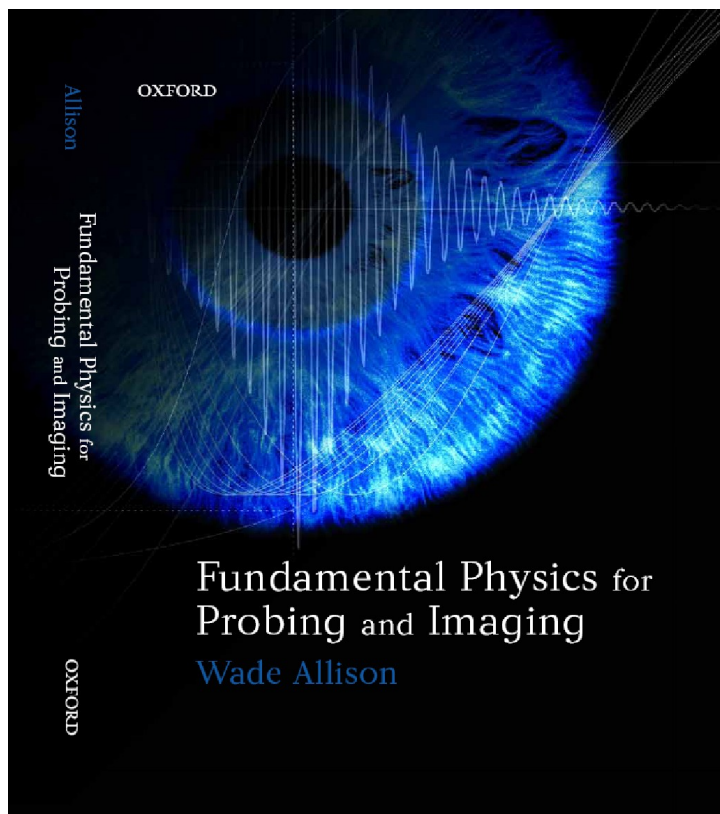


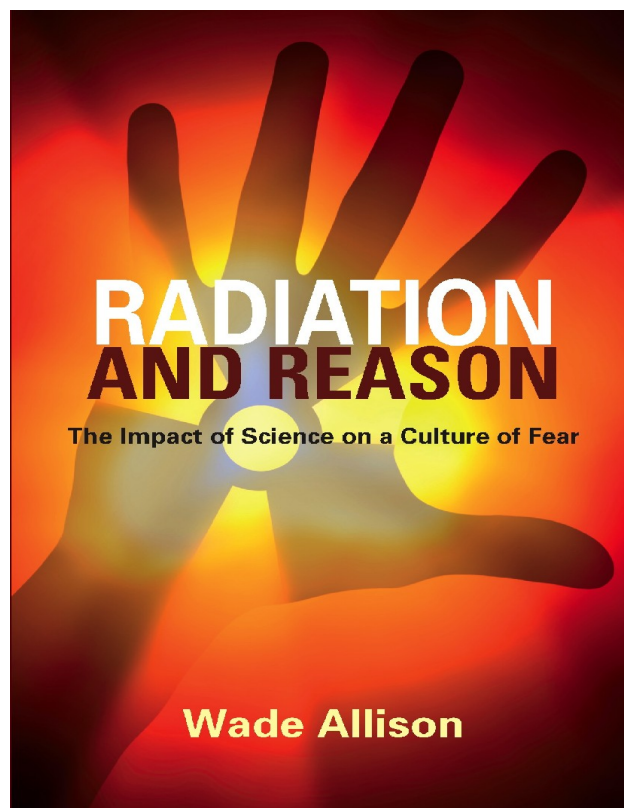
Radiation and Reason Fukushima and After

Talks given at the
Foreign Correspondents Club of Japan, Tokyo
by
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and
Professor Akira Tokuhiro, University of Idaho

3 October 2011



2006



2009



2011

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Tokyo, 3 October 2011

Agenda, points to be explained

1. Low or modest levels of nuclear radiation and radioactivity are not harmful.
2. Fear of radiation causes personal stress and social damage that is very harmful.
3. Current food regulations are scientifically unreasonable and cause hardship, as at Chernobyl.
4. Current evacuation regulations are scientifically unreasonable and cause hardship, as at Chernobyl.
5. International “safety” levels based on the lowest achievable should be relaxed upwards by a large factor.
6. Popular clamour in the Cold War era is responsible for this misunderstanding.

