Nks Seminar on the Fukushima Accident and Perspectives for Nordic Reactor Safety and Emergency Preparedness

Finlandshuset, Snickarbacken 4, Stockholm, Sweden, January 8-9, 2013

Fukushima:

Issues Identified from the Accident

vis-à-vis

the ICRP System of Radiological Protection

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Vice-Chair ICRP

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The main lessons from Fukushima

- In addition to the foreseeable events (however unlikely) that are usually considered for preventing nuclear accidents, unpredictable events may also occur.
- Prevention of conceivable accidents will remain a fundamental nuclear safety objective, but the possibility of unexpected events should be considered.
- Objective → *mitigation of consequences*, namely:
  - (i) containing radioactive releases

  and,
  - (ii) radiological protection .

Analysis

- In the aftermath of the accident:

  ICRP Recommendations proved to be effective

  - In spite of this dramatic radiological event, people were mostly protected against radiation exposure.
- Nobody received a lethal dose of radiation or a dose that result in acute radiation sickness of any type.
- However, many concerns and questions were raised and ICRP decided to learn radiological protection lessons from this accident to further improve its recommendations

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

ICRP ref 4832-6303-9753
June 18, 2011

Terms of Reference for Task Group 84 of the ICRP Main Commission

Initial Lessons Learned from the NPP Accident in Japan vis-à-vis the ICRP System of Radiological Protection

Approved by the Main Commission on June 18, 2011

ICRP Task Group 84: Membership

- Makoto Akashi , National Institute of Radiological Sciences (NIRS), Japan;
- John D. Boice Jr. , International Epidemiology Institute, USA;
- Masamichi Chino, Japan Atomic Energy Agency (JAEA), Japan;
- Toshimitsu Homma, Japan Atomic Energy Agency (JAEA), Japan;
- Nobuhito Ishigure, Nagoya University, Japan;
- Michiaki Kai Oita, University of Nursing and Health Sciences, Japan;
- Shizuyo Kusumi, Nuclear Safety Commission, Japan;
- Jai-Ki Lee, Hanyang University, Korea;
- Hans-Georg Menzel, CERN, Switzerland;
- Ohtsura Niwa, Kyoto University, Japan;
- Kazuo Sakai, National Institute of Radiological Sciences, Japan
- Wolfgang Weiss, Federal Office for Radiation Protection (BfS), Germany;
- Shunichi Yamashita, Nagasaki University and Fukushima Medical University, Japan;
- Yoshiharu Yonekura , National Institute of Radiological Sciences , Japan, and,
- Abel J. González, Autoridad Regulatoria Nuclear, Argentina (Chair)

Issues identified

1. inferring radiation risks;
2. attributing radiation effects;
3. quantifying radiation exposure;
4. assessing internal exposures;
5. managing emergency crises;
6. protecting rescuers and volunteers;
7. responding with medical aid;
8. justifying disruptive protective actions;
9. transiting from the emergency to an existing situation;

Issues identified

10. rehabilitating evacuated areas;
11. categorizing public exposures due to an accident;
12. restricting public individual doses;
13. caring for infants and children;
14. considering pregnant women;
15. monitoring public protection;
16. dealing with ‘contamination’ of territories, rubble and residues, and consumer products;
17. recognizing psychological consequences; and,
18. fostering the sharing of information

1.

Inferring Radiation Risks

(and the misunderstanding of nominal risk coefficients)

Issues

- Claims were raised by the media that the risk of radiation exposure is higher than the nominal risk coefficients recommended by ICRP.
- In particular, the dose and dose-rate effectiveness factor used by ICRP for estimating radiation risk at low doses were questioned in the media, notably, during a television show with a wide viewing audience in Japan

Detriment-adjusted Nominal Risk Coefficients

- ***Risk Coefficient***: A numeral, expressed in % Sv^{-1}, which –multiplied by dose– quantifies the plausibility of harm.
- ***Nominal***: The stated numeral does not necessarily correspond to its real value: it relates to hypothetical (no real) people who are averaged over age and sex.
- ***Detriment-adjusted***: The numeral is multidimensional, expressing plausible expectation of harm, and including *inter alia* the weighted plausibility of fatal and non-fatal harm, and life-lost should the harm actually occur.

Semantics

- Detriment-adjusted nominal risk coefficients for stochastic effects after exposure to radiation at low dose rate.

- 低線量率放射線被ばく後の確率的影響に対する，損害で調整された名目リスク係数

Detriment-adjusted nominal risk coefficients [% Sv^{-1}]			
Nominal Population	Cancer & leukæmia	Hereditable	Total
Whole	5.5	0.2	5.7
Adult	4.1	0.1	4.2

Rounded value used in RP standards⇒~5%Sv^{-1}

2.

Attributing Radiation Effects from Low-Dose Exposures

Issues

- Nominal risk coefficients are being improperly used to attribute hypothetical future deaths.
- These phantom numbers are obtained by multiplying the nominal risk coefficients by an estimate of the collective dose received by a large population of individuals who received tiny doses.
- The estimates of future causalities have oscillated between some tens of cases in the peer reviewed literature to half a million in reports by the media.

The Canadian
www.agoracosmopolitan.com

Death toll from Japan nuclear catastrophe could top 500,000

DATE: 13 AUGUST 2011 POSTED BY : SPECIAL TO THE CANADIAN

John H. Large has been reported as having predicted that the death toll in the years ahead could top the 500,000 attributed to the Chernobyl accident of 1986 and warned that panicked repair attempts could lead to an even greater disaster. Mr. Large, a British nuclear engineer, said: "The Japanese don't know how to deal with it. They're ad-libbing.

"Just throwing water on to the reactors, when they cannot get inside to see what the situation is, could mean the fuel goes critical again.

"And while the radiation leak so far is only a tenth of that at Chernobyl, that was in a rural area with a low population. In Japan it's an urban, densely packed area so the potential numbers of deaths and cancers are much higher."

Mr. Large is an independent nuclear engineer and analyst primarily known for his work in assessing and reporting upon nuclear safety and nuclear related accidents and incidents.[LINK] From the mid-1960s until 1986 Large was an academic in Brunel University's School of Engineering, where he undertook research for the United Kingdom Atomic Energy Authority.

Mr. Large prepared a critical review of the preliminary report of the IAEA Fact Finding Mission undertaken to Fukushima Dai-ichi in May 2011. [LINK][LINK]

Do you welcome and have reservations about Target taking over Zellers in Canada?

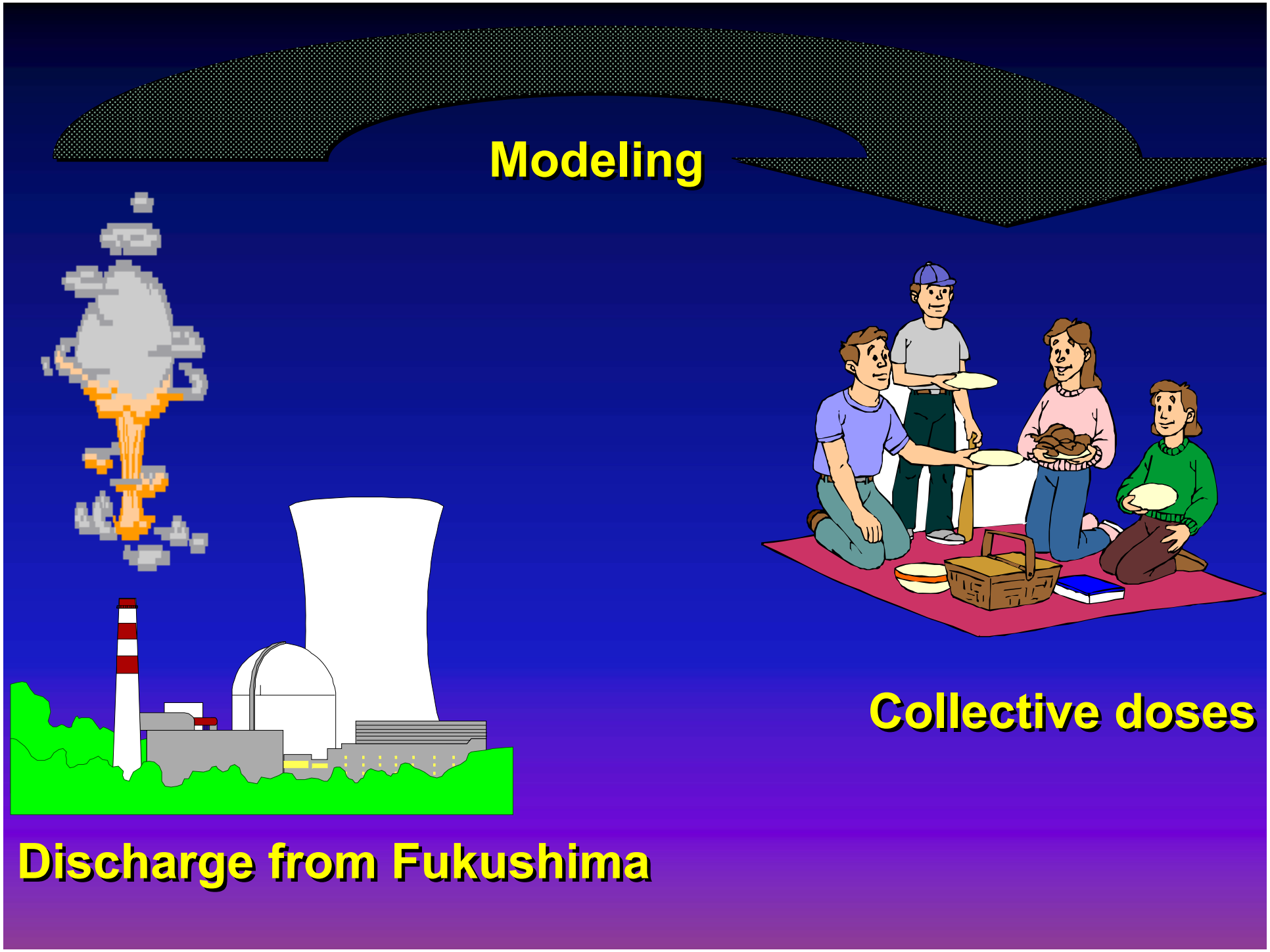
- Welcome it
- Have reservation

Vote Result

Blog | Books | Latest | Culture

- Manipulative Extraterrestrials control Earth suggests Dr. Michael Salla
- Humanized face of aliens control Earth suggests Dr. Michael Salla
- Perpetuated War and Canada's First Nations
- Toronto Housing Project linked to


Would I be one of the 500,000?


