13th International Congress of the International Radiation Protection Association

Lessons and Challenges following the Fukushima Accident

SECC, Glasgow, Scotland, U.K.; Friday, May 18th, 2012

Fukushima:

Lessons being learned and radiation protection challenges for ICRP

Abel J. González

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

Member of the Commission of Safety Standards of the IAEA

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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)

Content

My personal view on lessons being learned on…

1. …Radiation Risks
2. …Quantities/Units
3. …Internal Exposure
4. …Occup. Protection
5. …Public Protection
6. …Psychological Effects
7. …Monitoring
8. …'*Contamination*'

1.

Lessons on Radiation Risks

Misunderstandings on risk coefficients

- On the one hand, it has been claimed that the actual risk of radiation exposure is much higher.
- On the other hand, risk coefficients intended for radiation protection purposes have been incorrectly used to attribute future hypothetical deaths to the accident, by simply multiplying their values by calculated collective doses in large populations.

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.[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.

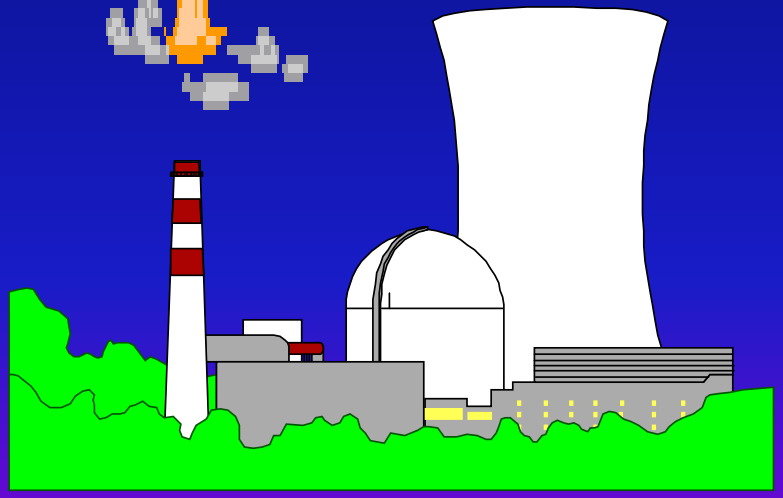
Mr. Large prepared a critical review of the preliminary report of the IAEA Fact Finding Mission undertaken to Fukushima Dai-ichi in May 2011. [LINK][LINK]

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



Discharge from Fukushima

Collective doses

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

Contact: Marshall Hoffman, USA
Office (703) 820-2244
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Melissa Fleming, IAEA, Vienna, Austria
Office (+43 1) 2600-21275
Mobile (+43) 699 165 21275

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.

theguardian

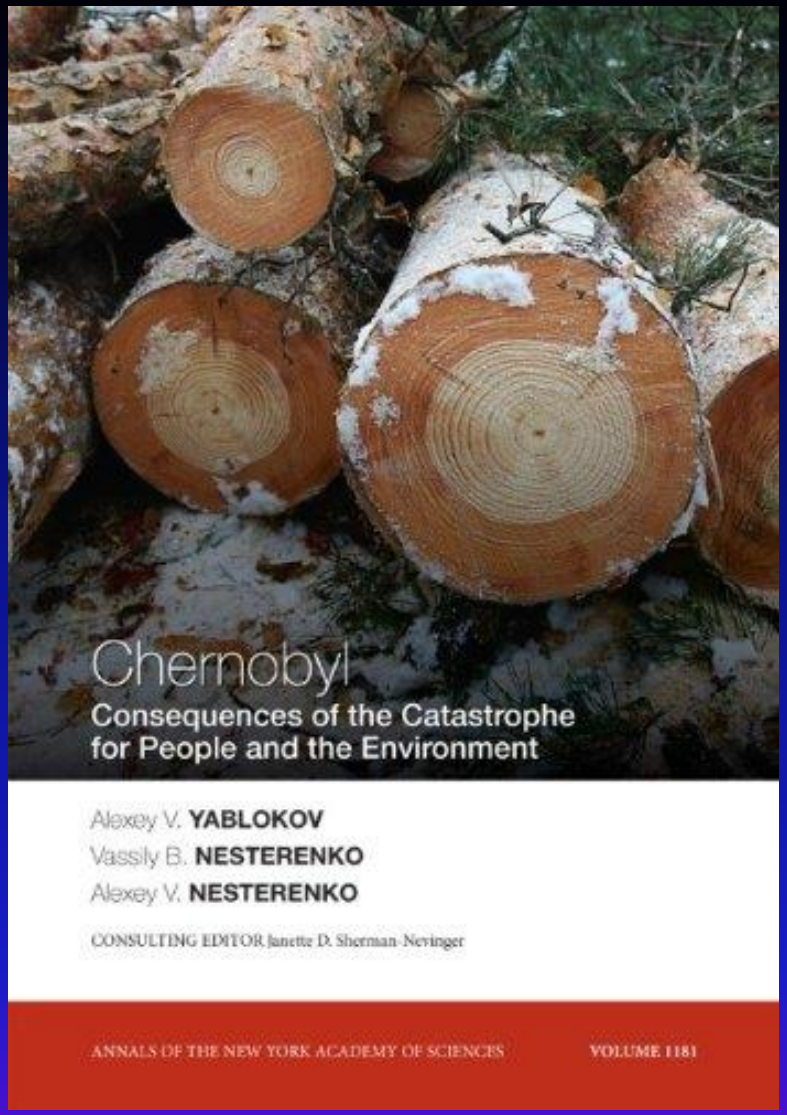
March 25, 2006 Saturday

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

Experts: This calculation cannot be done!

Stakeholder in Japan: Why not?

UNSCEAR: Next week

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

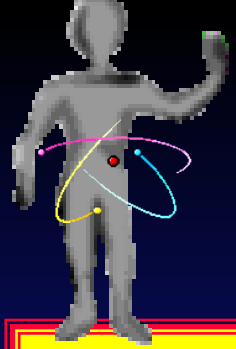
ATTRIBUTABILITY OF HEALTH EFFECTS TO RADIATION EXPOSURE

2.