For further detail see <http://www.radiationandreason.com>

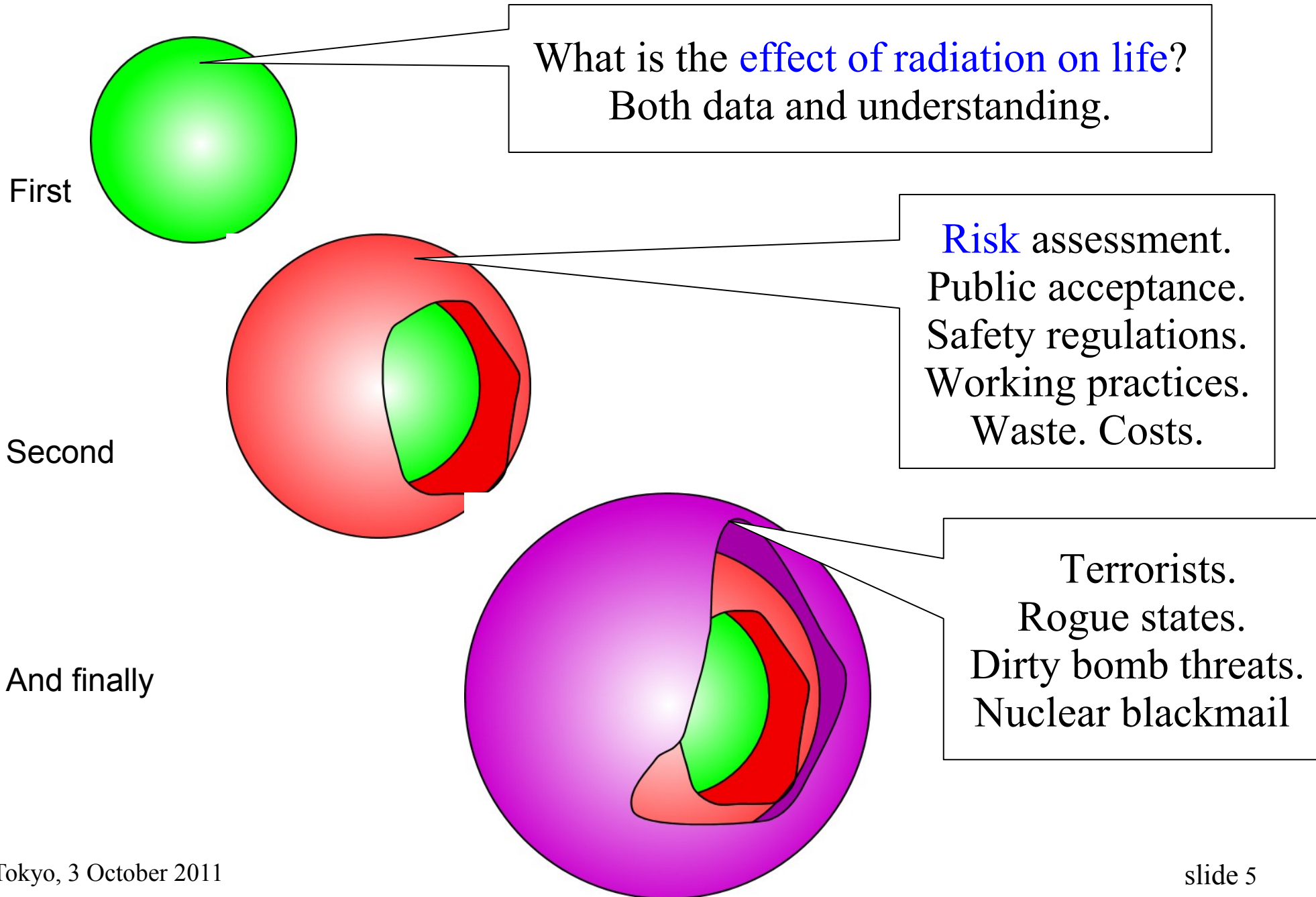
Fear of radiation



Basis:

1. Fear of [aftermath of a nuclear holocaust](#).
An effective Cold [War message](#) that frightened everybody at the time.
2. You cannot feel nuclear radiation.
But the cells of your body can - and then [repair](#) the damage, too.
3. The Regulations warn of radiation dangers.
Misunderstanding here, for which we all share responsibility, in part.