Modeling
Collective doses
Discharge from Fukushima

Collective dose
(person-sieverts)

X

Nominal
Risk
Coefficient
(5%/Sv)

=

Persons (nominal)
=
number of corpses

• PRESS RELEASE •

International Atomic Energy Agency
World Health Organization
United Nations Development Programme

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EMBARGOED: September 5, 2005 at 4 p.m. local time

Released simultaneously from London, Vienna, Washington, and Toronto
B-rolls are available for TV producers.

Chernobyl: The True Scale of the Accident

20 Years Later a UN Report Provides Definitive Answers and Ways to Repair Lives

A total of up to four thousand people could eventually die of radiation exposure from the Chernobyl nuclear power plant (NPP) accident nearly 20 years ago, an international team of more than 100 scientists has concluded.

the guardian

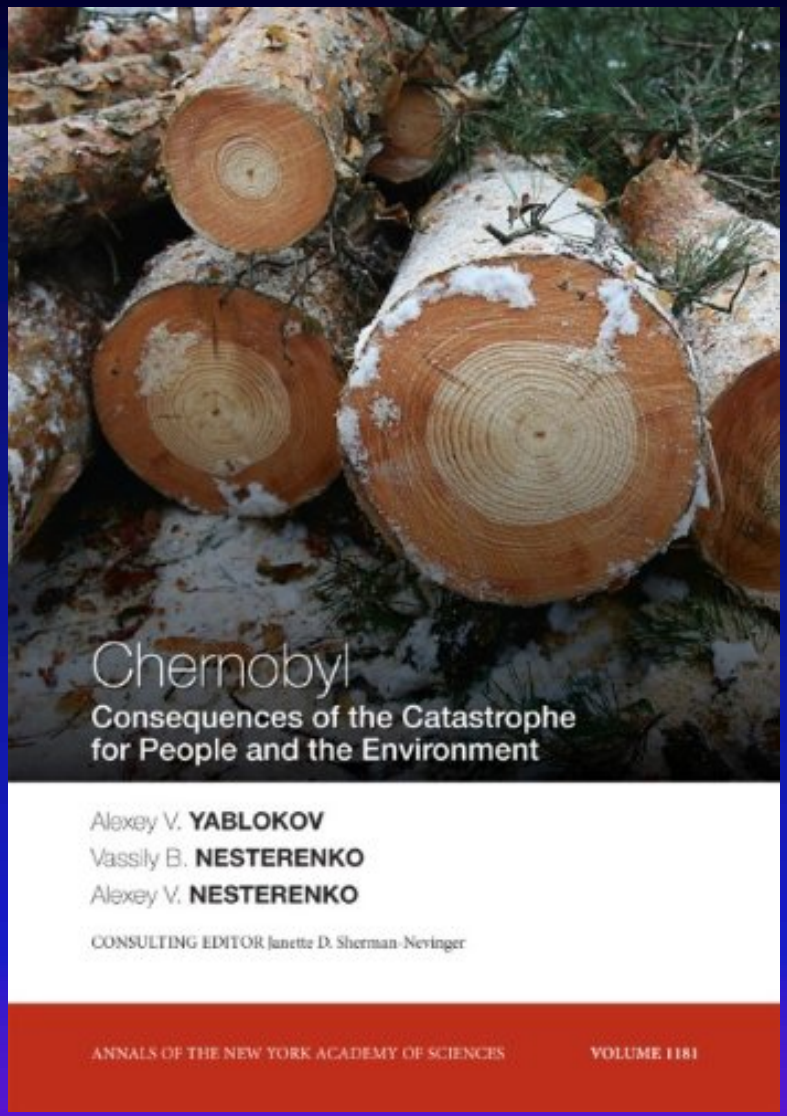
March 25, 2006 Saturday

SECTION: GUARDIAN INTERNATIONAL PAGES; Pg. 17

HEADLINE:

UN ignores 500 000 Chernobyl deaths

IAEA says will be less than 4 000



Chernobyl:

Consequences of the Catastrophe for People and the Environment

Annals

of the

New York Academy of Sciences

Alexey V. Yablokov (Editor),
Vassily B. Nesterenko (Editor),
Alexey V. Nesterenko (Editor),
Janette D. Sherman-Nevinger (Editor)

It concludes that based on records now available,

some 985,000 people died of cancer caused by the Chernobyl accident!

Scientific misleadingless

International Journal of Cancer
Volume 119, §6, pp 1224–1235
15 September 2006

REPORTED:

- …[by 2006] Chernobyl may have caused about 1,000 thyroid cancer and 4,000 other cancers in Europe.
- …by 2065 about 16,000 thyroid cancer and 25,000 other cancers may be expected due to radiation from the accident.

CAVEATS

- …several hundred million cancers are expected from other causes…
- …estimates are subject to considerable uncertainty…
- …it is unlikely that the cancer burden could be detected...
- …trends in cancer incidence and mortality in Europe do not indicate any increase in cancer rates that can be attributed to Chernobyl..

Dialogue

ICRP: This calculation cannot be done!

Stakeholder in Japan: Why not?

A/AC.82/R.676/Rev.1

United Nations

General Assembly

Distr.: Restricted

3 August 2010
Original: English only

United Nations Scientific Committee
on the Effects of Atomic Radiation

Fifty-seventh session
Vienna, 16 to 20 August 2010

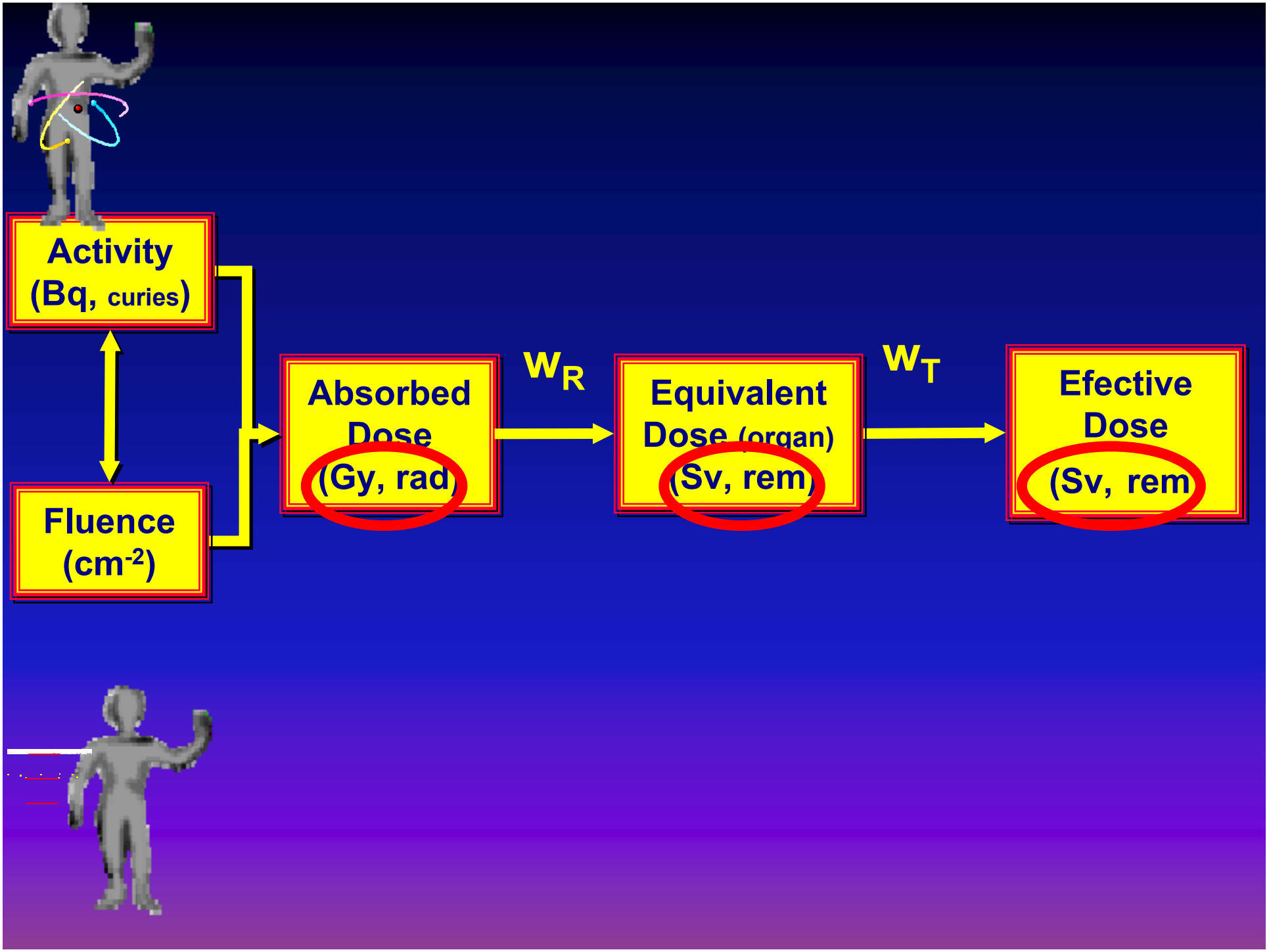
ATTRIBUTABILITY OF HEALTH EFFECTS TO RADIATION EXPOSURE

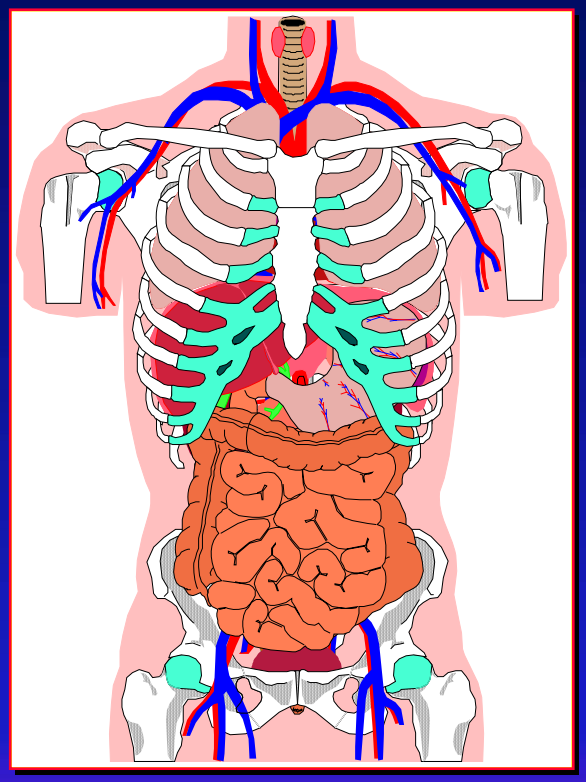
3.

Quantifying Radiation Exposure

Issues

- The differences between the quantities are not well understood even by educated audiences.
- The distinction between the radiological protection quantities and the operational quantities are even more difficult to understand *inter alia* due to semantic problems.
- The use of the same unit for these different quantities without specifying the quantity has enhanced confusion.
- The lack of a formal quantity for a radiation-weighted dose for high doses continues to be an unresolved issue.


