

**Nuclear Energy Agency of the OECD  
Multinational Design Evaluation Programme (MDEP)  
MDEP Workshop on LW-SMMR  
Ankara, Türkiye 10-11 June 2024**

**Recycling Decommissioned Nuclear Installations:  
A Challenge for LW-SMMR**

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# **NEA Director-General William D. Magwood, IV.**



- **Recycling is a major radiation safety challenge for the sustainability of nuclear energy**

**Nuclear renaissance will require  
that the recycling issue be  
resolved.**

**No industry can progress without  
recycling.**

**There is an historical experience  
on this.**

# Dilemma

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**No nuclear recycling**



**No nuclear renaissance**

# Some historical hits of recycling

- Advocates as far back as Plato in the IV cent. BC
- In pre-industrial times, scrap bronze and other metals were collected and melted down for reuse
- Paper recycling was first recorded in 1031 when Japanese shops sold repulped paper
- In 1813, rags turned into "shoddy" and "mungo" wool, combined recycled fibers with virgin wool.
- in Sweden, refundable deposits established for bottles in 1884, for aluminum cans in 1982;

# **Nuclear Recycling**

**The process of  
converting residual materials  
resulting from the  
decommissioning of nuclear  
installations into  
new consumer goods**

# What is new?

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**Better expectation for the  
decommissioning of**

**Small Medium & Modular Reactors  
(SMRs)**

# Analysis



**SMMRs represent an innovative approach to nuclear energy, designed to offer enhanced safety, flexibility, and cost-effectiveness compared to traditional large-scale nuclear reactors.**

**As the deployment of SMMRs  
grows, understanding **the  
decommissioning process is  
crucial.****

**SMMRs are simpler!**

**SMMRs' decommissioning and  
recycling must be simpler!**

# Key aspects of SMR decommissioning

- regulatory frameworks,
- technical challenges,
- environment and
- economic implications

# Technical Challenges

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- **Dismantling Techniques**
- **Safety Measures**
- **CLEAR GLOBAL REGULATIONS  
FOR THE RECYCLED GOODS**

# Dismantling Techniques

- **The compact and integrated design of SMRs may require specialized dismantling techniques and equipment**
- **The modular nature, while advantageous during construction and operation, can pose difficulties during disassembly.**

# Environmental Considerations

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- **Site Restoration**
- **Biodiversity Protection**

# Economic Implications

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- **Cost Management**
- **Economic Opportunities**
- **Funding Mechanisms**



# Recycling Potential

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## Radioactive Goods (ТоварыТ-ovary)

- **Metals**
- **Concrete**
- **Specialized Equipment**

# Challenges and Considerations

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- **Regulation**
- **Technical Complexity**
- **Public Perception**
- **Long-Term Management**

# Challenges of recycling materials containing radioactivity

- **Technical Challenges**
  - **Detection and Segregation**
  - **Decontamination**
  - **Regulatory challenges**
    - **Regulations controlling recycling goods**
    - **Accidents**
- **Environmental Challenges**
- **Logistical Challenges**
- **Economic Considerations**