How dangerous is radiation to life? All else follows



Effect of radiation depends on the dose and the period

- ◆ Example: for a dose of **paracetamol**, both the dose and the period are important.(100 tablets per person at once is fatal, but spread out regularly over several weeks cures a few headaches.)
- ◆ For radiation, dose is **milli-sievert, mSv**, and period, **mSv per month**.

You can trust radiation doses used in medicine

- ◆ Today many people benefit from **radiation diagnostic scans** and some have **radiation therapy for cancer**.
- ◆ A CT scan gives a dose of 5-10 mSv with an **external** source of radiation.
- ◆ PET and SPECT scans give a similar dose from an **internal** injected radioactive source.
- ◆ A screening CT+PET scan gives a whole-body dose of **15mSv**.
- ◆ This radiation and radioactivity, internal and external, are essentially the **same types** as that emitted at Fukushima.

Food regulations in error, for example caesium in beef

- “Measures against Beef which Exceeds the Provisional **Regulation** Values of Radioactive Cesium by the Government to Ensure Safety of Beef”, issued 27 July 2011
- **Eating 1 kg** of meat with regulation limit of 500Bq/kg gives a dose of **0.008mSv** [page 12, section 4. This number has been checked]
 - Exposure lasts over 4 months while the caesium is **excreted**
 - The radioactive caesium dose is evenly spread throughout the body **like the radioactive fluorine** in a PET radiation scan which gives 15 mSv all in a couple of hours
 - Therefore one scan gives the same dose as eating **2000 kg** per person of contaminated meat in 4 months. The Regulation is unreasonable.
 - After Chernobyl this error was admitted in **Norway** and Sweden.
 - The international safety standard (ICRP) underlying such regulations needs substantial **revision**.
 - But 15 mSv is **not a dangerous level**.

in Norway after Chernobyl

In June 1986, the Norwegian Directorate of Health imposed intervention radioactivity levels for the nuclides ^{137}Cs and ^{134}Cs . The intervention levels were 370 Bq kg⁻¹ for milk and baby food, and 600 Bq kg⁻¹ for all other foodstuffs. To maintain reindeer breeding in Norway and to reduce the social effects for the Sami reindeer breeders, it was necessary to consider a higher intervention level for reindeer meat. In November 1986, the intervention level for reindeer was increased to 6000 Bq kg⁻¹ and in July 1987, the level for wild freshwater fish and game was also increased to 6000 Bq kg⁻¹.

Harbitz, Skuterud and Strand, Norwegian Rad Prot Auth (1998)

Meat at level 6000 Bq per kg and some other food too

- So in Norway they raised the level to factor 12 above the level at Fukushima .
- At this level you can eat 170kg of condemned meat before equivalent to a CT/PET scan.
- And then the farmers and herders could sell their meat, and nobody suffered.
- Why not at Fukushima?



The original article was published in Swedish on the 24th April 2002 in Dagens Nyheter, the major Stockholm morning paper. The purpose was to explain to the public how the scientists' evaluation of the disaster has progressed since 1986. The article attracted quite some attention both at home and abroad and sparked a renewed discussion on the subject, so the Swedish Radiation Protection Authority was asked to provide an English translation in order to inform the international audience of its conclusions.

16 years after the Chernobyl disaster, the Swedish Radiation Protection Authority admits:

“We condemned tonnes of meat unnecessarily”

Tonnes of top quality reindeer and moose meat were disposed of unnecessarily in Sweden following the nuclear power accident in Chernobyl on the 26th April 1986. The caesium intervention level for meat set by the authorities was too low. In the slaughter of the same year, 78 percent of all the reindeer meat was destroyed at great cost to the taxpayers and temporary adversity for the reindeer herders. The thinking behind the intervention level was that the individual risk would be so low that the consumer would not need to think about what he or she bought in the shops.

