The International Safety Regime for Decommissioning and Remediation after a Nuclear Accident:
Lessons and Challenges from Fukushima

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The main purpose of this meeting is to deal with the relevant radiation protection and safety framework for tackling the huge challenges presented by the decommissioning of facilities and remediation of habitats after an accident…

….rather than resolving the technological problems.
The meeting is framed under an IAEA safety ‘action plan’, namely under the relevant statutory safety responsibilities of the IAEA –which are:

- Establishing standards for the protection of health, (including those for labour conditions).
- Providing for their application
- Facilitating compliance with legally binding obligations
The meeting was not convened for dealing with the serious problems of decommissioning and remediation linked to nuclear weapons.

This important issue will not be covered in the presentation but we would like to suggest that the IAEA may consider to convene an *ad hoc* meeting on this subject.
1. The international safety regime
2. Decommissioning and remediation: Relevant issues
3. Lessons from Fukushima
4. Epilogue
1. The international safety regime
The international system
UNSCEAR is responsible for the epistemology (i.e., for the scientific basis and its limitations)
Fifty-seventh session, includes Scientific Report: summary of low-dose radiation effects on health

Rapport du Comité scientifique des Nations Unies pour l'étude des effets des rayonnements ionisants 2010
Cinquantaseptième session, y compris le rapport scientifique sur les effets des rayonnements à basses doses sur la santé

Informe del Comité Científico de las Naciones Unidas para el Estudio de los Efectos de las Radiaciones Atómicas 2010
57th session, includes the scientific report on the effects of the radiations at low doses on health

Доклад Научного комитета Организации Объединенных Наций по действию атомной радиации, 2010 год
Пятдесят седьмая сессия, содержит научный доклад о краткосрочных эффектах воздействия радиации малых доз на здоровье

联合国原子辐射影响问题科学委员会 2010 年报告
第五十七届会议，包括科学报告：低剂量辐射对健康的影响概述

تقرير لجنة الأمم المتحدة العلمية لآثار الإشعاع الذري 2010
الدورة السابعة والخمسون، وهو يشمل التقرير العلمي: مرجعيات التقرير للأشخاص المتعرضين للإشعاع

UNSCEAR 2010 Report
The International Commission on Radiological Protection is responsible for the paradigm
Annals of the ICRP

ICRP Publication 109

Application of the Commission’s Recommendations for the Protection of People in Emergency Exposure Situations
ICRP
Annals of the ICRP

ICRP Publication 111
Application of the Commission’s Recommendations to the Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency

This special free release of ICRP Publication 111 is dedicated to those in Japan who have lost so very much
The IAEA is responsible for the global regime of intergovernmental obligations and standards.
IAEA statutory functions

related to decommissioning and remediation

- to establish standards
- to provide for their application
- to service international conventions
Legally Binding Conventions

- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Convention on Nuclear Safety
ILO Radiation Protection Convention
No. 115 (1960)
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International Radiation Safety Standards
IAEA Board of Governors

Commission on Safety Standards (CSS)

Nuclear Safety Standards Committee (NUSSC)
 Radiation Safety Standards Committee (RASSC)
 Waste Safety Standards Committee (WASSC)
 Transport Safety Standards Committee (TRANSSC)

Expert Groups
Provisions for the application of the standards: IAEA mechanisms

- providing TECHNICAL ASSISTANCE
- fostering INFORMATION EXCHANGE
- promoting EDUCATION & TRAINING
- coordinating RESEARCH & DEVELOPMENT
- rendering APPRAISAL SERVICES
Long experience

1962: first international standards.