Lessons on Quantities and Units

Bewilderment on Quantities and Units

- **Quantities and units used in radiation protection appear to be confusing and have jeopardized clear communication.**



Activity
(Bq, curies)

Fluence
(cm^{-2})

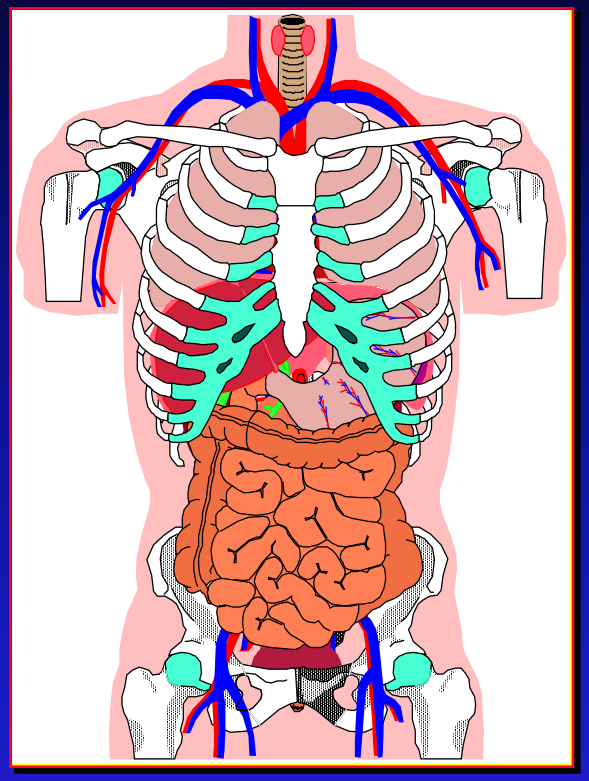
Absorbed
Dose
(Gy, rad)

W_R

Equivalent
Dose (organ)
(Sv, rem)

W_T

Efective
Dose
(Sv, rem)



Standards:
Equivalent Dose

Monitoring
Dose Equivalent

Confusion

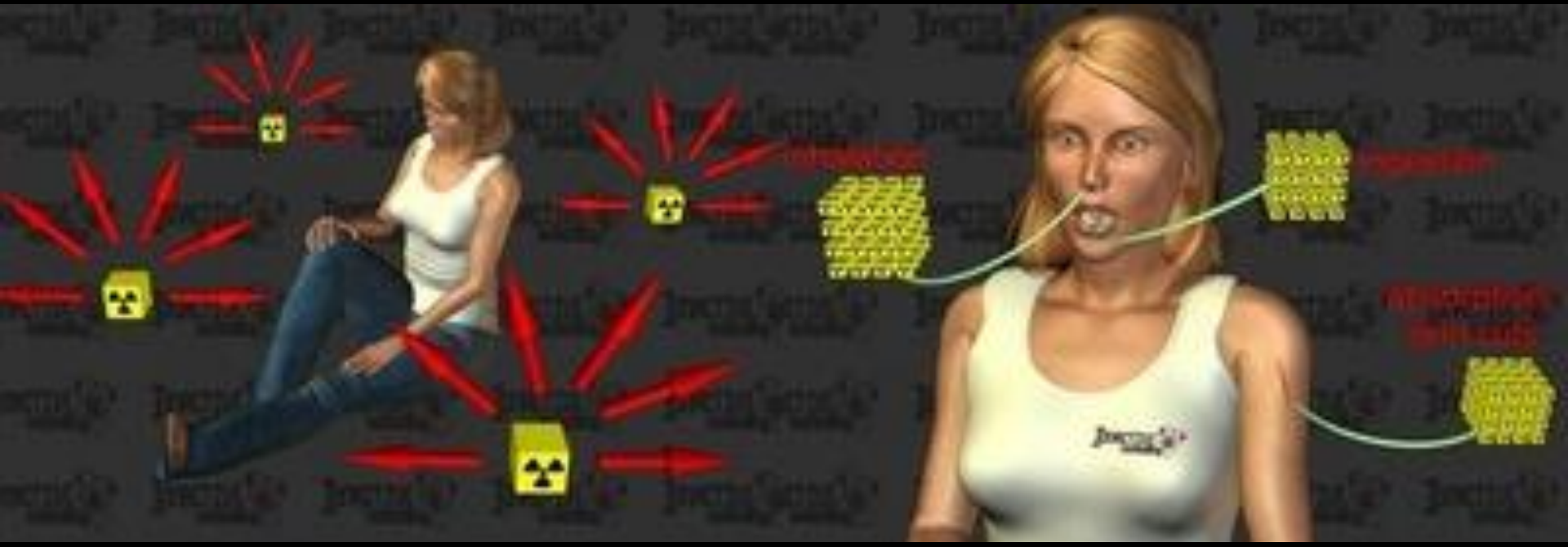
- The quantities ***equivalent dose*** and ***effective dose*** have a common unit, ***sievert***. (confusion in the reporting of thyroid doses).
- Further confusion between the use of the quantity ***equivalent dose*** (等価線量) for radiological protection purposes and the quantity ***dose equivalent***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

3.

Lessons on internal exposure

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.



UNSCEAR: Next week

United Nations
General Assembly
A/AC.82/R.690
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

4.

Lessons on Occupational Protection

Protection of rescuers and volunteers

- There is a lack of *ad hoc* international protection systems applicable to

  rescuers and volunteers.

- This complicates the regulation of the occupational doses of ‘nuclear’ workers.


REACTOR 2
GENERAL
=
?
Radiation Worker
Rescuer

Radiation Worker = ?