**The key challenge for regulating  
recycled goods from SMMR:**

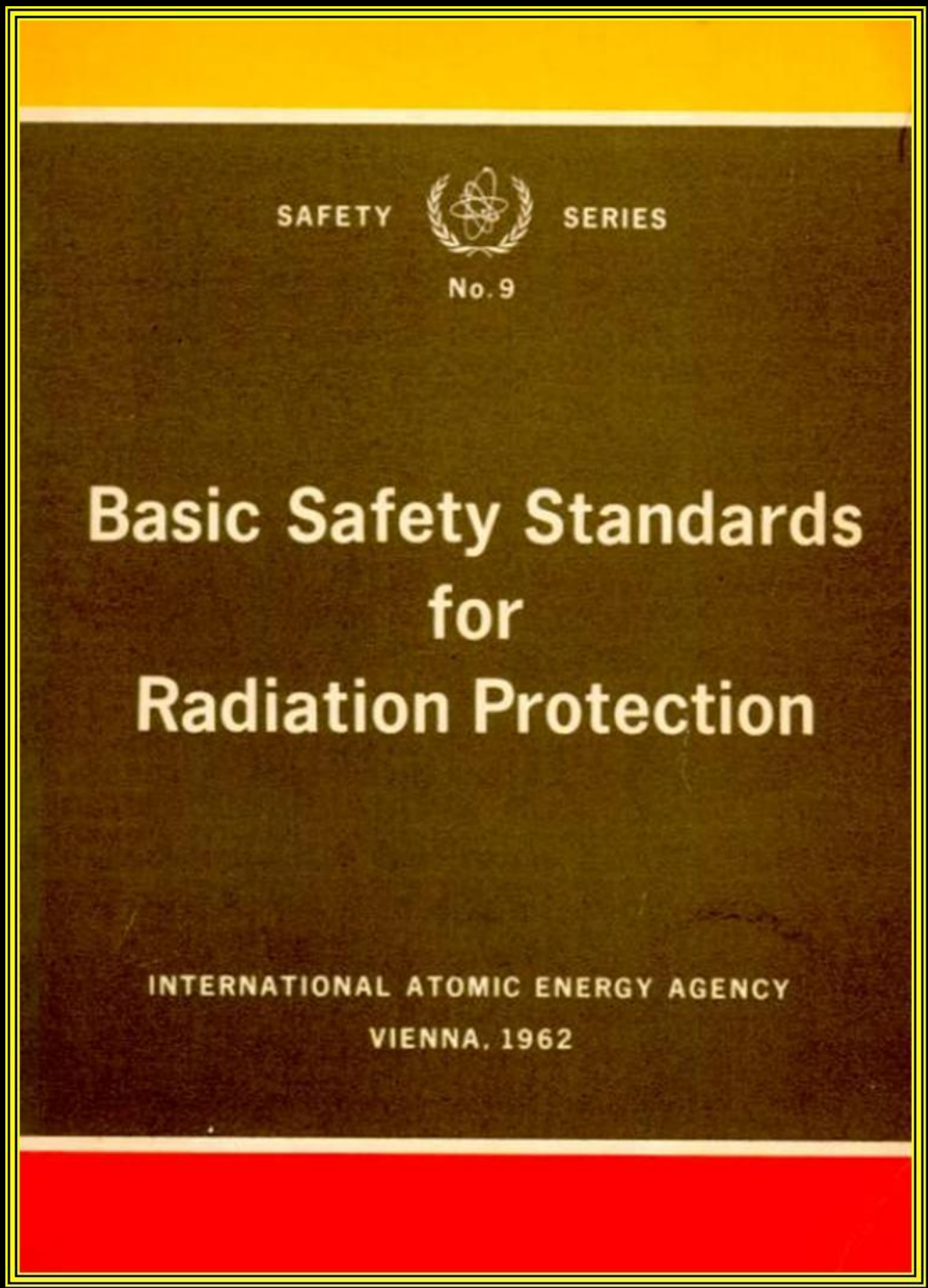
**A clear SCOPE for the international  
radiation protection regulations**

**The regulatory scope,**

**namely the extent to which  
regulatory actions are relevant,**

**has not been a major concern for the  
radiation protection profession and  
it is essential for recycling.**

**This was not  
always the case:  
the first radiation  
protection  
standards defined  
the regulatory  
scope very clear.**