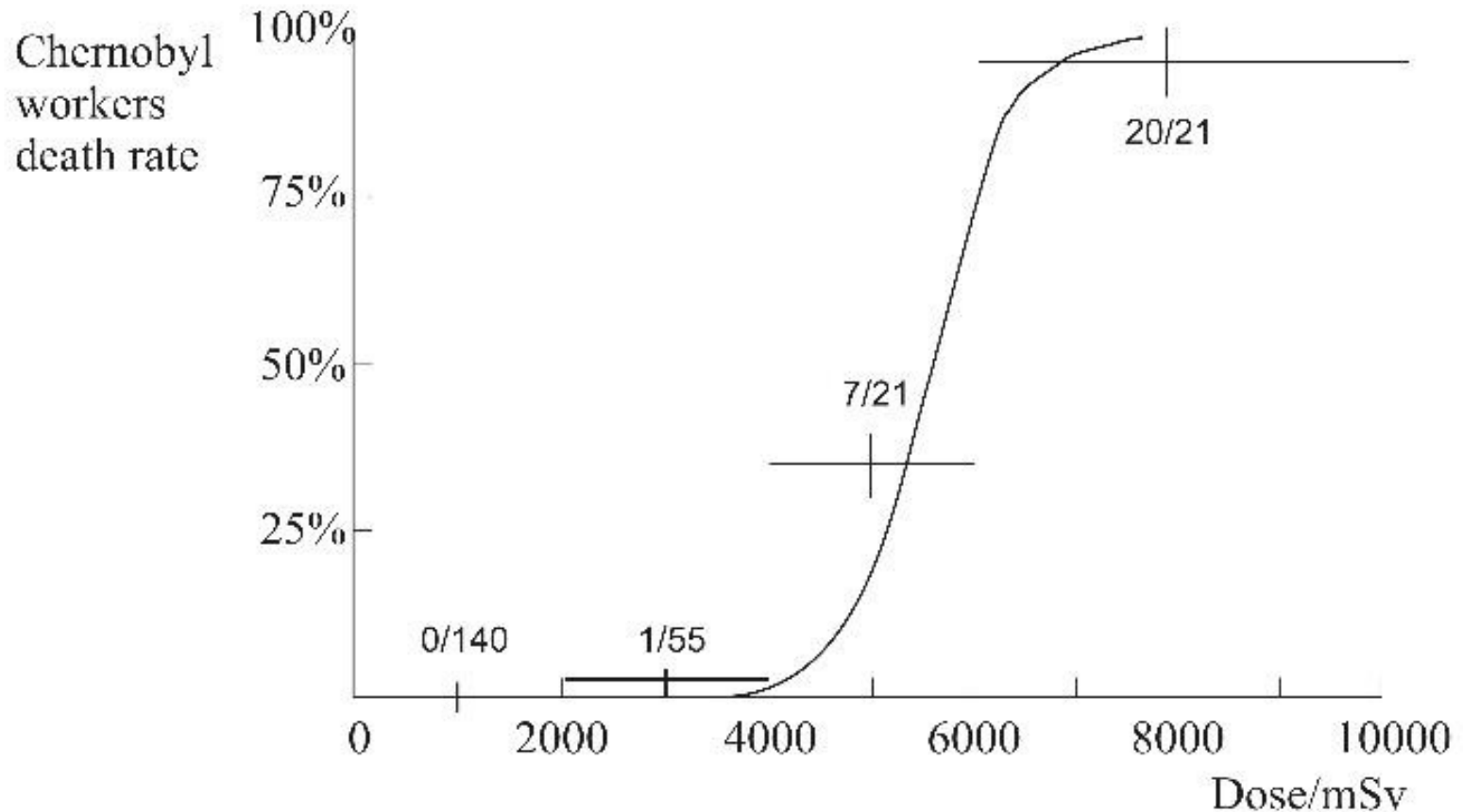
“Perhaps we took on too great a responsibility for the individual consumer,” write the directors of the Radiation Protection Authority.

[signed]

Lars-Erik Holm
Director General
Ulf Bäverstam
Dep. Director General
Leif Moberg
Principal Scientist

Real radiation danger levels

Crosses show the mortality of Chernobyl firefighters (curve is for rats).
The numbers show the number who died/total in each dose range.



Above **4,000 mSv** 27/42 died from Acute Radiation Syndrome (ARS), not cancer.

Below 4,000 mSv 1/195 died.