Volunteers

Occupational Dose Restrictions

mSv in a year

1000

500

100

50

20

Every effort not to exceed it

All reasonable efforts not to exceed it

Annual dose limit

Average dose limit

Optimization of Protection

EMERGENCY

NORMAL

Protection of rescuers and volunteers

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

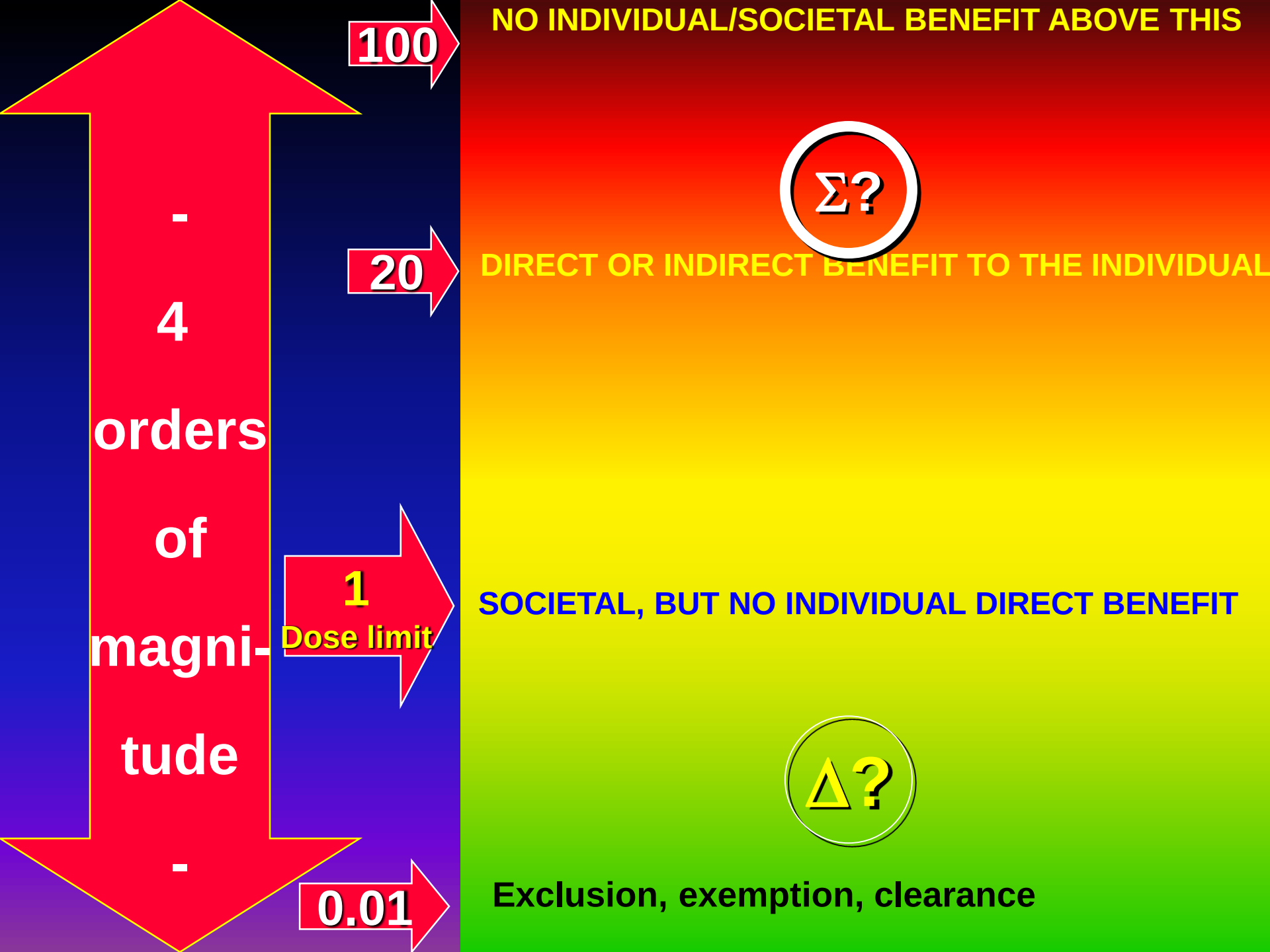
5.

Lessons on Public Protection

Justification of severe countermeasures, such as evacuation

Level of Doses

- The ICRP reference levels for the protection of the public were widely misunderstood by the public.
- As a result the public feeling is of being not well protected.


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.

Are Children Properly Protected?

Parents are particularly concerned with the protection of children

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

UNSCEAR: Next week

United Nations
General Assembly

A/AC.82/R.692
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

Pregnancy and hereditary effects

Importance of clarifying effects on pregnancy

6.

Lessons on Psychological Effects

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

The psychological aftermath

Common Symptoms after catastrophes

*Depression
*Grieving
*Post-traumatic stress disorder (PTSD)
*Chronic anxiety
*Sleep disturbance
*Severe headaches
*Increased smoking and heavy alcohol use

Plus:

*Anger
*Despair
*Long-term anxiety about health and health of children
*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

For many there is a social *stigma* associated with being an "exposed person"

Stigma is responsible for anxiety and psychological trauma on people

Sterility

(People sincerely believe that school girls in Fukushima will not be able to have a baby in future!)

Would we be able to have a baby?

Pregnancy

Should I terminate my pregnancy?

- Stigma is responsible for great apprehension among pregnant women and probably for unnecessary terminations of pregnancies.

7.
Lessons on Monitoring

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.