**There are specific  
ICRP  
recommendations,  
but they are not  
implemented**

Volume 37 No. 5 2007

ISSN 0146-6453  
ISBN 978-0-7020-3101-4

# ICRP

## Annals of the ICRP

ICRP Publication 104

**Scope of Radiological  
Protection  
Control Measures.**

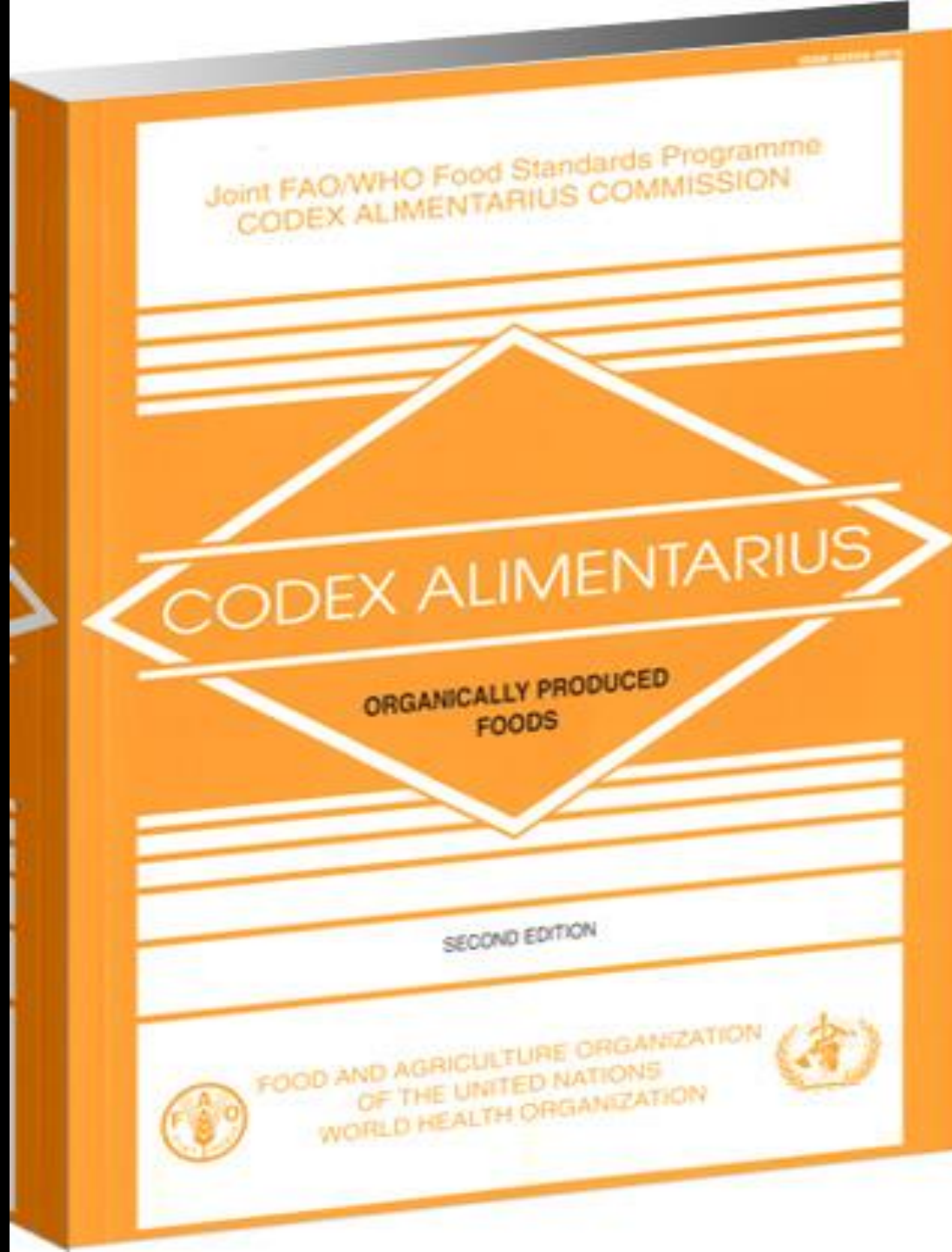


**Current situation**



- **Their regulatory control of radioactivity in consumer goods is not straightforward**
- **Some international intergovernmental agreements exist but they are incoherent and inconsistent.**