Activity
(Bq, curies)
Fluence
(cm-2)
Absorbed
Dose
(Gy, rad)
WR
Equivalent
Dose (organ)
(Sv, rem)
WT
Efective
Dose
(Sv, rem



Standards:
Equivalent Dose

Monitoring
Dose Equivalent

Confusion

- The quantities *equivalent dose* and *effective dose* have a common unit, *sievert*. (confusion in the reporting of thyroid doses).
- Further confusion between the use of the quantity *equivalent dose* (等価線量) for radiological protection purposes and the quantity *dose equivalent* (線量当量) on which instruments are calibrated.

4.

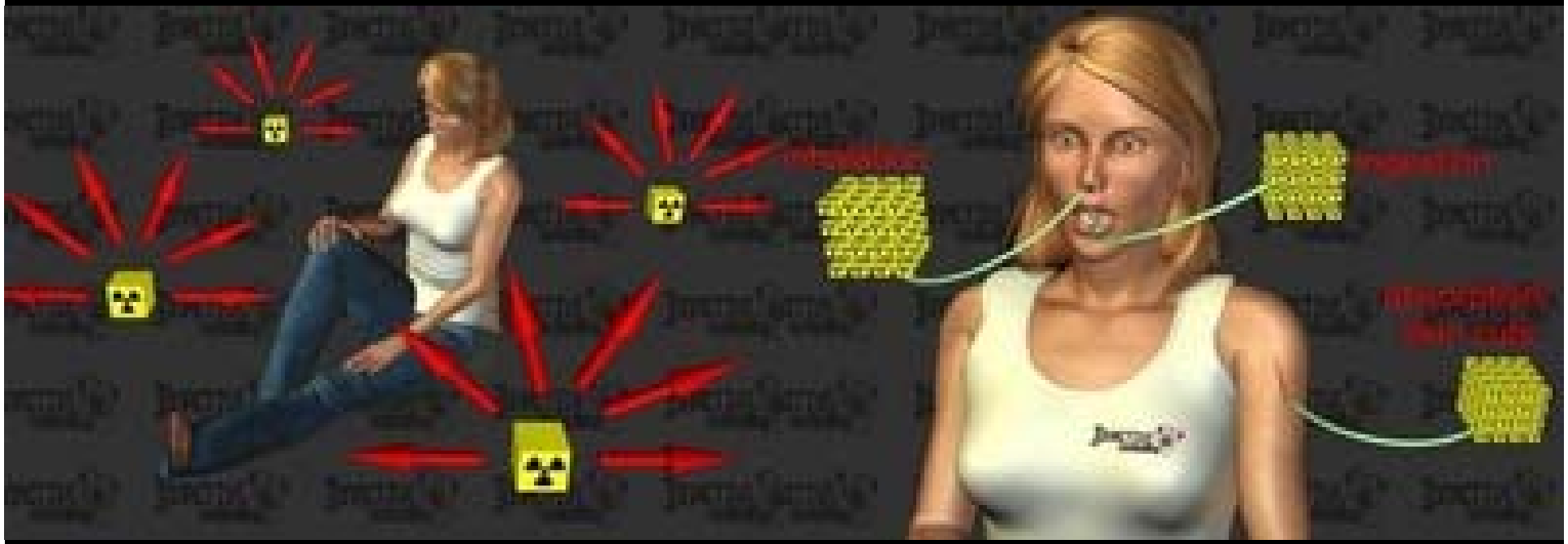
Assessing the Importance of Internal Exposures

Issues

- Internal exposures have been a source of debate among the public and the media and also in some scientific circles in Japan.
- They appear to be perceived as more dangerous than the same exposure from external sources.
- This perception may have been exacerbated in Japan by a legal case related to the atomic bomb survivors of Hiroshima and Nagasaki

Concerns on internal exposure

- The sophisticated system of protection for restricting internal exposure is misunderstood.
- Internal exposures are perceived as more dangerous than external exposures.
- This created a lot of anxiety among the people.



United Nations
A/AC.82/R.690

General Assembly

Distr.: Restricted

26 April 2012
Original: English

United Nations Scientific Committee
on the Effects of Atomic Radiation

Fifty-ninth session
Vienna, 21 to 25 May 2012

Agenda item 4(e)
Technical discussions

BIOLOGICAL EFFECTS OF SELECTED INTERNAL EMITTERS

5.

Managing Emergency Crises

Issues

- Managing a prolonged release from multiple units rather than by an acute release from single unit.
- Extending the emergency planning zones in order to follow a changing situation.
- Prioritizing of emergency protective measures.
- Planning for lifting measures.
- Transiting to an existing situation

6.

Protecting Rescuers and Volunteers

Issues

- Questioning the adequacy of the occupational radiological protection recommendations for workers who are not customary ‘radiation’ workers, namely:
  - rescuers and
  - volunteers.
- For rescuers, the dose limitation for ‘normal’ workers in an emergency had to be increased *after* the accident, thus creating a credibility issue.
- For volunteers: what dose restriction should be applied? - inhabitants *vis-à-vis* outsiders.


REACTOR 2
GENERAL
Radiation Worker

=

?


Rescuer

Radiation Worker = Volunteers

?

Occupational Dose Restrictions

(Apply to 'radiation' workers)

mSv in a year

1000

500 — Every effort not to exceed it

100 — All reasonable efforts not to exceed it

50 — Annual dose limit

20 — Average dose limit

Optimization of Protection

EMERGENCY

NORMAL

Protection of rescuers and volunteers

- The current occupational protection regime was conceived for ‘radiation’ workers working in ‘normal situations’ and ‘emergency situations’
- It was not specifically envisaged for ‘rescuers’, in one extreme, and ‘volunteers’, in the other extreme.

7.

Responding with Medical Aid

Issues

- Dealing with an accident as combined disaster.
- Personnel involved in emergency medicine.
- Dealing with the contamination of victims.
- Role of health physics experts.
- Appropriate curriculum in medical schools.
- Medical preparedness including drills and exercises

8.

Justifying Necessary but Disruptive Protective Actions

(disruptive protective actions deemed to be unjustifiable)

Issues

- Some of the measures taken were extremely disruptive and caused considerable social harm, including significant psychological consequences.
- Are these measures *justified*, in the sense that they really produce more good than harm?


Justification of severe
countermeasures,
such as evacuation

9.

Transiting from an Emergency to an Existing Exposure Situation

Issues

- How to define and decide when the emergency exposure situation should be terminated and the existing exposure situation should start?
- It is felt that it would be easier to judge when the existing situation should starts if the ICRP recommendations were more quantitative.

10.

Rehabilitating Evacuated Areas

Issues

- Relocating evacuated people back to their homes and re-constructing residential habitats has proved to be extremely difficult.
- The population may want to move into the region in spite of that the exposure might still be somewhat elevated.
- What category the exposure situation is?
- What the type of exposure is? and, consequently,
- How the exposure should be controlled?

11.

Categorizing Public Exposures due to an Accident

Issues

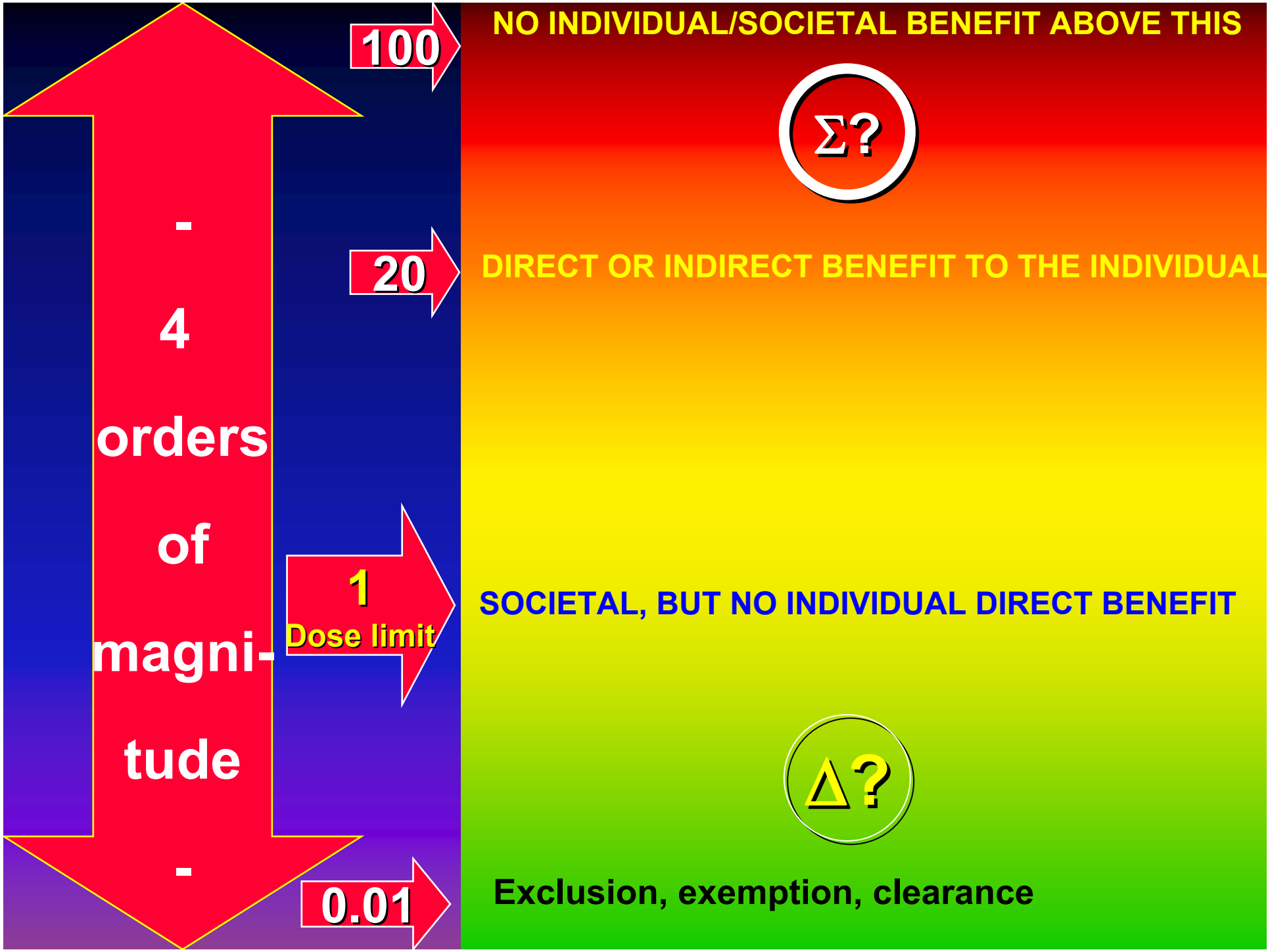
- Difficulties for categorizing public exposures due to the accident *vis-à-vis* the current categorisation of exposure situations recommended by ICRP.