Basic Safety Standards for Radiation Protection

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 1962
ICRP recommendations

- 1958 (“Publication 1”)
- 1966 (Publication 9)
- 1977 (Publication 26)
- 1990 (Publication 60)
- 2007 (Publication 103)

IAEA Basic Safety Standards

- 1962
- 1967
- 1982
- 1996
- 2011 – Interim edition
Safety Standards Hierarchy

Safety Fundamentals

Safety Requirements

Safety Guides
IAEA Safety Standards
for protecting people and the environment

Fundamental Safety Principles

Safety Fundamentals
No. SF-1
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)
Application of the Concepts of Exclusion, Exemption and Clearance

SAFETY GUIDE

No. RS-G-1.7

IAEA
International Atomic Energy Agency
IAEA Safety Standards for protecting people and the environment

Decommissioning of Facilities Using Radioactive Material

Safety Requirements
No. WS-R-5

IAEA
International Atomic Energy Agency
Decommissioning of Nuclear Power Plants and Research Reactors

SAFETY GUIDE

No. WS-G-2.1

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
IAEA Safety Standards
for protecting people and the environment

Safety Assessment for the Decommissioning of Facilities Using Radioactive Material

Safety Guide
No. WS-G-5.2

IAEA
International Atomic Energy Agency
Occupational Radiation Protection

JOINTLY SPONSORED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY AND THE INTERNATIONAL LABOUR OFFICE

SAFETY GUIDE

No. RS-G-1.1

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
Release of Sites from Regulatory Control on Termination of Practices

Safety Guide
No. WS-G-5.1

IAEA Safety Standards
for protecting people and the environment
Remediation of Areas Contaminated by Past Activities and Accidents

SAFETY REQUIREMENTS

No. WS-R-3

IAEA
International Atomic Energy Agency
IAEA Safety Standards
for protecting people and the environment

Environmental and Source Monitoring for Purposes of Radiation Protection

Safety Guide
No. RS-G-1.8

IAEA
International Atomic Energy Agency
SAFE DECOMMISSIONING FOR NUCLEAR ACTIVITIES

Proceedings of an International Conference
Berlin, 14–18 October 2002

IAEA
International Atomic Energy Agency
LESSONS LEARNED FROM THE DECOMMISSIONING OF NUCLEAR FACILITIES AND THE SAFE TERMINATION OF NUCLEAR ACTIVITIES

PROCEEDINGS OF AN INTERNATIONAL CONFERENCE ON LESSONS LEARNED FROM THE DECOMMISSIONING OF NUCLEAR FACILITIES AND THE SAFE TERMINATION OF NUCLEAR ACTIVITIES

ORGANIZED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY,
CO-SPONSORED BY THE EUROPEAN COMMISSION,
IN COOPERATION WITH THE OECD NUCLEAR ENERGY AGENCY AND THE WORLD NUCLEAR ASSOCIATION,

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2007
International Conference on Remediation of Land Contaminated by Radioactive Material Residues

18–22 May 2009
Astana, Kazakhstan

Organized by the International Atomic Energy Agency (IAEA)
Hosted by the Government of Kazakhstan

CN–172
Does this comprehensive international regime provide solutions to the concrete practical issues of decommissioning and remediation?
2. Relevant Issues
Decommissioning
The main safety issues in decommissioning are

- Providing occupational protection
- Managing the radioactive waste
- Dealing with the ‘contaminated’ rubble
- Remediating the ‘contaminated’ site
Occupational Protection

- Legally binding instruments already exist.
- States shall comply with their obligations.
ILO Radiation Protection Convention
No. 115 (1960)
Management of Radioactive Waste

- Legally binding instruments already exist.
- States shall comply with their obligations.

International Atomic Energy Agency
INFORMATION CIRCULAR

INF

INFCIRC/546
24 December 1997

GENERAL Distr.
Original: ARABIC, CHINESE
ENGLISH, FRENCH, RUSSIAN and
SPANISH

JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT
AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT
Unsolved issues

- Dealing with the ‘contaminated’ rubble
- Remediating the ‘contaminated’ site
Remediation
Terminology
Remediation

- providing a *remedy*?
  
  (pharmaceutical product, cure or treatment)

- ‘*cleanup*’ (making a place ‘clean’)?