**Foodstuff**



# **Guidelines for Drinking-water Quality**



**FOURTH EDITION**

IAEA  
SAFETY  
STANDARDS  
SERIES

Application of the  
Concepts of Exclusion,  
Exemption and  
Clearance

SAFETY GUIDE

No. RS-G-1.7



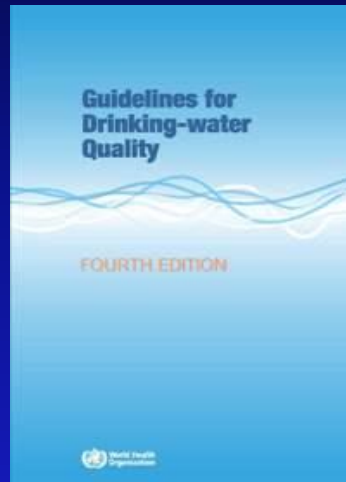
**IAEA**

International Atomic Energy Agency

# Incoherence in drinking liquids



+



= 10 Bq L<sup>-1</sup> for <sup>137</sup>Cs

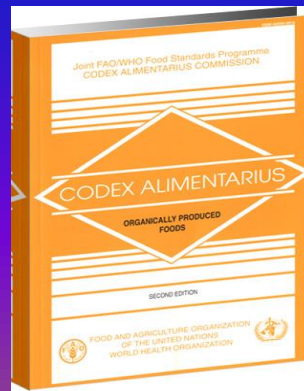


+

= ∞ Bq L<sup>-1</sup>



+

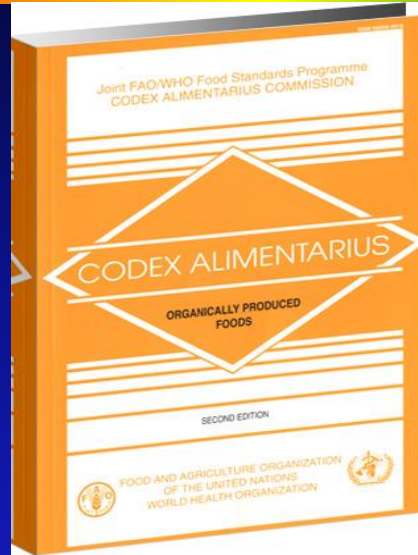


= 1000 Bq L<sup>-1</sup> for <sup>137</sup>Cs

# Incoherence in non-edible vs. edible



+



= 1000 Bq kg<sup>-1</sup> for <sup>137</sup>Cs

<http://funini.com>

月宫殿 (日本)  
Moon Palace Rice Paper (Made in Japan)