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

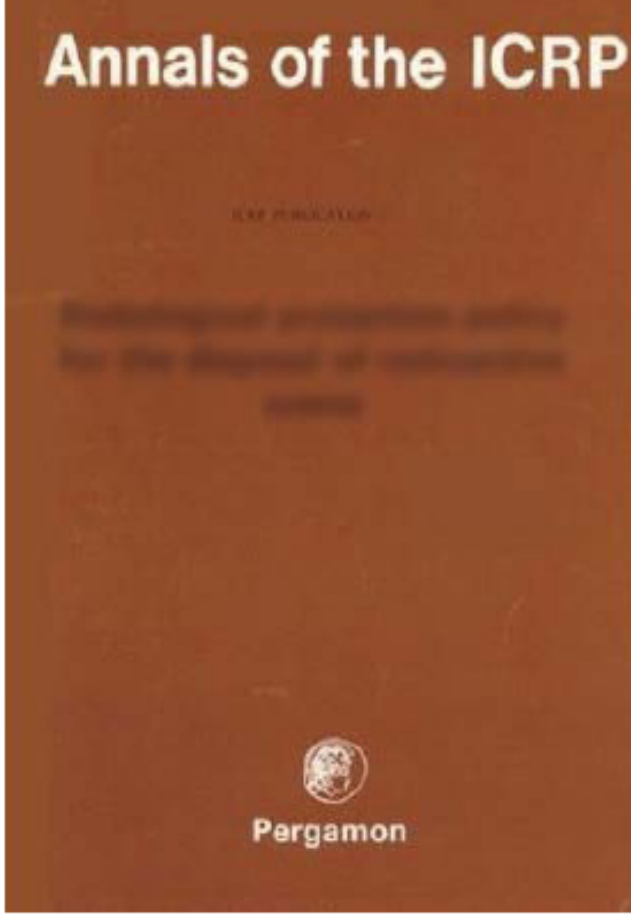
ICRP Publication 43

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).



8.

Lessons on '*Contamination*'

Mission impossible: Dealing with 'contamination'

- There are no clear quantitative standards to deal with "*contamination*"; e.g.:
  - remediation of "contaminated" territories;
  - disposing of "contaminated" debris and rubble;
  - 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