- removing ‘*contamination*’ from land?, or

- reducing radiation exposure?…

- how much?
Aim
The aim of international policies on remediation should be to resolve unambiguously elementary questions being asked by the public.
Is it safe for me and my family to live here?
Can we play on the outdoor area?
Is it safe for me and my family to eat this food?
These kakis (persimmons) contain 90 Bq/kg, but when dried they contain 110; are they edible?
This water is safe; I drunk it!
Deputy Minister Yasuhiro Sonoda

Is it safe?
The Minister does not drink water from the Fukushima Prefecture every day!
If water is not safe, why is orange juice safe?
Why I am permitted to drink this water but not to swim in it?
Are these rice-paper room-divider screens safe?
This patient shows some contamination, should I send her to Chiba?
We were told this water is contaminated; shall we use it?
Does the current international regime of
have an unambiguous answer to these questions?

It seems that it doesn’t
I seems that even climbing this mountain will not solve the problem of ‘contamination’?
Well, if the system cannot answer unambiguously these straightforward questions, then something is wrong!

Limiting the solution of this serious problem to the involvement of ‘stakeholders’, and then giving the question back to them, is unfair and, somehow, ethically incorrect.
‘Contamination’

- from Latin *contaminare*, ‘make impure’.
- Religious understanding (e.g., no-kosher food)
- Experts’ denotation: presence of radioactivity
- Public’s connotation: danger of radiation
The food is ‘contaminated’, but do not worry the ‘contamination’ is low?
‘Contaminated’ Territories
Contamination?: Wrong connotation!
What is the meaning of ‘contaminated’ land?
Natural Background

Few people in few areas ⇒ ~100

Many people in many areas ⇒ ~ 10

Majority of people around the world ⇒ ~ 2.4

~ 1

annual dose mSv/year

VERY HIGH

TYPICALLY HIGH

AVERAGE

MINIMUM
Preliminary dose estimation from the nuclear accident after the 2011 Great East Japan Earthquake and Tsunami
In Chernobyl, radiation doses measured in vivo were much lower than those estimated theoretically.
How to ‘remediate’ ‘contaminated’ land

- Exempting?
- Controlling minute radioactivity?
- Mixing the soil?
- Scraping?
What are they going to do with all this?
‘Contaminated’ Rubble
93 grams! 'talc powder'

50mm (2')

1375 Ci !!

Source material:
Density: 3000 kg/m³
Specific activity: 814 TBq/kg
Total activity (1971): 74 TBq

Modified fitting for attachment to existing cobalt-60 teletherapy machine (international capsule)

External capsule (stainless steel)

Internal capsule (stainless steel)

Total window thickness 1 mm
Window diameter 30.2 mm

Source material diameter 36.3 mm

Float seal
5,000 m$^3$ of ‘contaminated’ rubble
Shall I put this waste in the truck or shall I phone the radioactive waste management group?
‘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.
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)

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<th>Radioactive Iodine(^{131}\text{I})</th>
<th>Radioactive Cesium</th>
<th>Uranium</th>
<th>Total of (^{238}\text{Pu},^{239}\text{Pu},^{240}\text{Pu},^{242}\text{Pu},^{241}\text{Am},^{242}\text{Cm},^{243}\text{Cm},^{244}\text{Cm})</th>
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<tr>
<td>Milk, dairy products</td>
<td>&gt; 3x10^2Bq/kg</td>
<td>&gt; 2x10^2Bq/kg</td>
<td>&gt; 20Bq/kg</td>
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<td>Vegetables and fruits</td>
<td>&gt; 2x10^3Bq/kg (excluding root vegetables and potatos)</td>
<td>&gt; 5x10^2Bq/kg</td>
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<tr>
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<td>Meat, Egg, Fish, etc</td>
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New radiation limits for food in Japan

- On 22 December 2011 the Japanese government announced new limits for caesium 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)
Japón: encuentran un pez con 2500 veces el nivel legal de radiactividad

Fue hallado cerca de la central nuclear accidentada de Fukushima durante 2011 por un terremoto y posterior tsunami.