Workers at Chernobyl

- No worker with less than 2000 mSv died from ARS.

Workers at Fukushima

- After six weeks 30 workers had received between 100-250 mSv.
- So there will be no deaths from ARS at Fukushima.

Radiation therapy to cure cancer

- Patients receiving radiotherapy spread over about 6 weeks to cure cancer get a **daily dose of 2000 mSv** to the tumour that kills the cancer cells.
- They also receive daily **1000 mSv to many healthy organs** and tissue that survive -- more than **20,000 mSv per month**.
- That is more than **5 X** an acute fatal dose (4,000mSv).
- **Credible data?**

Most people personally **know someone** who has benefited from such treatment.

- How? **Recovery from radiation damage.**

After each **daily** treatment healthy organs just have time to repair the radiation damage - and the tumour cells just do not.

Evacuation at Fukushima

- Criterion was **set at 20 mSv per year**.
- Radiotherapy shows that doses of **more than 20,000 mSv per month** are tolerated.
- Radiotherapy equivalent to 1000 years at the evacuation criterion.
This criterion is unreasonable.
- In general, evacuation is at least as traumatic as radiotherapy treatment.
- The criterion has taken no account of **damage to personal and socio-economic health**.
- Radiation safety at the expense of **mental health and community well being** is unjustifiable.

Experience from Chernobyl ignored at Fukushima

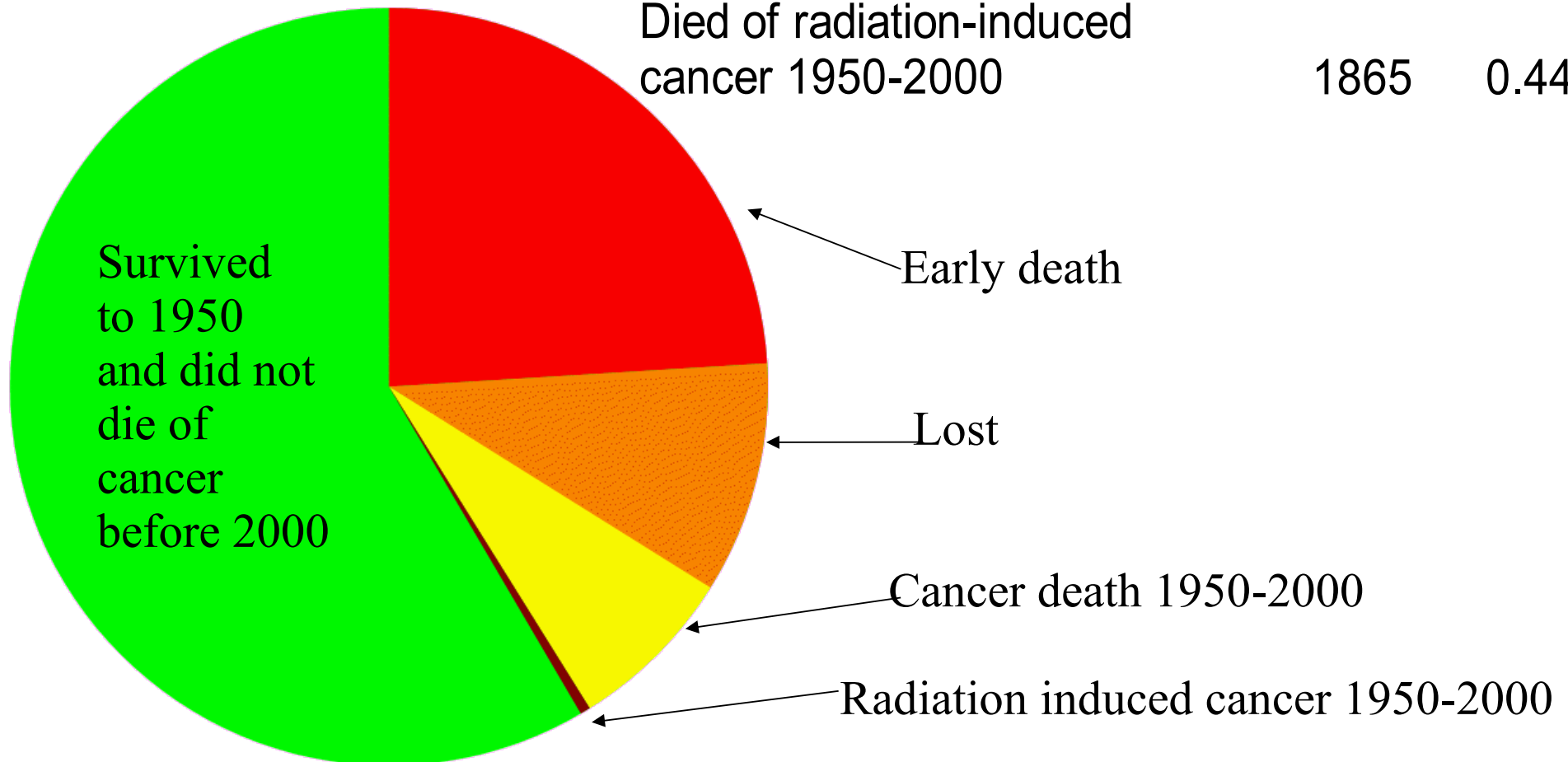
- The evacuation (and the advice to the population that their health was threatened by radiation) caused **far more damage** to public health than the radiation itself [**UN(2011)** and **IAEA(2006)** reports].
- These reports have **not been read** at Fukushima? Lesson not learnt and error repeated.