Annals of the ICRP

ICRP PUBLICATION 104

Scope of Radiological Protection Control Measures

Editor
J. VALENTIN

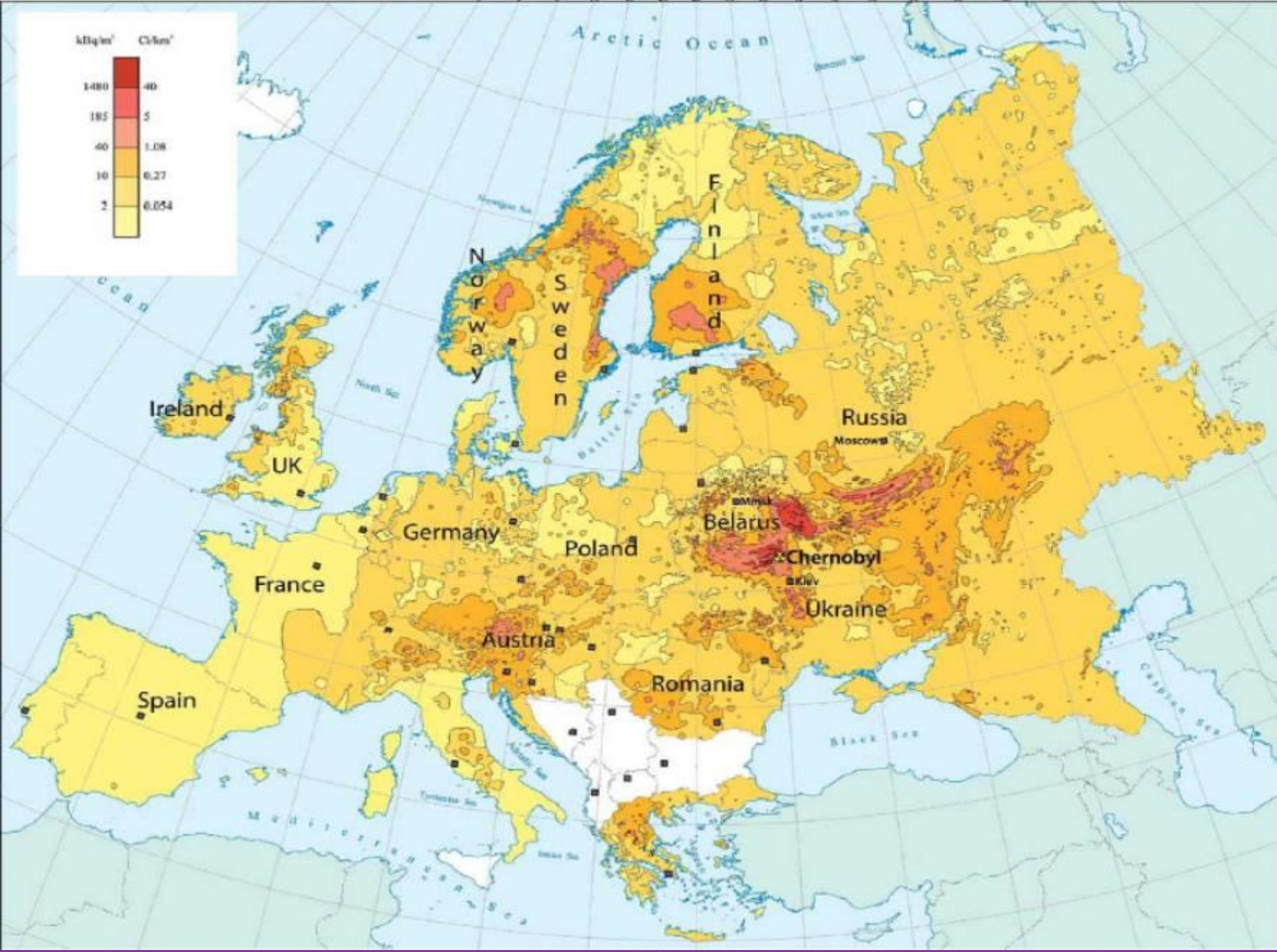
PUBLISHED FOR

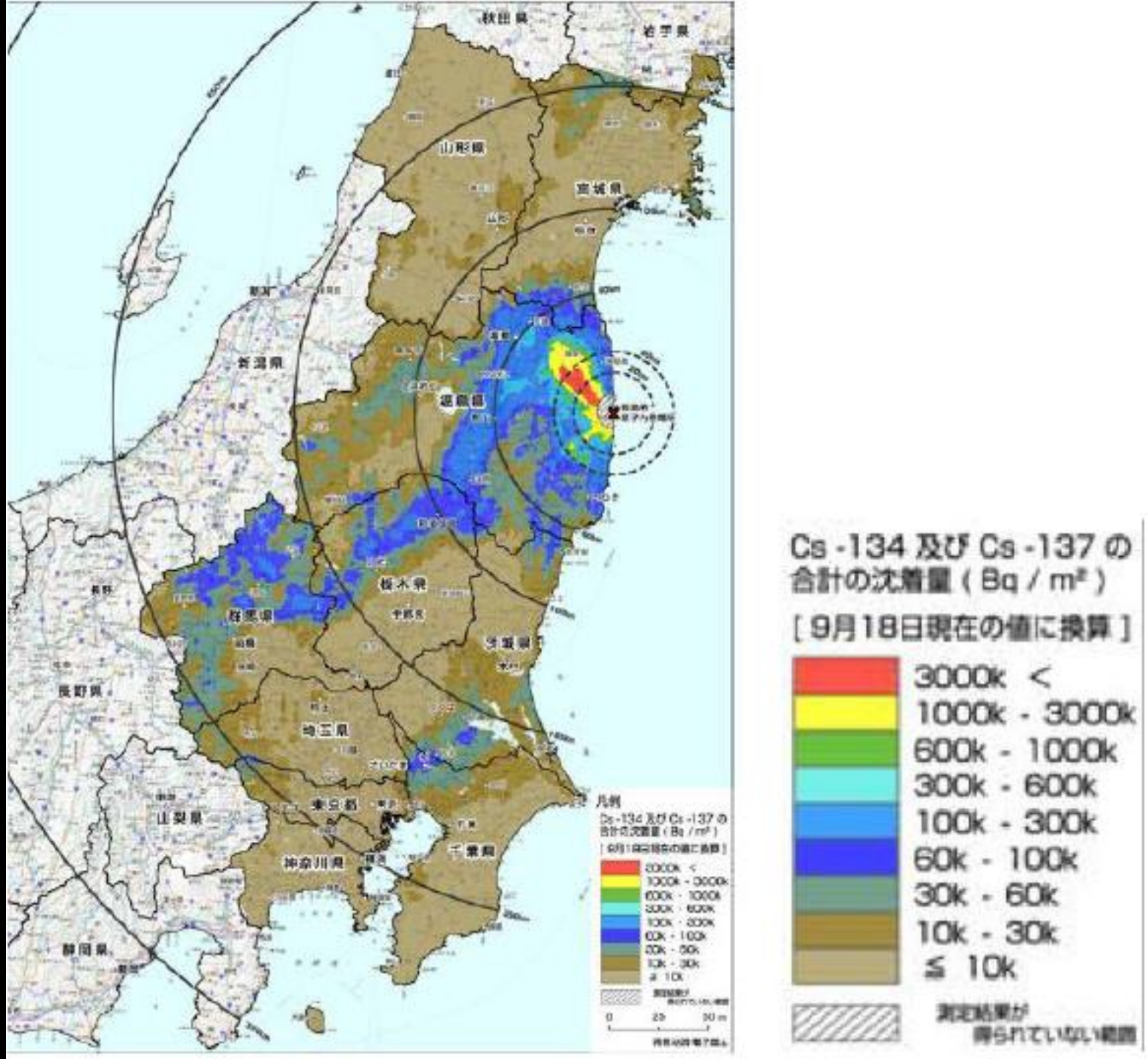
The International Commission on Radiological Protection