12.

Restricting Individual Doses of Members of the Public

Issues

- People were confused with the logic behind the restrictions applied to their individual doses.
- They were uncertain on the levels of individual dose restrictions recommended for public protection……from the dose limit of 1mSv/y to reference levels up to 100 mSv.


100
NO INDIVIDUAL/SOCIETAL BENEFIT ABOVE THIS
Σ?
20
DIRECT OR INDIRECT BENEFIT TO THE INDIVIDUAL
-
4
orders
of
magni-
tude
-
1
Dose limit
SOCIETAL, BUT NO INDIVIDUAL DIRECT BENEFIT
Δ?
0.01
Exclusion, exemption, clearance

- A typical question from the public is:

Why doses of 20 to 100 mSv per year are allowed after the accident, when doses greater than 1 mSv per year were unacceptable before the accident?

- The Japanese expression for the 1mSv/y dose limit,

線量限度, [線= radiation, 量= amount, 限=border, 度=time]

is unequivocal: amount of radiation dose not to be exceeded in the time.

13.

Caring for Infants and Children

Issues

Parents are:

- Extremely worried about the health of their children.
- Suspicious that the levels of dose applied to the protection of the population as a whole do not provide sufficient safety for their offspring.
- Feeling that the reference level of 20 mSv/y is unacceptably high for children since 1 mSv/y is the established dose limit for the public.

Is my child protected?

Parents do not believe that children are adequately protected by the radiation protection standards

Detriment-adjusted nominal risk coefficients

for stochastic effects after exposure to radiation at low dose rate [% Sv^{-1}]

Nominal Population	Cancer & leukæmia	Hereditable	Total
Whole	5.5	0.2	5.7
Adult	4.1	0.1	4.2

30%

United Nations
A/AC.82/R.692

General Assembly

Distr.: Restricted

30 April 2012
Original: English only

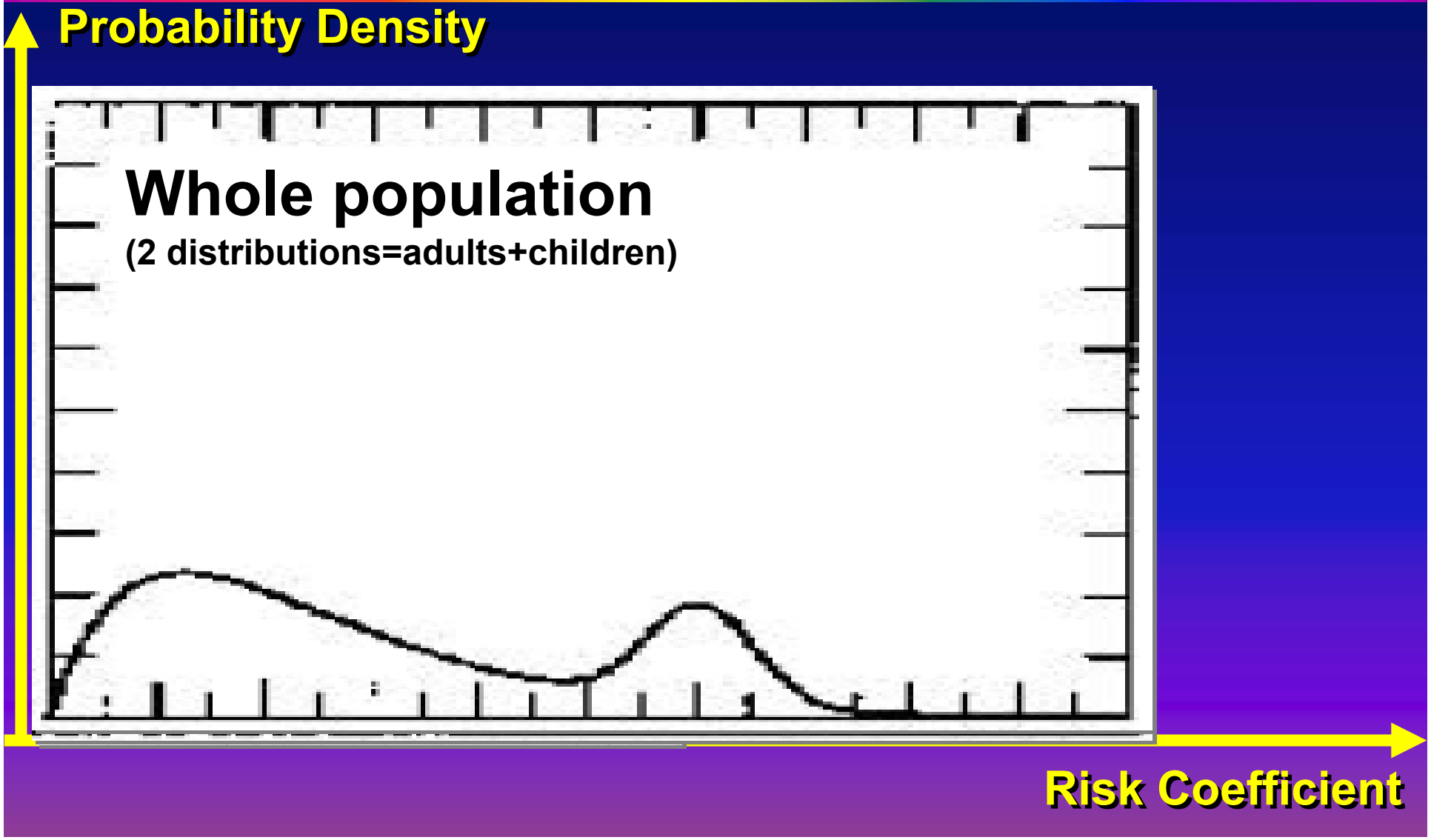
United Nations Scientific Committee
on the Effects of Atomic Radiation

Fifty-ninth session
Vienna, 21 to 25 May 2012

Agenda item 4(g)
Technical discussions

EFFECTS OF RADIATION EXPOSURE ON CHILDREN

A basic question for ICRP



14.

Considering Pregnant Women and their Fœtuses and Embryos

Issues

- Pregnant women are extremely concern on the effects of radiation on their expected offspring.
- Affording proper protection to fœtuses and embryos has been controversial and unclear.
- Concerns are especially high with respect to exposures after uptake of radioactive material

Importance of

clarifying effects on pregnancy

Pregnancy and hereditary effects

Unnecessary terminations of pregnancies?

Should I terminate my pregnancy?

- Great apprehension among pregnant women, probably responsible for unnecessary terminations of pregnancies.

15.

Monitoring Public Protection

Issues

- What should be the general policy of environmental monitoring after an accident?
- Why members of the public are not individually monitored while workers receive that benefit?

Why members of the public are not monitored?

If is it done for them….

….why not for them

Absence of Environmental Monitoring Policy

- There is a lack of updated international recommendations on environmental monitoring policy following a large accidental release of radioactive materials into the environment.

RADIATION PROTECTION

Principles of Environmental Monitoring related to the Handling of Radioactive Materials

ICRP PUBLICATION 7

A Report by Committee 4 of the International Commission on Radiological Protection

Adopted by the Commission on September 13, 1965

PUBLISHED FOR
The International Commission on Radiological Protection
BY
PERGAMON PRESS
OXFORD · LONDON · EDINBURGH · NEW YORK
TORONTO · PARIS · BRAUNSCHWEIG

Principles of Monitoring for the Radiation Protection of the Population

ICRP Publication 43

Ann. ICRP 15 (1), 1985

Abstract - Since the publication of the previous report dealing with environmental monitoring the commission has revised its basic recommendations and some aspects of its philosophy dealing with dose limitation. Although many of the previous recommendations are still relevant it was felt necessary to reassess the general principles on which monitoring programs should be based, to make the recommendations consistent with current radiation protection philosophy and to extend the scope to all types of monitoring outside the workplace. In this report all exposures are considered except occupational exposure and exposure to patients from medical uses of radiation.

Recommended reference format for citations

ICRP, 1985. Principles of Monitoring for the Radiation Protection of the Population. ICRP Publication 43. Ann. ICRP 15 (1).

16.

Dealing with '*Contamination*' of

- Territories,
- Rubble and Residues, and
- Consumer Products

Issues

- Serious problems arose in relation to the presence of radioactive substances in the public domain, including the environment and consumer products.
- Such presence is confusedly termed '*contamination*'
- Concerns in the population.
- Pressure to the authorities to act.

Mission impossible:
Dealing with the concept of '*contamination*'

- There are no clear quantitative standards to deal with "*contamination*"; e.g.:
  - remediation of "contaminated" territories;
  - disposing of "contaminated" debris and rubble;
  - Free use of "contaminated" consumer products.
- In aftermath of Fukushima, this is one of the more important issues to deal with.

‘Contamination' is a confusing term

- from Latin *contaminare*, ‘made impure’.
- Religious origin (e.g., no-kosher food)
- Professional denotation: presence of radioactivity
- Public connotation: radioactive danger