Radiation-induced cancer

- There are many **overlapping repair** methods including immunity.
- The immune system may fail (usually with poor health in later years) resulting in **cancer**.
- Usually it is not possible to **distinguish** cancers caused by radiation.
- Only seen when the lifelong health records of a **large population are** compared, those **highly irradiated** with those not irradiated.
- For example, cancer fatalities among the survivors of **Hiroshima and Nagasaki** for the period 1950-2000.
- The average dose 160 mSv and average cancer risk increased by **1 in 15**.
- Higher doses show a clear **increased risk**, but not for those less than 100 mSv.

What do we know from Hiroshima and Nagasaki?

Total population	429000	100.00%
Known killed or died 1945-1950	103000	24.01%
Lost or died 1945-1950	43000	10.02%
Survived to 1950	283000	65.97%
for whom dose known	86955	
Died of cancer 1950-2000	32057	7.47%
Died of radiation-induced cancer 1950-2000	1865	0.44%



Solid cancer deaths among Hiroshima and Nagasaki survivors,
1950-2000, separated by dose range (Preston et al., 2004)

Dose range mSv	survivor number	solid cancer survivor actual	deaths 1950-2000 expected	extra risk per 1000
less than 5	38507	4270	4282	-2.0 to 1.4
5 to 100	29960	3387	3313	0.0 to 3.5
100 to 200	5949	732	691	3.5 to 12.5
200 to 500	6380	815	736	9 to 18
500 to 1000	3426	483	378	25 to 37
1000 to 2000	1764	326	191	63 to 83
above 2000	625	114	56	72 to 108
all	86611	10127	9647	5.0 to 5.2

“expected” means the number of deaths predicted from those in other cities.
- Doses highlighted have risk compatible with zero, final column.