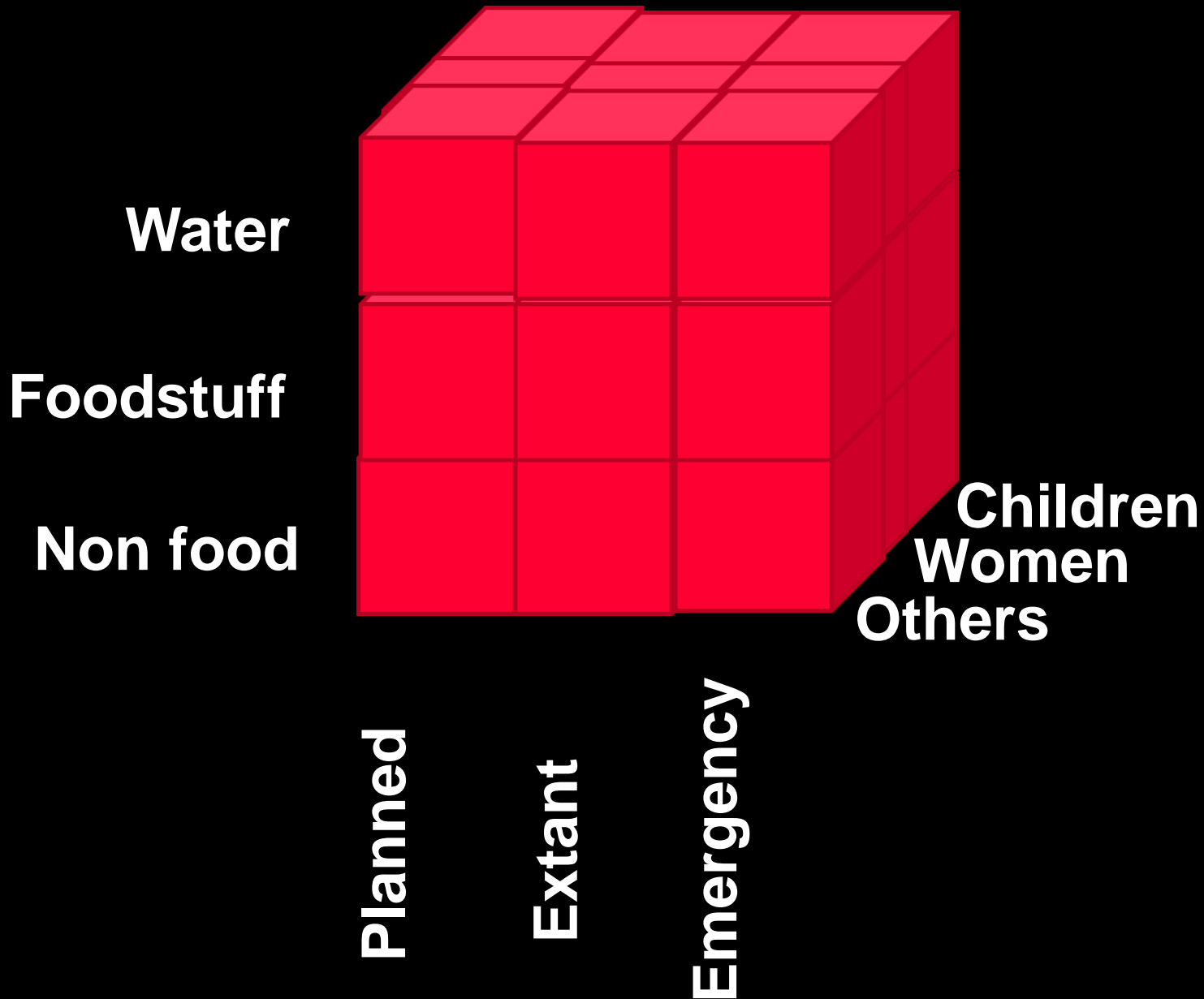
+



= 100 Bq kg<sup>-1</sup> for <sup>137</sup>Cs

[ChineseCultureOnline.com](http://ChineseCultureOnline.com)

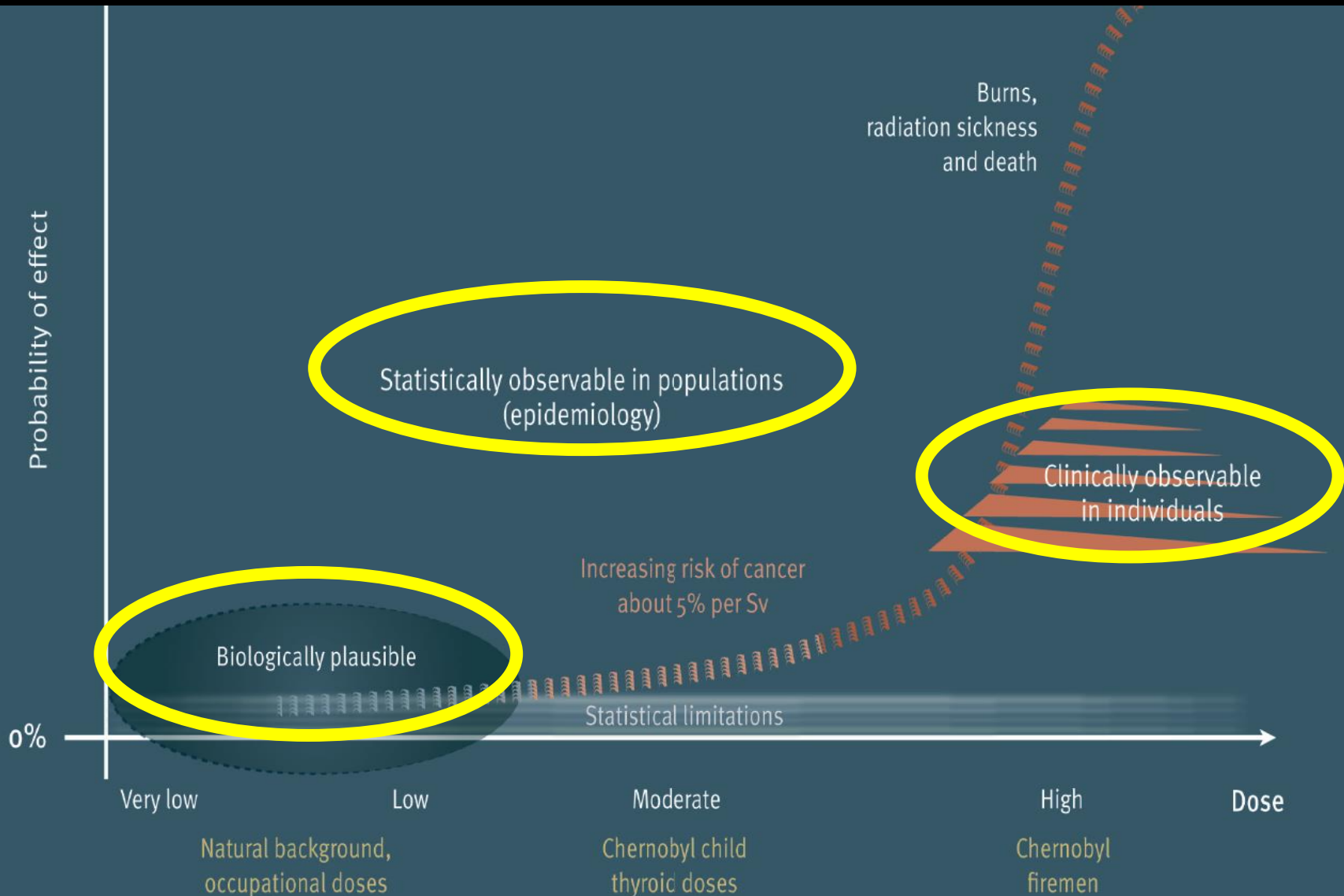
# Rubik cube of consumer goods regulation