Annals of the ICRP

ICRP PUBLICATION 104

Scope of Radiological Protection Control Measures

Editor
J. VALENTIN

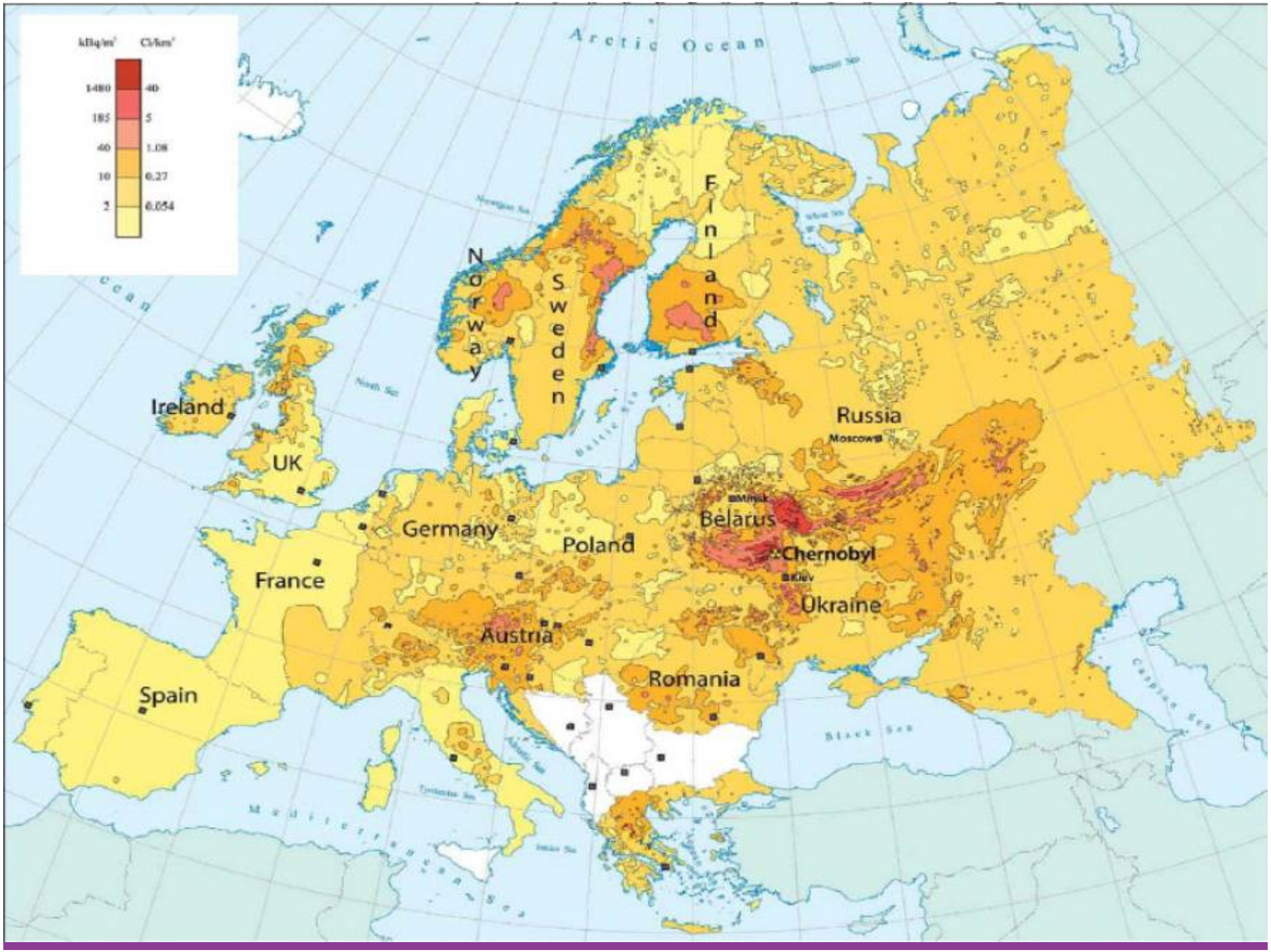
PUBLISHED FOR

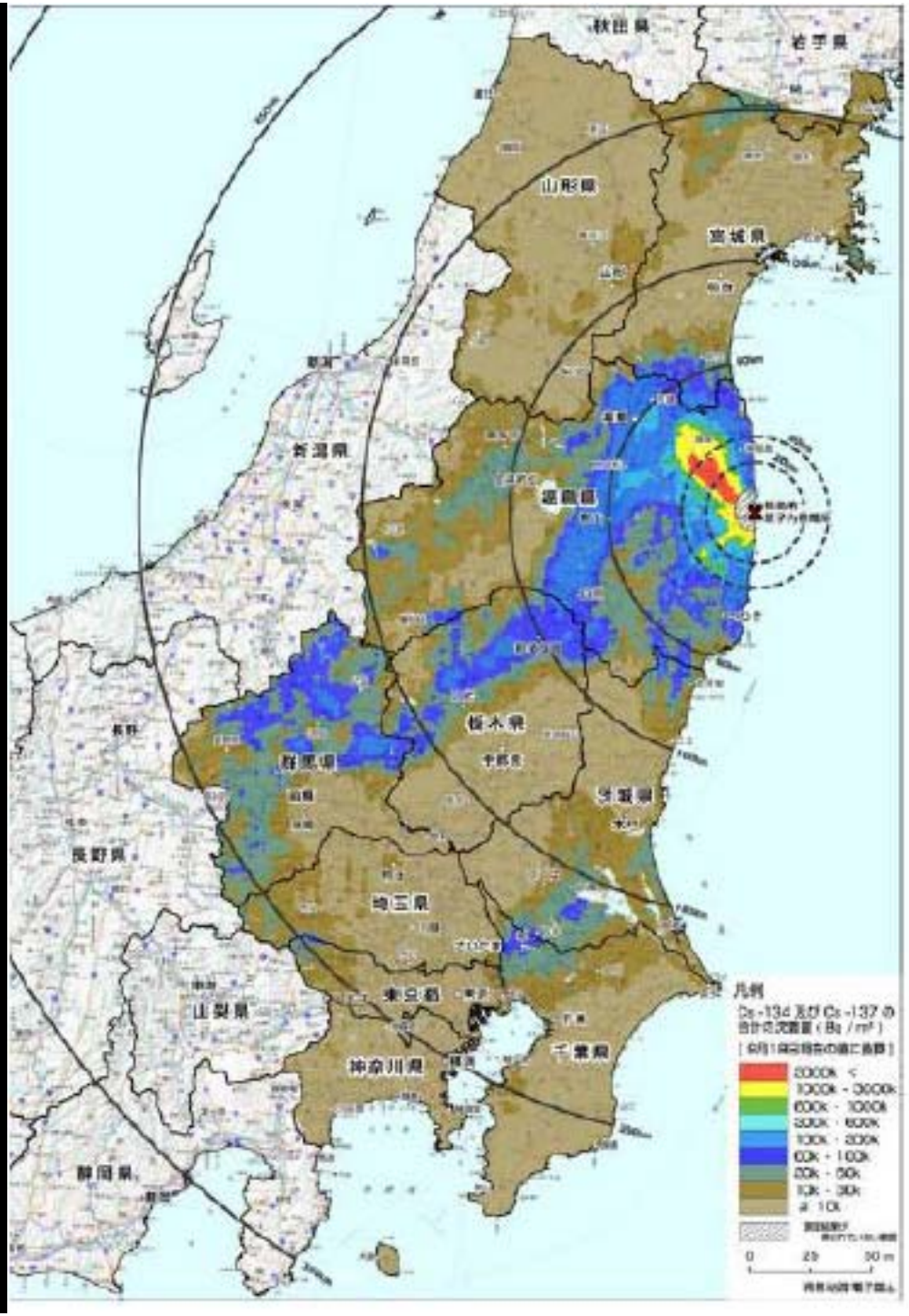
The International Commission on Radiological Protection

by

ELSEVIER

‘*Contaminated*’ Territories


kBq/m²
Ci/km²
1480
40
185
5
40
1.08
10
0.27
2
0.054
Arctic Ocean
Norway
Sweden
Finland
Ireland
UK
Russia
Moscow
Minsk
Belarus
Chernobyl
Kiev
Ukraine
Germany
Poland
France
Austria
Romania
Spain
Black Sea
Caspian Sea
Baltic Sea
North Sea
Norwegian Sea
Barents Sea
White Sea
Adriatic Sea
Tyrrhenian Sea
Ionian Sea
Mediterranean Sea