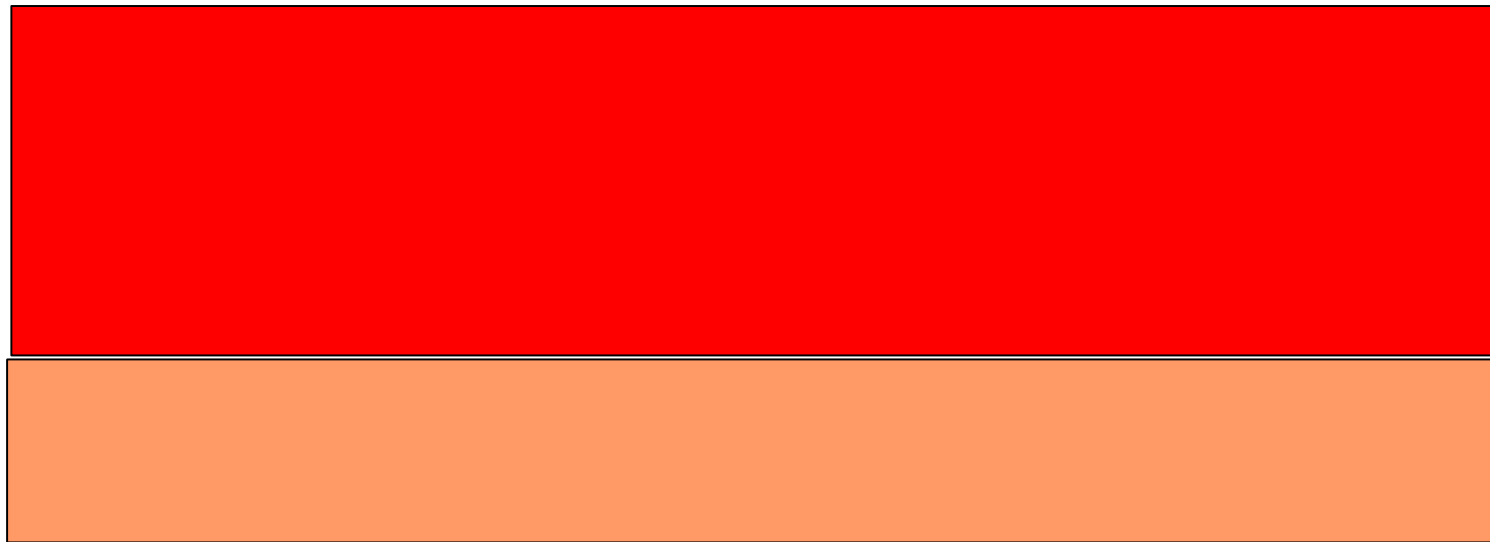
Why are regulations wrong? Who is to blame?

- National regulations are **based on advice** from the international committee (ICRP)

ICRP advice is to ignore other risks and to reduce radiation As Low As Reasonably Achievable (**ALARA**), close to natural levels. **Not for safety** but for social reasons.

- ALARA is what a radiation-phobic **world demanded** in the Cold War years. We should correct our mistake.
- Safety levels should be **As High As Relatively Safe** (AHARS), where “**relatively**” refers to competing risks.
- AHARS levels should take account of **recovery from radiation damage** shown by the **success** of radiotherapy.
- What might AHARS safety levels be?

Some monthly doses shown by area with ALARA and AHARS.



■ Suggested safe level 100 mSv per month, [conservative by a factor 200]
50 times larger than current evacuation level 2 mSv per month [20 mSv/yr]

→ ICRP public ALARA level 0.1 mSv per month, [or 1 mSv per yr]

Suggested new safety levels (AHARS):

100 mSv max single dose
100 mSv max in any month
5000 mSv max lifelong

A relaxation by *about 1000 times* compared to public ALARA, 1 mSv per year .

How many will die from radiation cancer at Fukushima?

It is very unlikely that anyone will die from radiation as a result of Fukushima, even over the next 50 years. Here is why.....

After six weeks 30 workers had received a radiation dose between 100 and 250 milli-sievert. At Chernobyl no emergency worker who received less than 2000 milli-sievert died from Acute Radiation Syndrome, although there were 140 of them.

At Hiroshima and Nagasaki, out of 5949 citizens who received a dose in **this range, 1 in 150** died of radiation-induced cancer in 50 years.

The chance that ANY worker at Fukushima will die of extra cancer is less than 25%. Doses to the public have been far lower and so without risk.

In Japan seaweed is in the diet and many children received iodine tablets. Both protect against child thyroid cancer.

At Chernobyl, an iodine-deficient region, 6000 children contracted thyroid cancer but just 15 died.

No radiation deaths are expected at Fukushima.

Some conclusions

- At Fukushima the **mental health, self confidence and livelihood** of hundreds of thousands are put in danger by tight food and evacuation regulations.
- In fact, at Fukushima as at Chernobyl, **appeasing fear** of radiation by tight regulation has had the **opposite** effect.
- Radiation and radioactivity **cure 1000s of cancers** a year and are harmless at low dose.
- Radiation is **not a big threat** to mankind, unlike geology, climate change, socio-economic stability, population, water and food supplies.
- Everywhere, new **fresh education** is needed to explain radiation to more people in simple terms to remove the **stigma**.
- Everywhere, we should learn to use nuclear radiation for the benefit of **society** with the same **care and respect** that we already do when it is used for our **personal health**.