**Scope is usually defined**  
**without taking full account of**  
**the epistemological constraints**  
**of our basic knowledge**



# Regulators have been ignoring a clear warning from UNSCEAR: The distinction between effects: clinically observable, statistically observable and biologically plausible



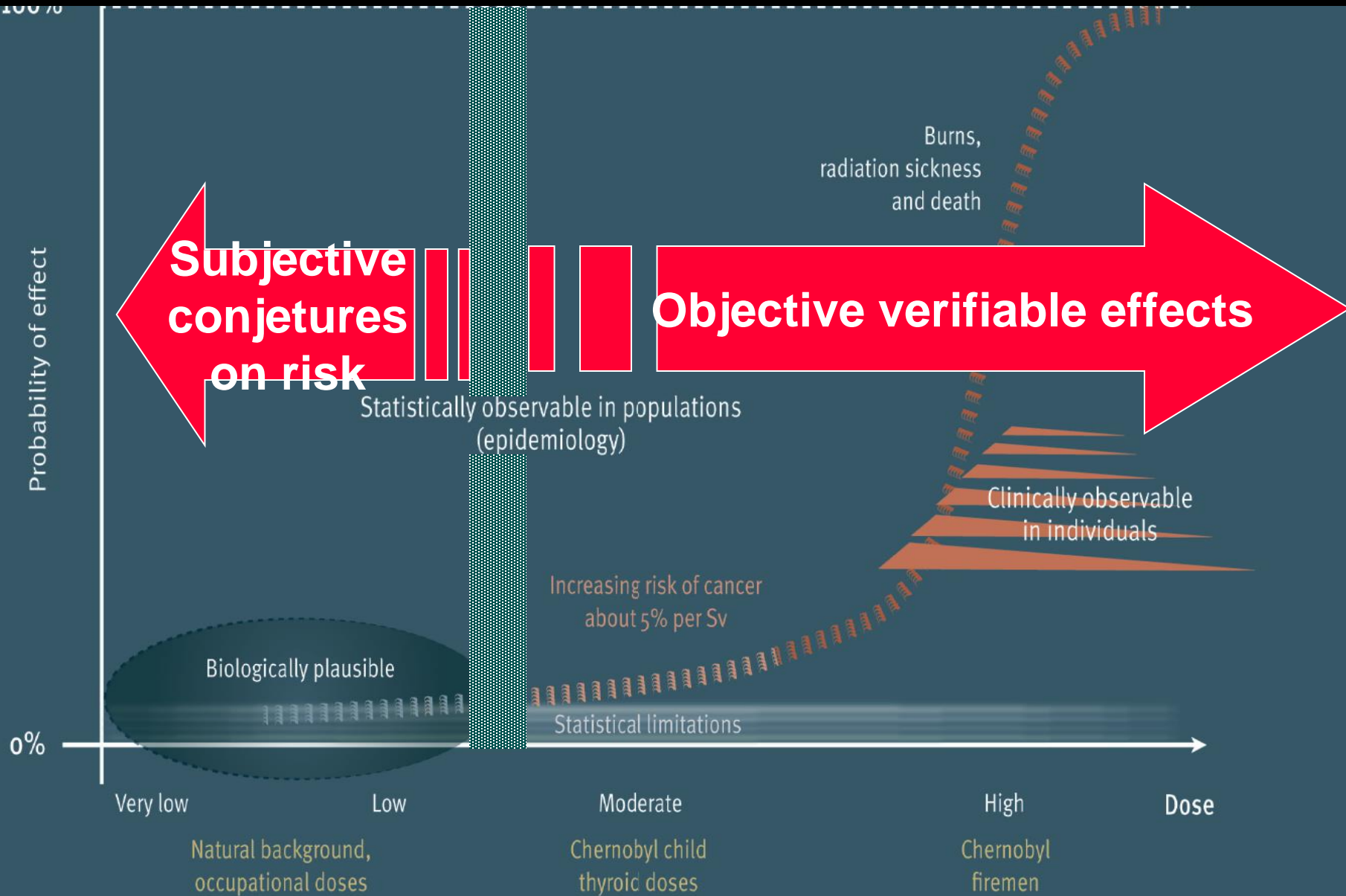
**...and its epistemological  
consequence...**