Cs -134 及び Cs -137 の
合計の沈着量（Bq / m²）

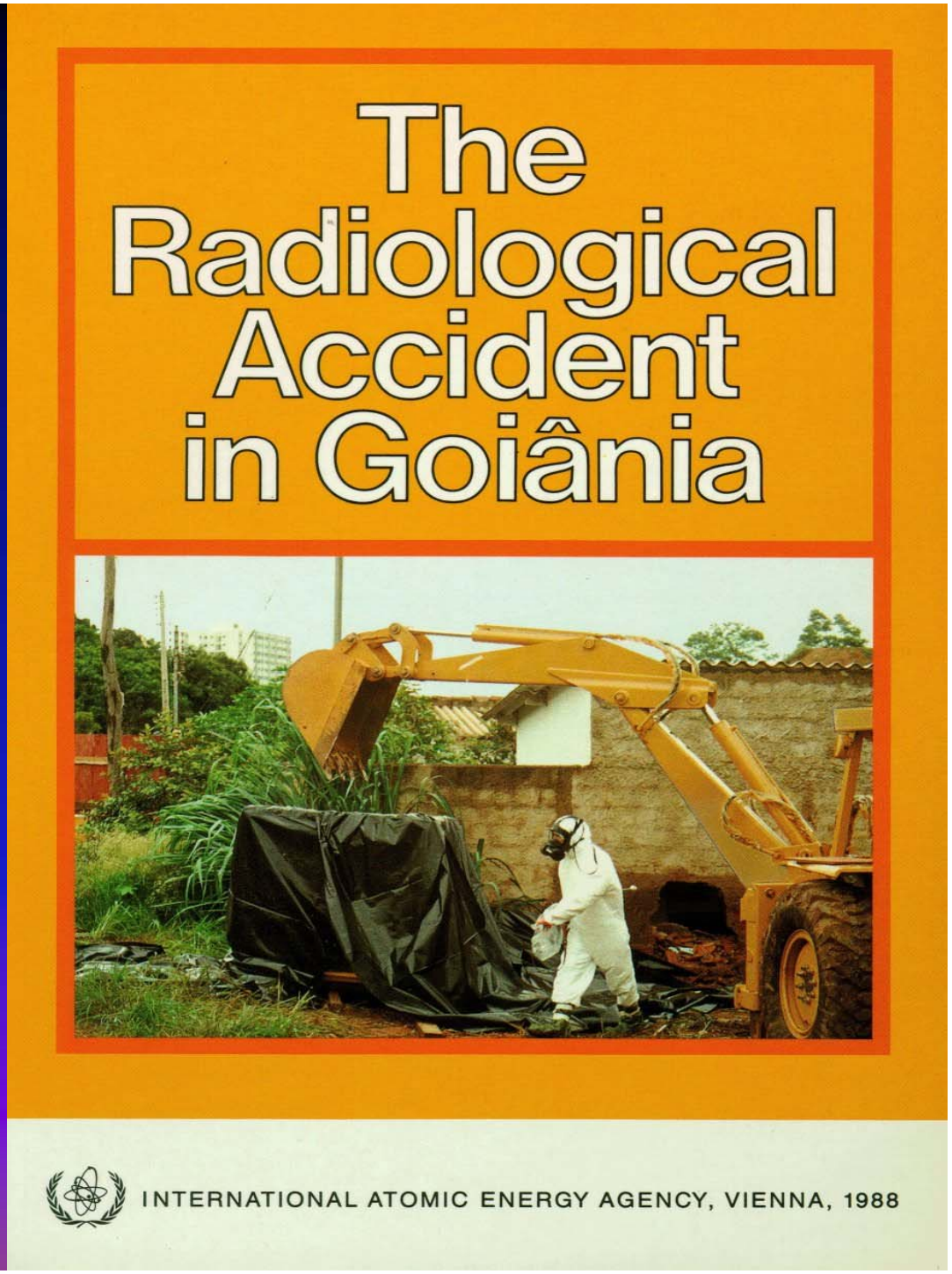
［9月18日現在の値に換算］

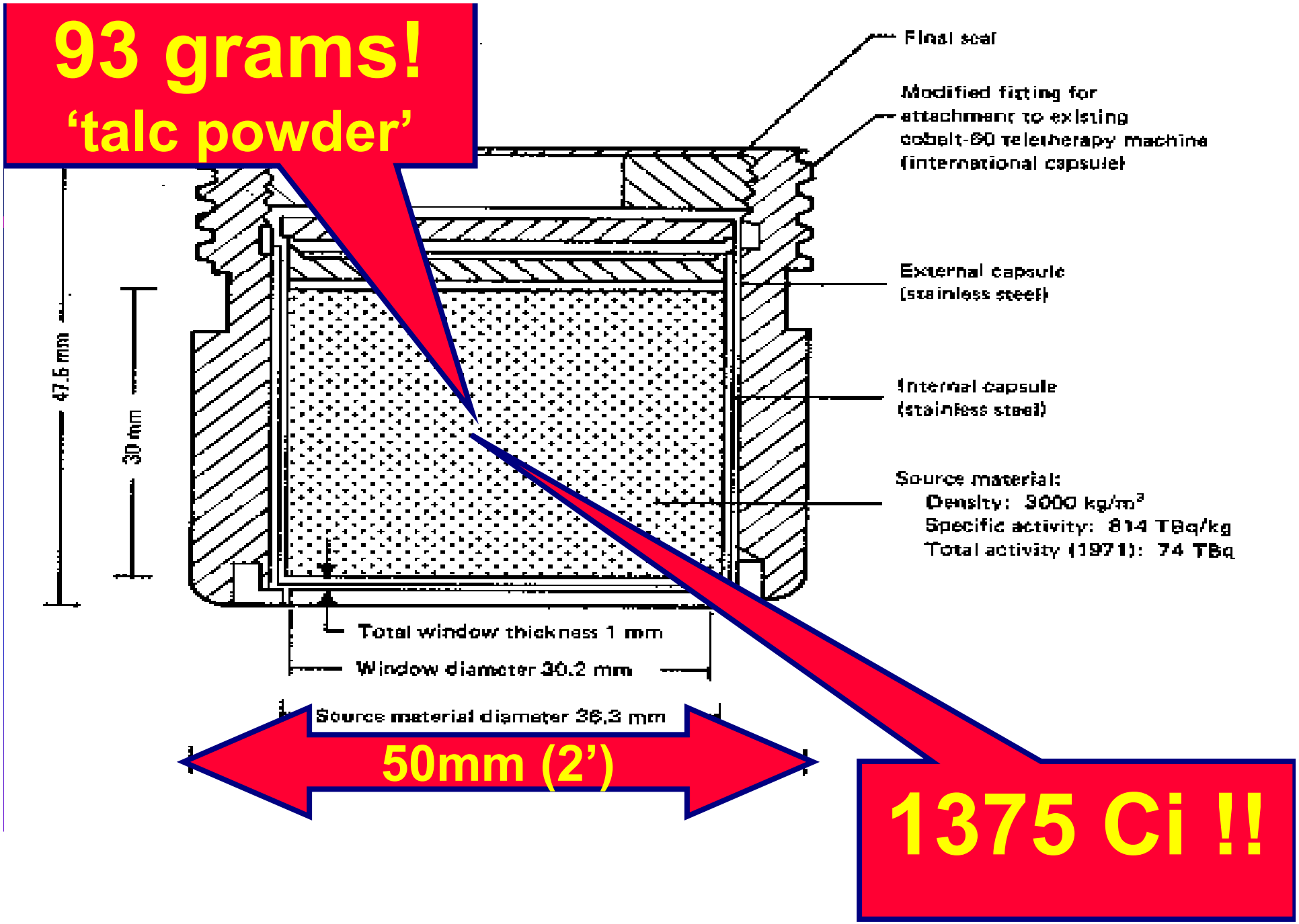
- 3000k ＜
- 1000k - 3000k
- 600k - 1000k
- 300k - 600k
- 100k - 300k
- 60k - 100k
- 30k - 60k
- 10k - 30k
- ≦ 10k

測定結果が
得られていない範囲

‘*Contaminated*’ Rubble

Example


The Radiological Accident in Goiânia
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1988


93 grams!
'talc powder'
Final seal
Modified fitting for attachment to existing cobalt-60 teletherapy machine (international capsule)
External capsule (stainless steel)
Internal capsule (stainless steel)
Source material:
Density: 3000 kg/m³
Specific activity: 814 TBq/kg
Total activity (1971): 74 TBq
47.5 mm
30 mm
Total window thickness 1 mm
Window diameter 30.2 mm
Source material diameter 36.3 mm
50mm (2')
1375 Ci !!

13. Contaminated rubble from the demolition of R.A.'s house on 57th Street.

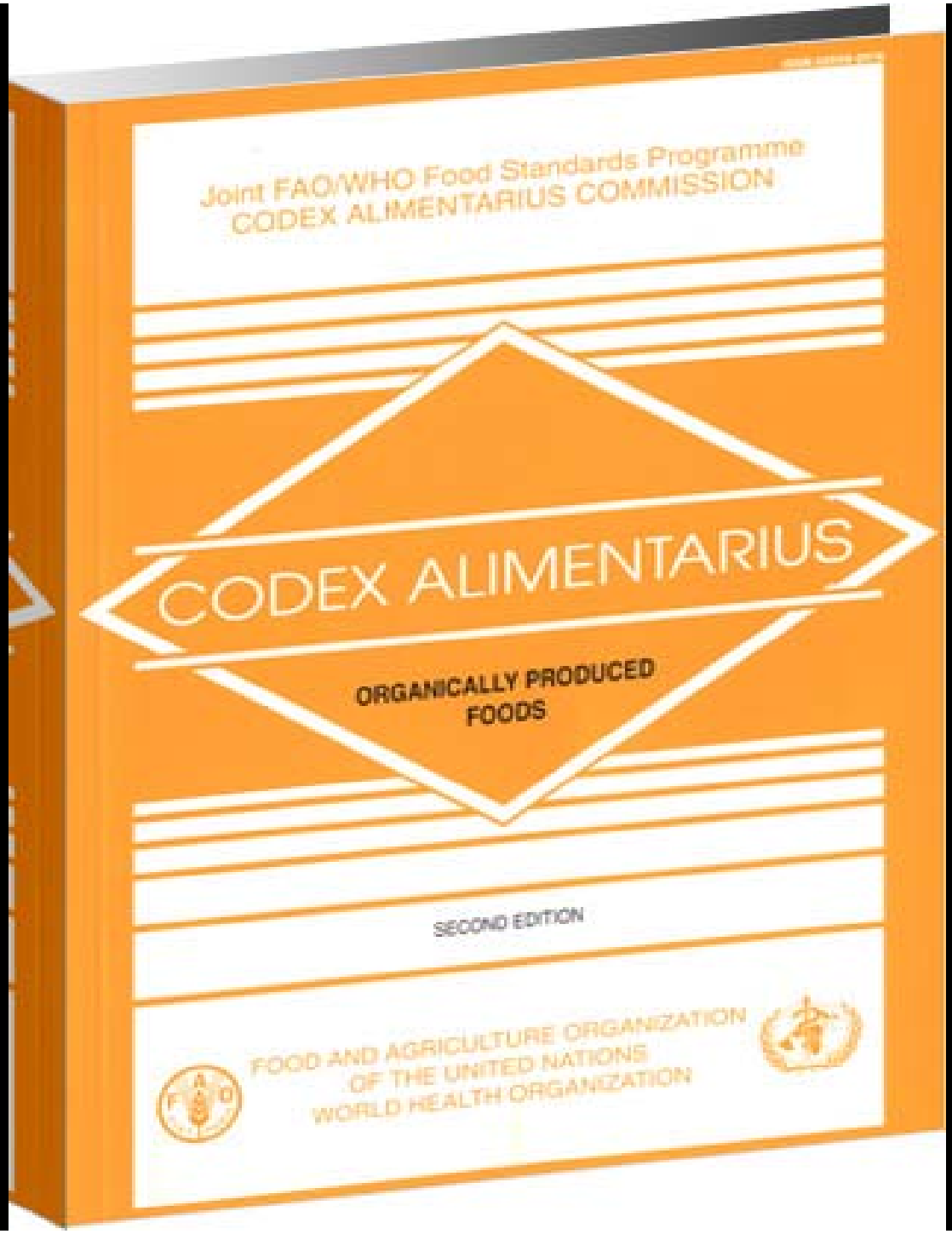
22. *Stacking waste containers to be taken to the temporary storage site.*