by

ELSEVIER

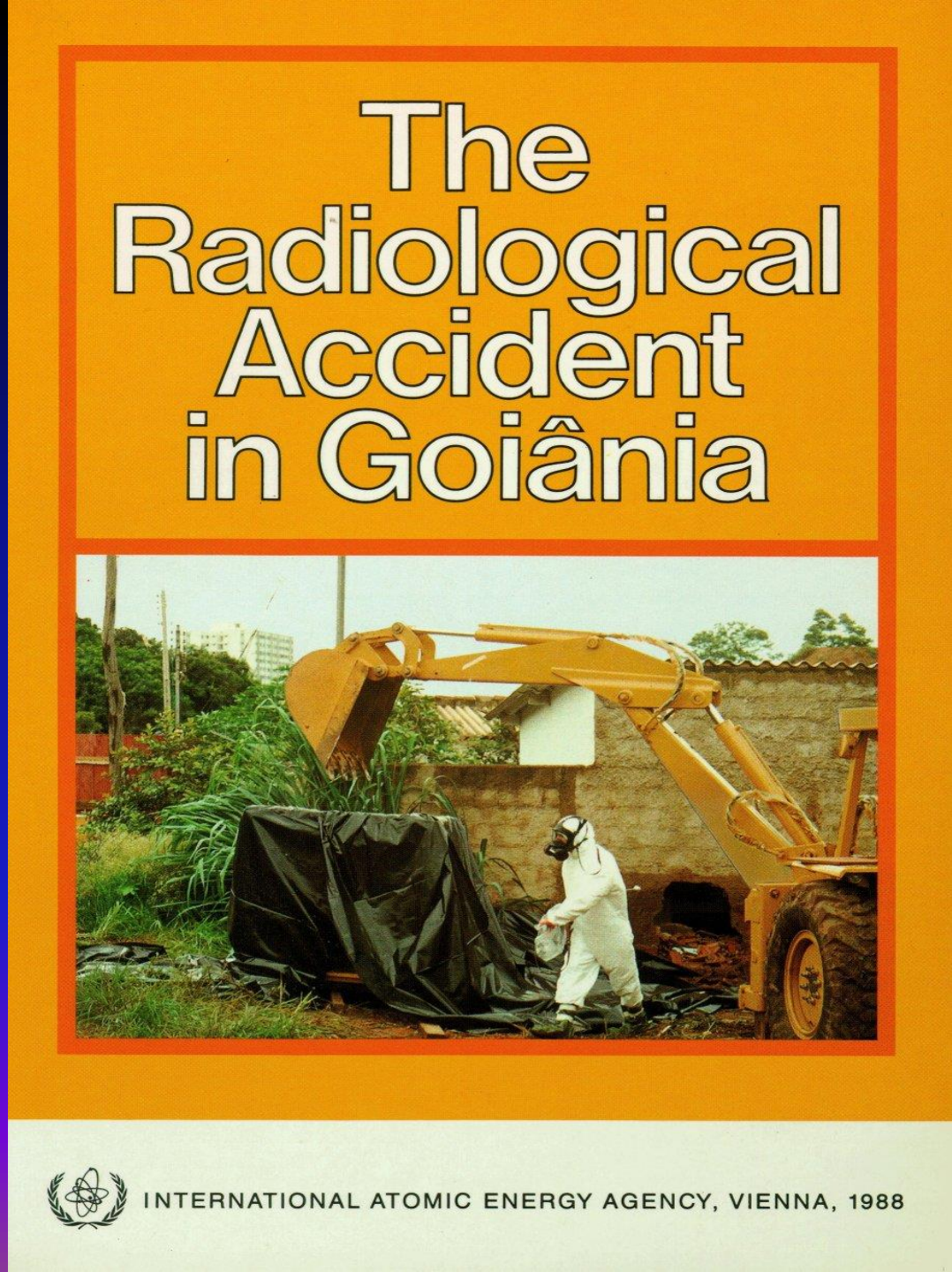
'Contaminated' Territories


kBq/m²
Ci/km²
1480
40
185
5
40
1.08
10
0.27
2
0.054
Arctic Ocean
Finland
Norway
Sweden
Ireland
UK
Germany
France
Poland
Belarus
Russia
Moscow
Chernobyl
Ukraine
Austria
Romania
Spain
Black Sea

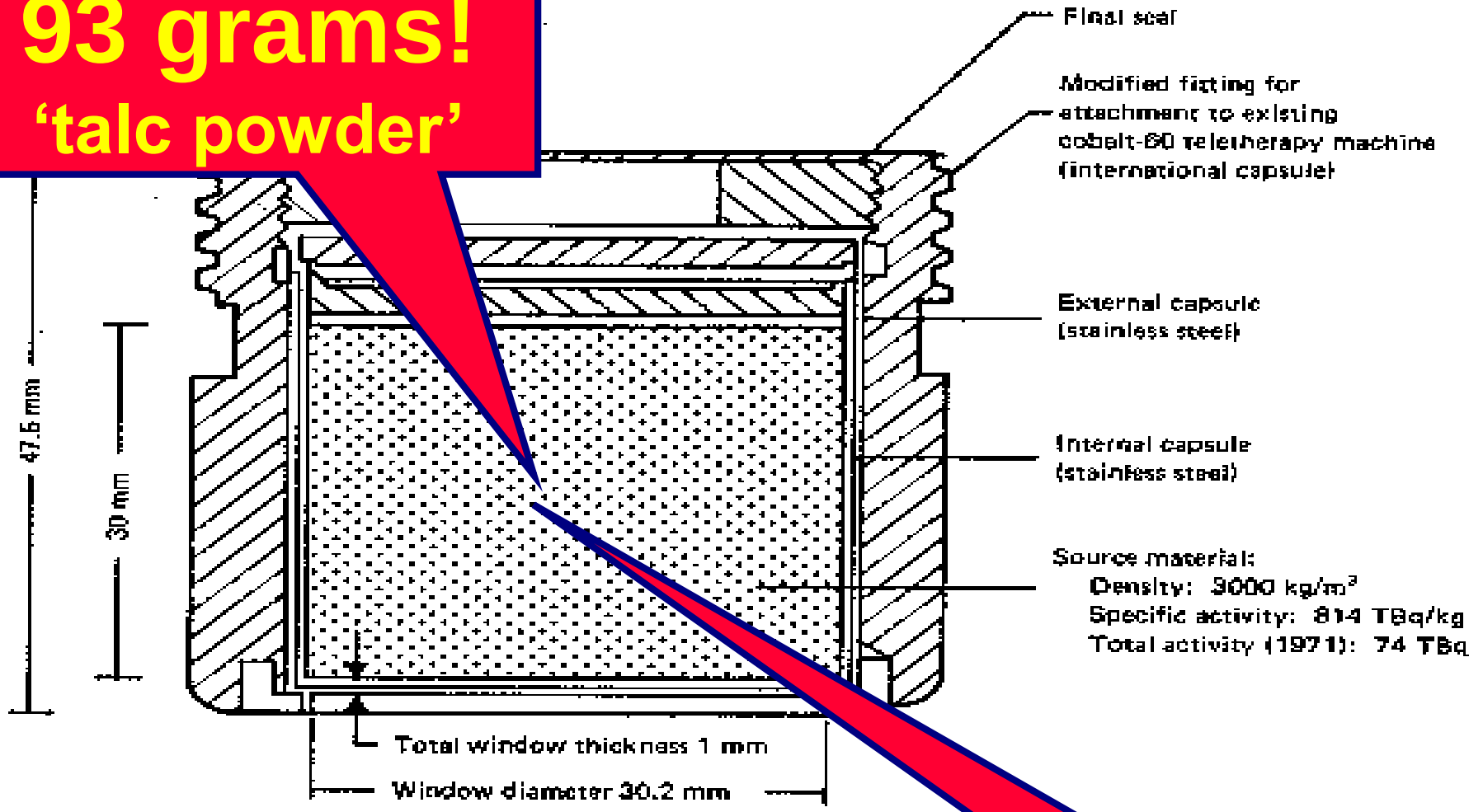

秋田県
岩手県
山形県
宮城県
新潟県
福島県
栃木県
茨城県
群馬県
長野県
埼玉県
東京都
千葉県
山梨県
神奈川県
静岡県
凡例
Cs -134 及び Cs -137 の
合計の沈着量 (Bq / m²)
[9月18日現在の値に換算]
3000k <
1000k - 3000k
600k - 1000k
300k - 600k
100k - 300k
60k - 100k
30k - 60k
10k - 30k
≦ 10k
測定結果が
得られていない範囲
0
25
50 km

‘*Contaminated*’ Rubble

Example


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

93 grams!
‘talc powder’



50mm (2’)