**objective verifiable health effects**

***vis-à-vis***

**subjective conjectures on risks**

# Scope do not distinguish objective verifiable health effects from subjective conjectures on risks



# Quantities

- **Consumer goods are usually regulated on the basis of the so-called ‘protection quantities’, such as equivalent and effective dose, which are not real quantities.**
- **Rarely we use, as a basis, (real) quantities, such as activity in the good.**

**Some basic questions shall  
be answered as SMMR are  
deployed**

# Should regulations differentiate between goods that...

- ...contain radionuclides that
  - ✓ are **artificial** versus those **natural**?
  - ✓ are **added** by SMMRs or incorporated due to **natural environmental processes**;
- ...are **consumed** and those that are **used**;
- ...are considered **edible** and those which are not?
- ...are consumed or used by a given **sex** or **age**?
- ...incorporate radionuclides from **diverse** initial **exposure situations**?

**Suggestion for going forward  
and respond to the needs of a  
recycling policy for SMMRs**

**A discussion document**

**jointly prepared by**

**the Autoridad Regulatoria Nuclear (ARN) of**

**Argentina**

**and**

**the International Atomic Energy Agency**

**is presented for consideration**



**Radioactivity in Goods Supplied for Public  
Consumption or Use:**

**Towards an Internationally Harmonized Regulatory  
Framework**

A discussion document prepared jointly by the  
Autoridad Regulatoria Nuclear (ARN) of Argentina  
and the  
International Atomic Energy Agency

**The propossal from Argentina is  
freely available at**

**[https://www.iaea.org/sites/default/files/19/02/iaea-arn\\_document\\_on\\_consumer\\_goods.pdf](https://www.iaea.org/sites/default/files/19/02/iaea-arn_document_on_consumer_goods.pdf)**

# CONTENT

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- 1. Background**
- 2. Semantics and terminology**
- 3. Quantities**
- 4. Exposure situations**
- 5. Views from States**
- 6. Recommendations**
- 7. Epilogue**

# A long saga

- For nearly half a century the international community has been requesting to the radiation protection professionals a simple answer to a simple question:

**What are the radioactivity levels in consumer goods that made them unsuitable for consumption and use?**

# Analysis

Many diverse detailed examination were made of the elements of regulating consumer products separating them into its constituent elements!

- **Water**
- **Goods, including metals**
- **Food**
- **Non-food products**
- **etc**

# Synthesis

But, an international agreement combining those analysed components to form a simple, connected, coherent, and consistent whole, namely, a

**synthesis**

on how to regulate the consumer goods that will result from recycling SMMRs

**has been elusive.**

# Purpose

**Suggesting a synthetic simple approach for the regulatory control of radioactivity in goods supplied for public consumption and use, which will result, inter alia, from the decommissioning and recycling of SMMRs.**

# The proposed way forward

1. Clarifying the basic concepts, including that of '*consumer goods*'.
2. Revising the basic control *quantity*.
3. Homogenizing the *exposure situations*.
4. Converging the current multiple approaches into a *simple criterion*



# **Semantics and terminology**

# Words that might confuse

- **Commodities**
- **Consumer products**
- **Consumer goods**
- **Planned situations**
- **Emergency situations**
- **Existing situations**
- **Extant situations**
- **Drinking water**
- **Bottled water**
- **Mineral water**
- **Foodstuff**
- **Non food products**
- **Contamination**

# Commodities

- **Common parlance:** A raw material or primary agricultural product that can be bought and sold
- **ICRP/IAEA definition:** Commodities are products generally used or consumed by the public that can contain radioactive substances.
- **It is an untranslatable term - 'basic product'?**

# Our proposal

- To use for our generic definition

## consumer goods

- i.e., **any article or substance**, supplied for public consumption or use, **which may be the result of recycling**, and is **manufactured or refined or produced during a natural, chemical, or manufacturing process**, including, **merchandises materials, goods and articles**, which are **consumed or used by the public at large**.

**How the consumer  
goods have been  
(artificially) divided**

# Water

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Is '*drinking water*' water pure enough for drinking?