27. *Waste containers at the temporary storage site.*

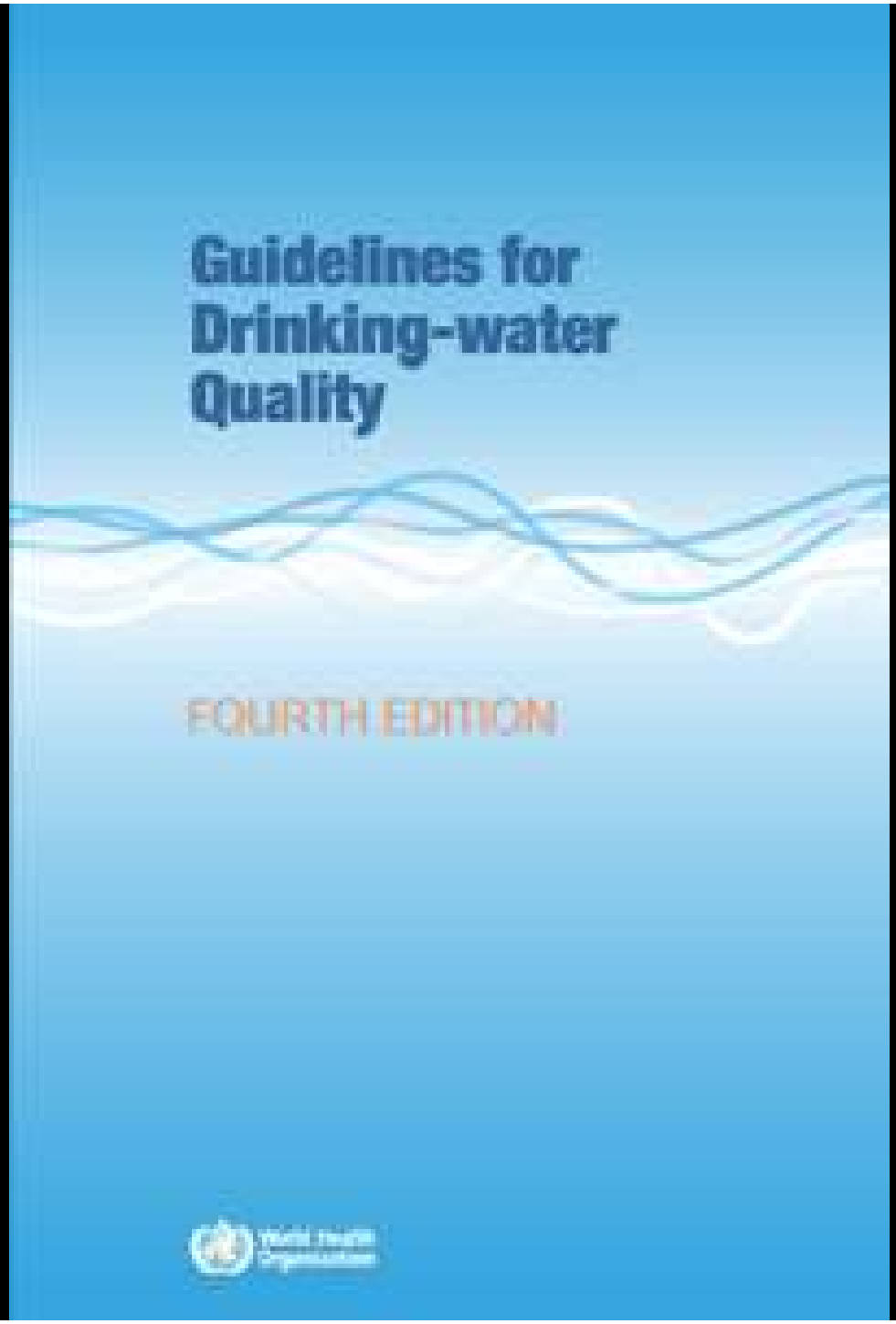
‘*Contaminated*’ Consumer Products

- The control of acceptable levels of radioactivity in consumer products is not straightforward
- Some international intergovernmental agreements exist but they are incoherent and inconsistent.

Foodstuff


Joint FAO/WHO Food Standards Programme
CODEX ALIMENTARIUS COMMISSION
CODEX ALIMENTARIUS
ORGANICALLY PRODUCED FOODS
SECOND EDITION
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
WORLD HEALTH ORGANIZATION

Water



Non edible

IAEA
SAFETY
STANDARDS
SERIES

Application of the Concepts of Exclusion, Exemption and Clearance

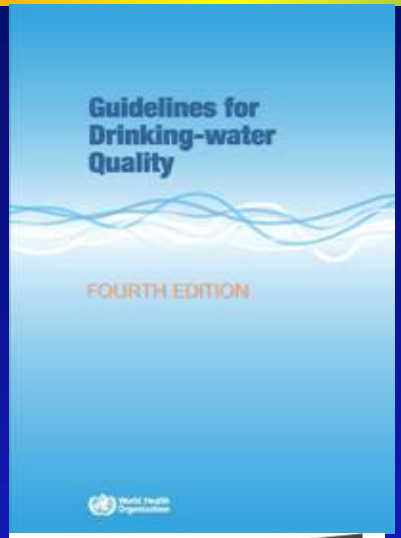
SAFETY GUIDE

No. RS-G-1.7

IAEA
International Atomic Energy Agency

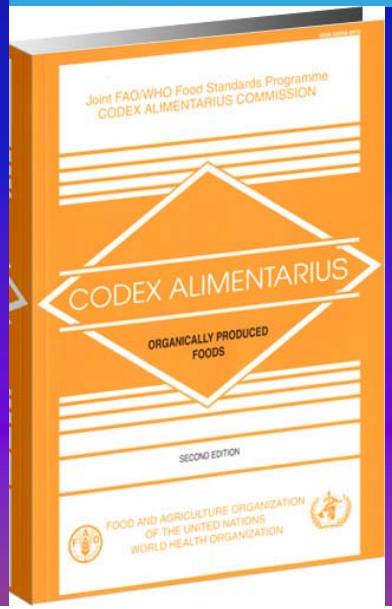
Incoherence in drinking liquids

+



= 10 Bq/l for ^{137}Cs

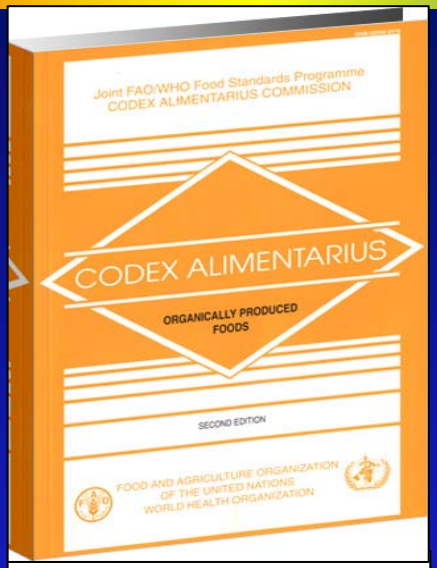
+



= 1000 Bq/l for ^{137}Cs

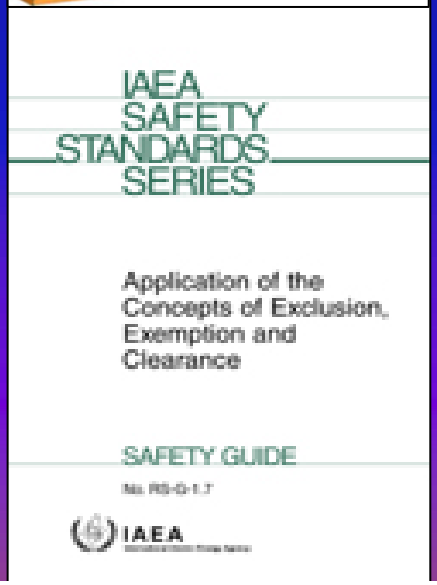
Incoherence in non-edible vs. edible

+



= 1000 Bq/kg for ^{137}Cs

+



= 100 Bq/kg for ^{137}Cs

Guidance values in Japan

Guideline values for food and drink intake restrictions

(Nuclear Safety Commission)

	Radioactive Iodine(^{131}I)	Radioactive Cesium	Uranium	Total of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{242}Cm, ^{243}Cm, ^{244}Cm
Drinking water	> $3x10^2$Bq/kg	> $2x10^2$Bq/kg	> 20Bq/kg	> 1Bq/kg
Milk, dairy products				
Vegetables and fruits	> $2x10^3$Bq/kg (excluding root vegetables and potatos)	> $5x10^2$Bq/kg	> $1x10^2$Bq/kg	> 10 Bq/kg
Grains	-			
Meat, Egg, Fish, etc				

New radiation limits for food in Japan

- On 22 December 2011 the Japanese government announced new limits for cesium in food.

  (The new norms were enforced in April 2012).
- Rice, meat, vegetables, fish: 100 Bq/Kg (500 Bq/Kg),
- Milk, milk-powder, infant-food: 50 Bq/Kg (200 Bq/Kg)
- Drinking water: 10 Bq/Kg (200 Bq/Kg)

17.

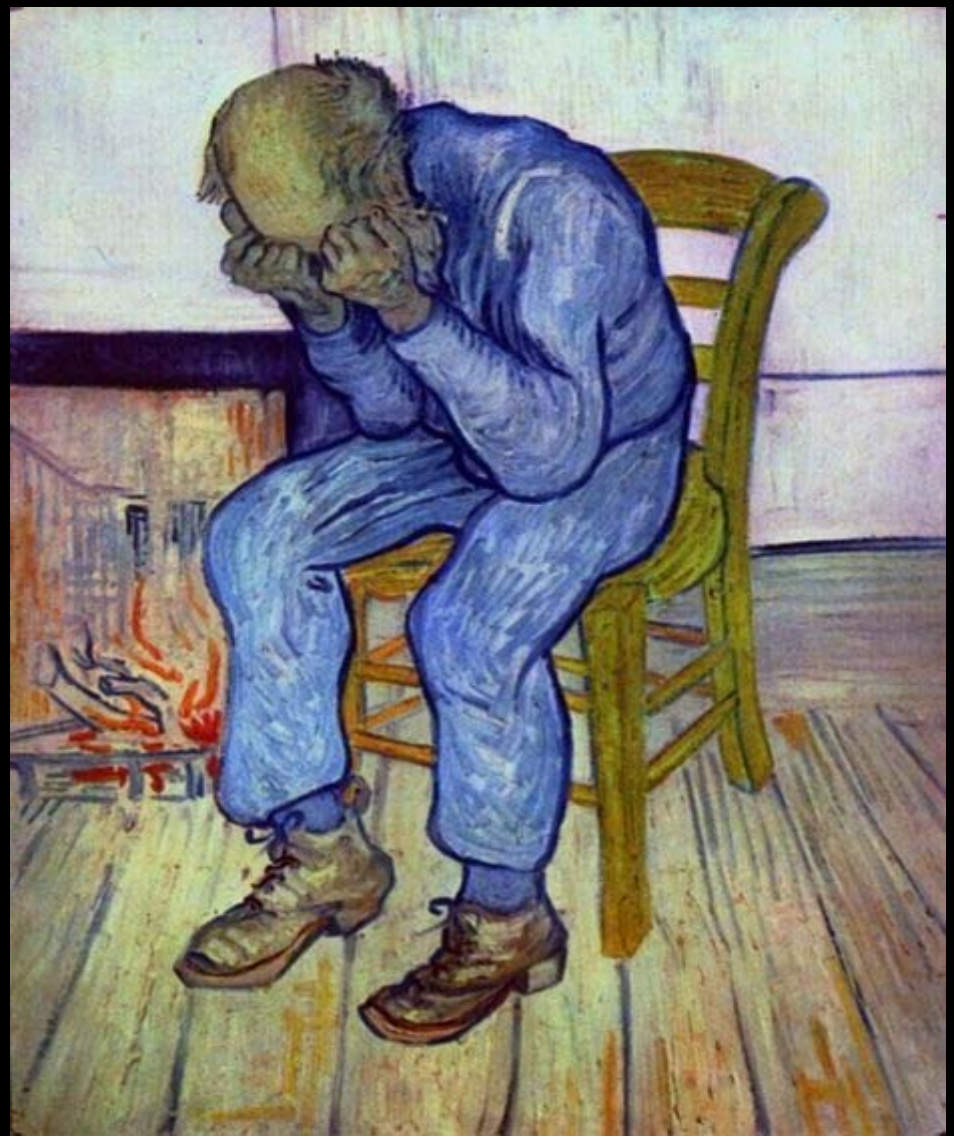
Recognizing the Importance of Psychological Consequences