1375 Ci !!

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

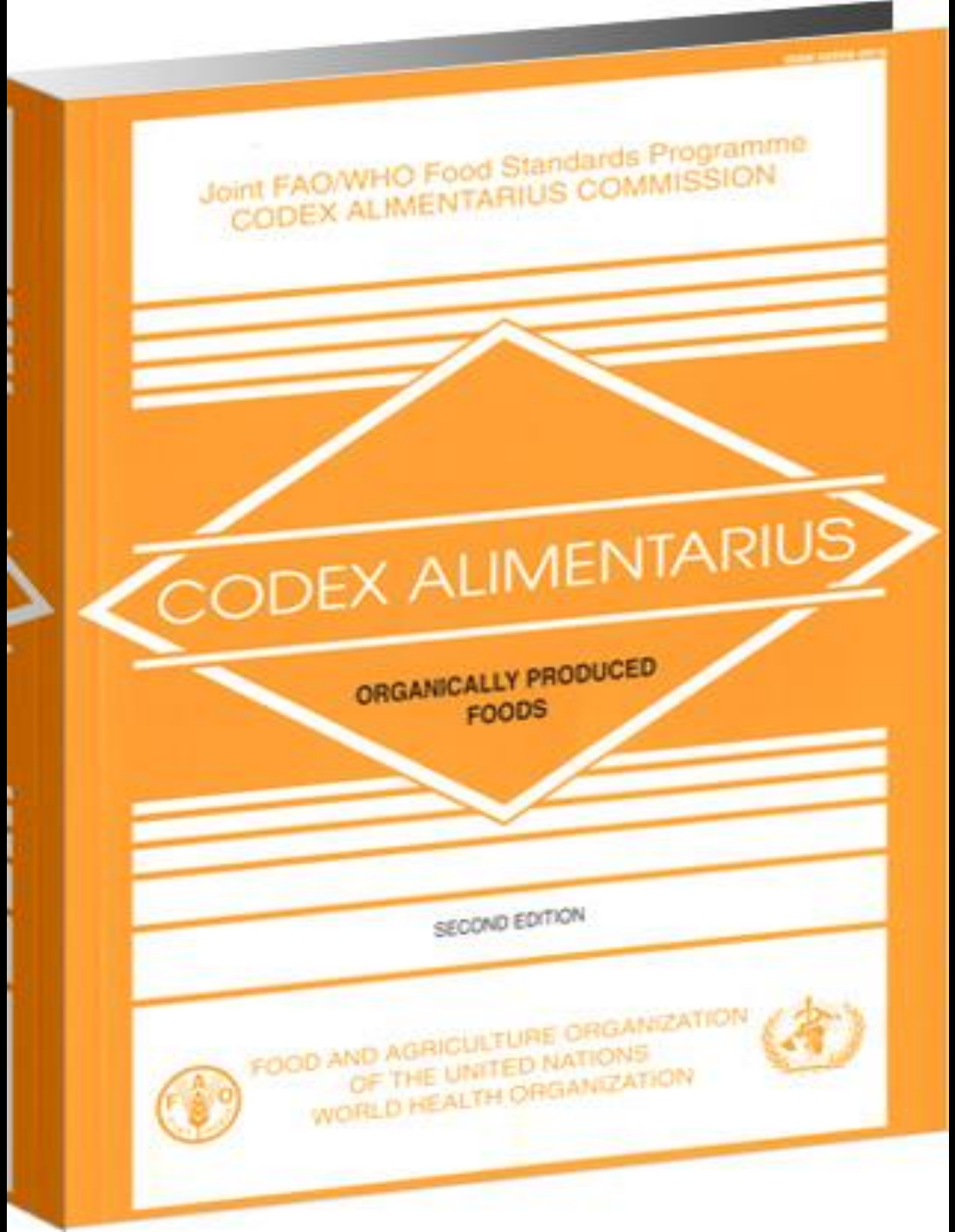
22. *Stacking waste containers to be taken to the temporary storage site.*