Why then *bottled water* and *mineral water* were treated separately of drinking water?

# The meaning of 'water'

(different regulations for various 'waters')

- **Drinking (?) water** (translated as 'potable' water)
- **Packaged drinking waters**  
(packed waters other than natural mineral waters, which may contain minerals, naturally occurring or intentionally added, and carbon dioxide, naturally occurring or intentionally added, but shall not contain sugars, sweeteners, flavourings or other foodstuffs)
- **Natural Mineral Waters**
  - naturally carbonated natural mineral water;
  - non-carbonated natural mineral water;
  - decarbonated natural mineral water;
  - natural mineral water fortified with carbon dioxide from the source;  
or
  - carbonated natural mineral water.

# Foodstuff

- Is **food** any consumer good that be **edible**?...namely... fit to be ingestible?
- But **edibility** is a cultural issue, its definition changes among nations.



# The meaning of 'edible'

- Does food include **drinks**?
- Is **water** as edible as food?....and, if so....
- ...why food and water are regulated differently?
- Should edibles that people eat for **pleasure or vice** (nor for nutrition) be out from food regulation?
- Understanding food has **cultural connotations**; substances that are edible in some cultures are considered inedible in others.

# We shall prohibit the use of the word *Contamination*

Formally it means:

- the *presence* of radioactive substances on surfaces, or within solids, liquids or gases (including the human body), or
- the *process* giving rise to such *presence*.

It has a connotation that is not intended

(it gives no indication of the magnitude of the hazard involved)

# However, *contamination* ...

- has a religious origin linked to sin
- conveys the idea of danger.
- causes public concern, as people perceive it as a binary situation, namely
  - either there is contamination, and some danger, or
  - there is not.

(The concept of 'low levels of contamination' is incomprehensible for many people)

**These undertones cause anxiety to people and confusion to the authorities when dealing with or discussing recycling.**

**The use of the term contamination shall**  
**be prohibited!**

# Quantities

**The temptation of basing the  
regulation of recycled  
materials on dose**

**Is it reasonable to use the RP  
system's dosimetric approach for  
the regulatory control of the  
consumer goods resulting from  
recycling?**

# **Bequerels per unit mass**

**are factual, measurable and traceable,  
and comparable to natural radioactivity!**

**They can be regulated!**

# **$\mu\text{Sv}$ per year**

**are conjectural, neither measurable  
nor traceable**

**They cannot be regulated**



# **Exposure situations**

# Radionuclides in consumer goods could

- already be present in the environment and from there reach the goods (existing situation and extant situation), or
- be there due to an authorized discharge from a regulated activity (planned situation), or
- be the result of a non-anticipated situation (emergency situation).

**Currently, these situations are subject to different regulatory approaches!**

**Radioactivity in consumer goods does not fall neatly into one of the exposure situations**

**Consumers and users of consumer goods are not interested in the exposure situation that originated the presence of radioactivity but on whether the product is safe to be consumed or used!**

Therefore, the categorization into  
**planned, emergency and existing**  
exposure situations does not fit into the concept  
of **controlling consumer goods.**

**It is suggested that this categorization should  
not be used when considering controlling  
consumer goods resulting from recycling  
SMMRs!**

# Epilogue

**1. We expected that the suggestions in this presentation will be helpful for clarifying issues related to the recycling of decommissioned materials from SMMRs, with a focus on the required control of radioactivity in consumer goods.**

**2. Until now, these issues have not been properly resolved and have been the subject of differing interpretations and confusion.**

**3. It is essential that the relevant  
intergovernmental international bodies  
address and resolve the issues referred to  
heretofore, in cosponsorship.**

**NEA CAN AND SHOULD HELP!**

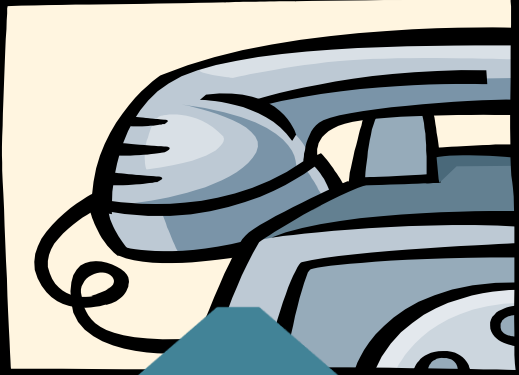




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*Thank you!*



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