Issues

- Psychological effects are dominant in Fukushima.
- They are health effects in their own right
- However, they are basically ignored in radiation protection recommendations and standards

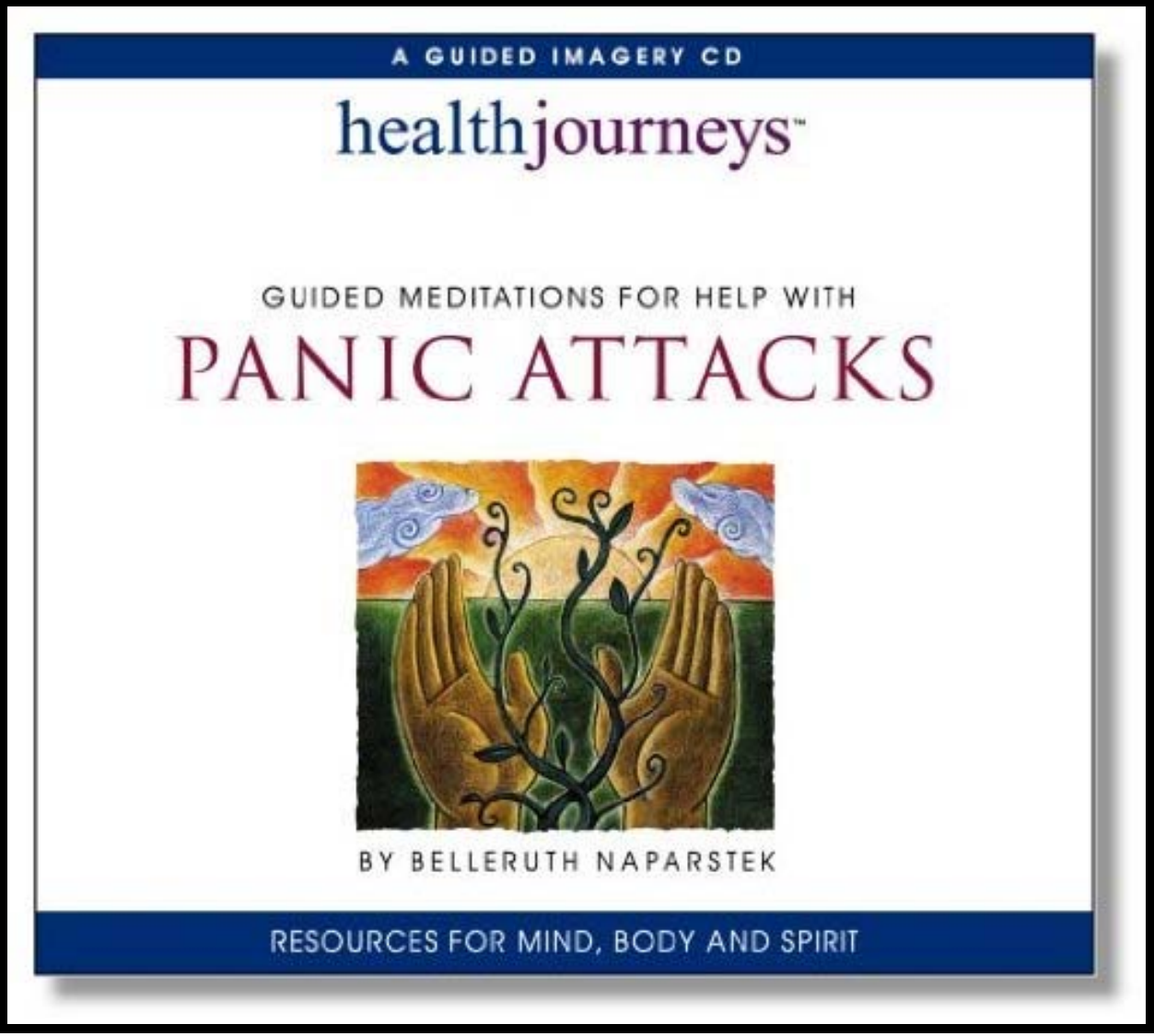
The psychological aftermath

Depression

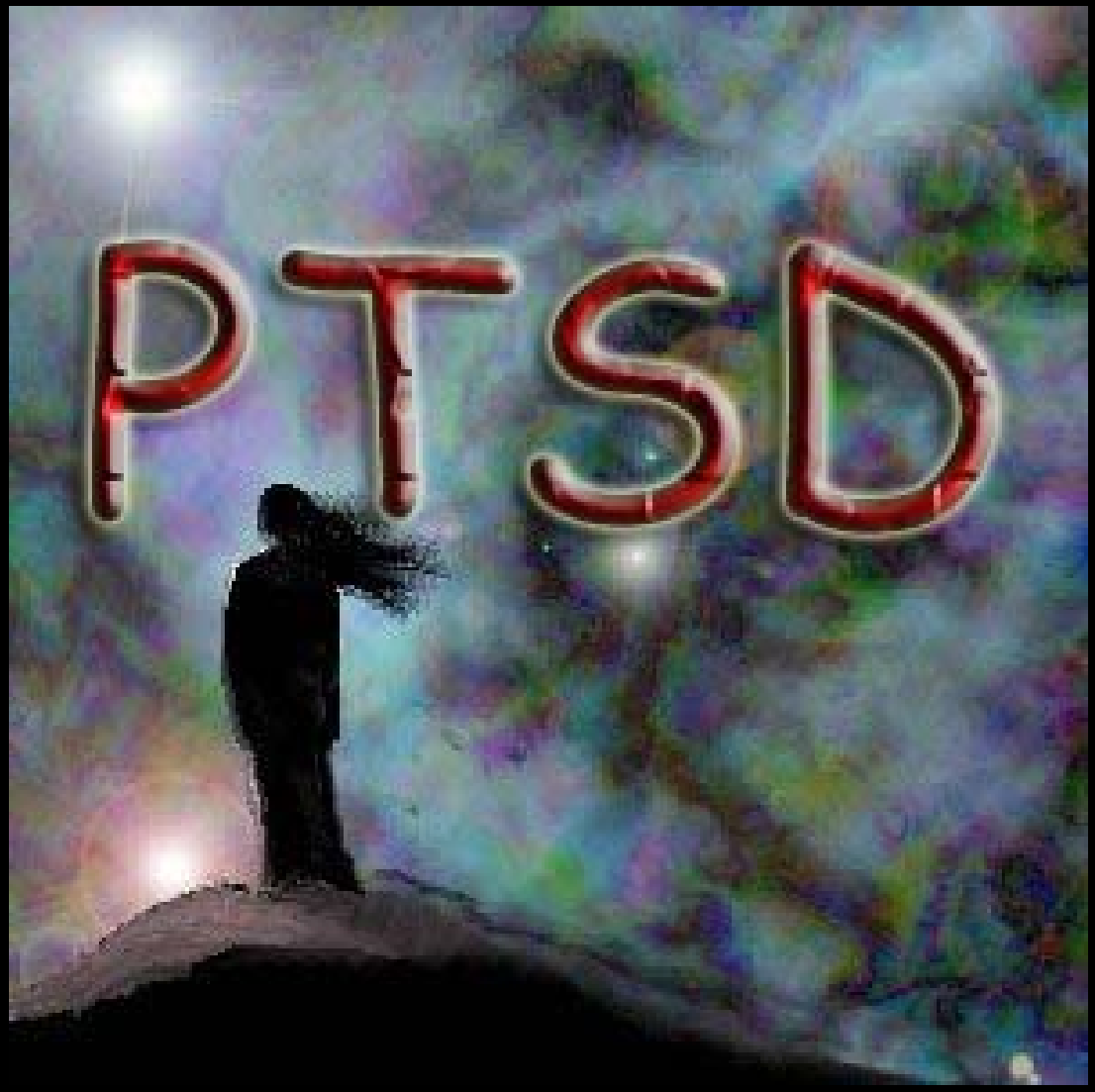


Grieving

Chronic anxiety



Post-traumatic Stress Disorder



Insomnia

Severe headaches

Smoking y alcoholism

Anger

Desperation

Parents' Anguish

Stigma

Stigma

HEALTH FEARS

Stigma

A mark of disgrace associated with being associated with a radiation- or radioactivity-related accident

- 汚名　: Polluted name
- 烙印　: Mark
- 恥　: Shame
- 不名誉　: Deshonor
- 不面目　: Humiliation
- 被差別 : Discrimination

Stigma is responsible for anxiety and psychological trauma on people

Example: Fears of sterility

School girls in Fukushima are stigmatized: they sincerely believe that will not be able to have a baby in future!)

Would we be able to have a baby?

18.

Fostering the Sharing of Information

Issues

- As it has happen in most previous accidents involving radiation exposure, the communication between the radiological protection experts and the authorities and between the authorities and the public at large has presented difficulties.

Epilogue

(10 commandments)

Many lessons can be extracted from the Fukushima accident experience.

We have the **ethical duty** of:

- learning from these lessons and
- resolving their challenges.

Before any another large accident occurs...

…it should be ensured that *inter alia*:

1. radiation risk coefficients of potential health effects be properly interpreted and the limitations of epidemiological studies for attributing radiation effects following low exposures be understood;
2. any confusions on protection quantities and units be resolved;
3. the potential hazard from the intake of radionuclides into the body be elucidated;
4. rescuers and volunteers be protected with an ad hoc system;
5. clear recommendations on crisis management and medical care and on recovery and rehabilitation be available;

Before any another large accident occurs...

…it should be ensured that *inter alia*:

6. recommendations on public protection levels (including infant, children and pregnant women and their expected offspring) and associated issues be consistent and understandable;
7. updated recommendations on public monitoring policy be available;
8. acceptable (or tolerable) 'contamination' levels be clearly stated and defined;
9. strategies for mitigating the serious psychological consequences arising from radiological accidents be sought; and, last but not least,
10. that failures in fostering information sharing on radiological protection policy after an accident be addressed with recommendations to minimize such communication lapses

…and humbly recognize our failures in communication

- Public communication of radiation protection policy after an accident is still an unsolved problem.

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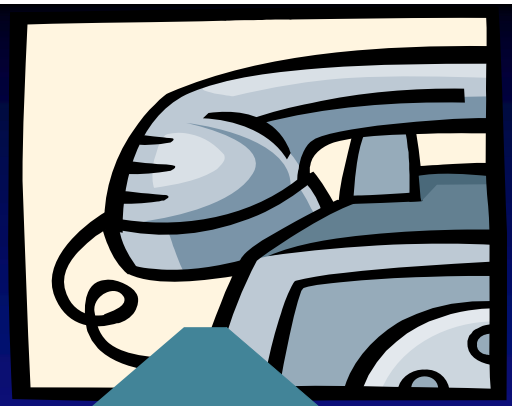
Buenos Aires
Argentina



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Thank you!

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