27. Waste containers at the temporary storage site.

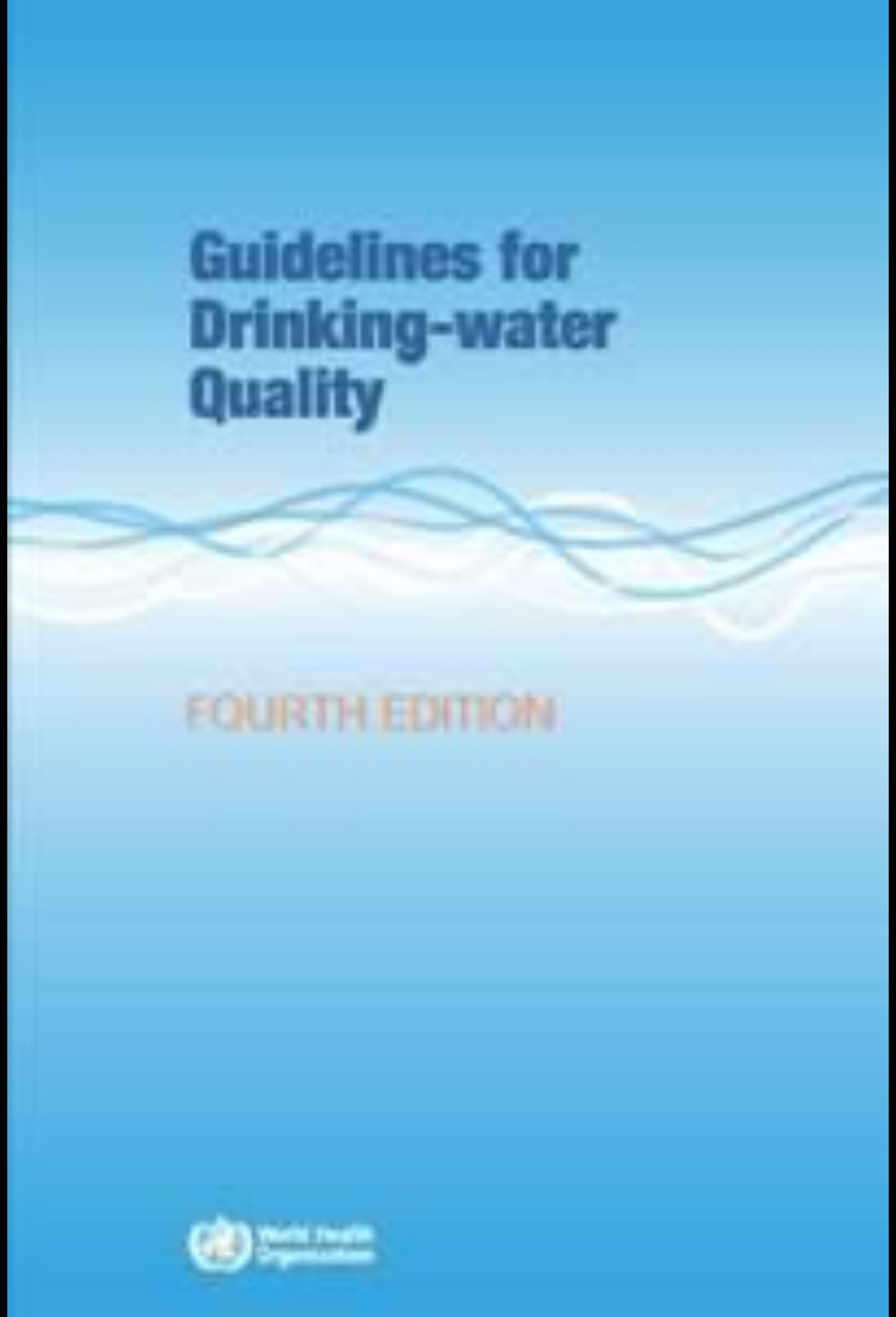
'Contaminated' Consumer Products

- 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

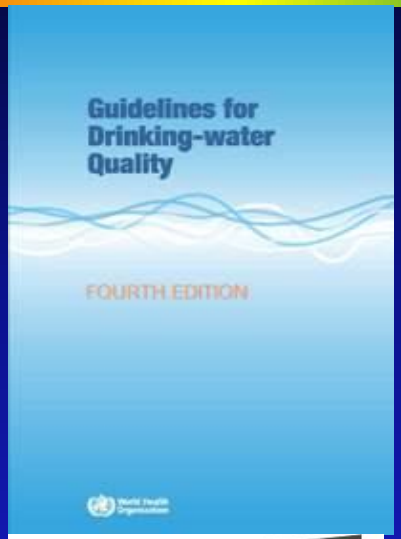
SAFETY GUIDE

No. RS-G-1.7

IAEA
International Atomic Energy Agency

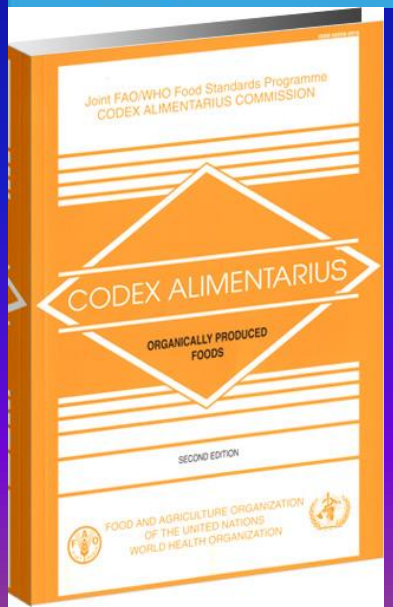
Incoherence in drinking liquids

+



= 10 Bq/l for ^{137}Cs

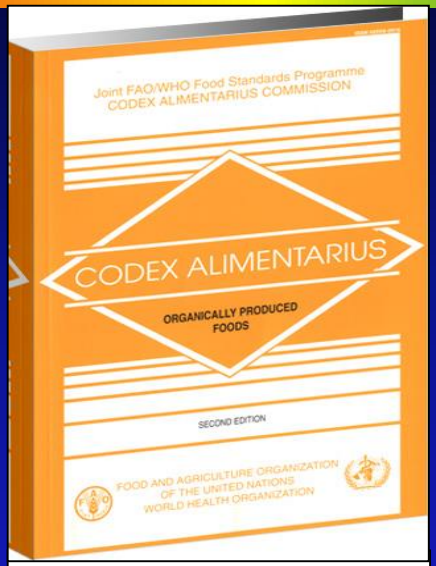
+



= 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)

Related News: Environment · Asia · Japan · Commodities · Health Care · Retail

Want to save this for later? Add it to your Queue!

Radioactive Cesium in Meiji Milk Spurs Recall

Q

By Kanoko Matsuyama and Yuriy Humber - Dec 6, 2011 8:32 AM GMT-0300

“Meiji Step”

powdered milk formulated for babies older than nine months

Epilogues

1. **Many lessons** can be extracted from the Fukushima accident experience.

2. We have the **ethical duty** of:

- learning from these lessons and
- resolving their challenges.

Before any another large accident occurs...

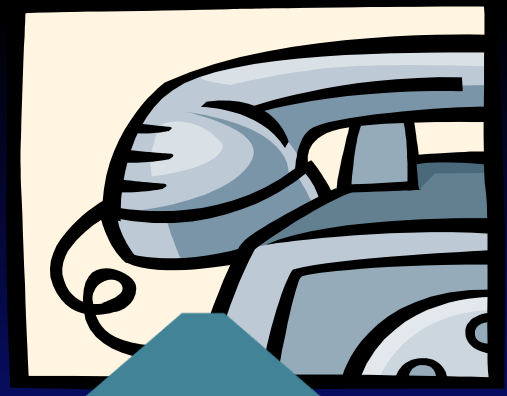
…we ought to ensure that:

- Risk coefficients are properly interpreted.
- Confusion on quantities and units is clarified.
- The hazard of internal exposure is elucidated.
- Rescuers and volunteers are protected with an *ad hoc* system.
- The protection level of the public and children is clear
- The psychological problems caused by radiation are faced
- The issue of what is contamination and what is not is resolved
- Clear recommendations on monitoring policy are available
- Radiation protection communication is improved

…and humbly recognize our failures in communication

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

Av. del Libertador 8250
Buenos Aires
Argentina



+541163231758

Thank you!

agonzalez@arn.gob.ar