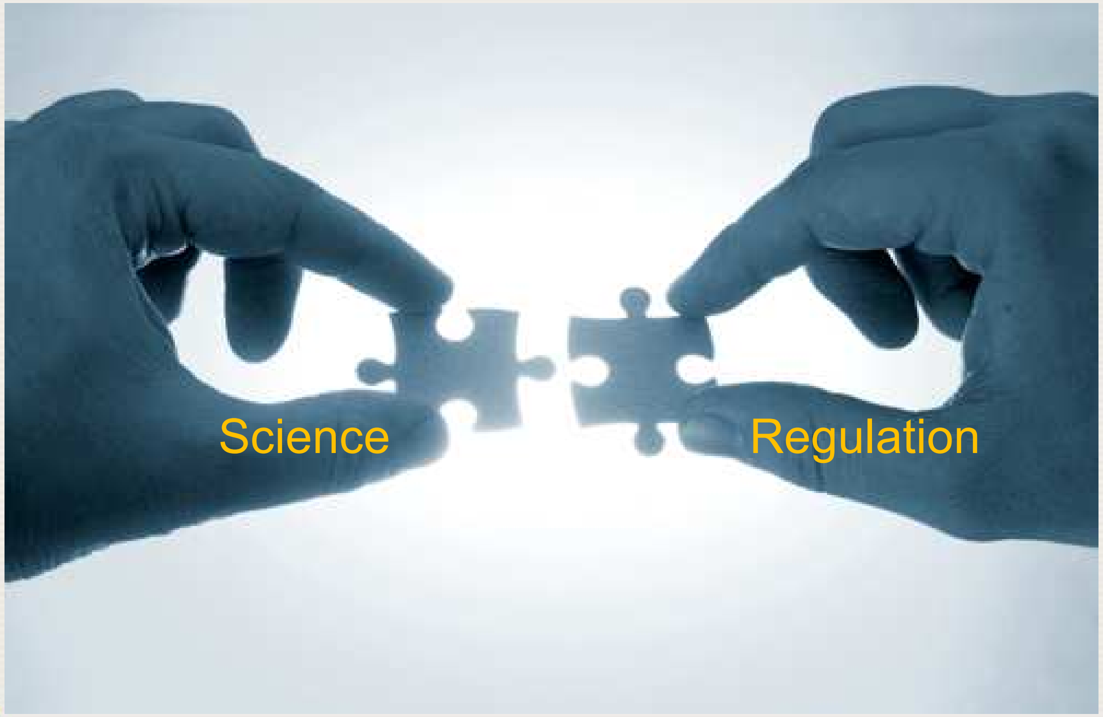
… and maybe there is a challenge for the radiation protection community

Do we provide sufficient and understandable information to help people make informed decisions?



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Thank you for your attention

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