OKIO.- Un pez atrapado con la finalidad de realizar un control cerca de la central nuclear accidentada de Fukushima presenta un nivel impresionante de contaminación radioactiva, casi 2.500 veces superior al límite legal fijado por Japón, anunció el viernes el operador de esta instalación atómica.

La compañía Tokyo Electric Power (TEPCO) declaró que midió en un pez llamado "murasoi" una cantidad de cesio radioactivo igual a 254,000 becquerles por kilo, o sea 2,540 veces el límite de 100 becquerles/kg definida para los productos marinos por el gobierno.

Japan: find a fish with 2500 times the legal level of radioactivity.
Deceit!

- Highly ‘contaminated’ fish = 254,000 bequerel/kilo
- Even assuming that a 1 year old Japanese baby eats 1 kilogram! of THIS fish!!.....
- …such a fish-greedy baby would have ingested 254,000 bequerels of $^{137}$Cs and, as a result, would have committed a dose of

$$250,000 \text{Bq} \times 2.1 \times 10^{-8} \text{ Sv Bq}^{-1} = 0.5 \text{ mSv}$$

over 70 years

...namely, the same dose that the baby would incur, in one go, if the parents travel with him by plane to Argentina to visit a relative!
3. Lessons from Fukushima
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;
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.
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]
Would I be one of the 500,000?
Justification of severe countermeasures, such as evacuation
NO INDIVIDUAL/SOCIETAL BENEFIT ABOVE THIS

DIRECT OR INDIRECT BENEFIT TO THE INDIVIDUAL

SOCIETAL, BUT NO INDIVIDUAL DIRECT BENEFIT

Exclusion, exemption, clearance

- 4 orders of magnitude -

1 Dose limit

Σ?

Δ?
Probably the big lesson of Fukushima

- The confusing situation created by the ‘contamination’ of the habitat is responsible of the only serious health effect attributable to Fukushima: physiological consequences!
The psychological aftermath of Fukushima
Depression
Grieving
Chronic anxiety
Post-traumatic Stress Disorder
Insomnia
Severe headaches
Smoking and alcoholism
Anger

STOP!

GENPATSU
Desperation
Parents’ Anguish
Stigma
Stigma
Stigma
A mark of disgrace associated with being associated with ‘contamination’

- 汚名: Polluted name
- 烙印: Mark
- 恥: Shame
- 不名誉: Dishonour
- 不面目: Humiliation
- 被差別: Discrimination
Outcome from Fukushima ‘contamination’

- Psychological effects caused by the experience of living in a ‘contaminated’ habitat are dominant.
- They are health effects in their own right.
- However, they are basically ignored.
4. Epilogue
International Experts' Meeting on
Decommissioning and Remediation
after a Nuclear Accident
The position of Argentina

The IAEA shall definitively:

- establish *quantitative* safety standards for remediation.

- provide, at the request of States, for the application of these standards by means of *objective* and *quantitative* appraisals.
The position of Argentina

The international safety regime (and the IAEA) will fail in its objectives unless it is able to establish **safe levels of ‘contamination’** (in land, rubble, consumer products, etc) below which the situations may be considered **harmless**, without any caveat.
ICRP 104 may be helpful
The "Action Plan" should focus on the specific technical issues brought to light by Fukushima, e.g. establishing universal remediation standards, rather than on generic nuclear safety issues.
Argentina considers that the IAEA standards and its application should be:

- quantitative,
- objective,
- measurable and comparable,

and that all qualifying subjectivism, either in the formulation of the standards or in their application, should be avoided.
Argentina’s advise to both Ministerial Conferences

The Fukushima accident should

- be analyzed with total transparency, technical accuracy, political serenity and deep retrospection.
- remain a challenge for nuclear power plant similarly located and/or designed, but should not be converted in a global nuclear safety problem.
- not be used as an argument for declaring nuclear power as inherently unsafe and much less to encourage early abandonment of nuclear renaissance.
Let’s start solving the concrete problems of remediation

A possible initial trigger
Av. del Libertador 8250
Buenos Aires, Argentina

Thank you !

agonzalez@arn.gob.ar