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International Atomic Energy Agency
Atoms for Peace and Development

Environmental and Remediation Challenges and Responses Following Nuclear Accidents: Lessons Learned from the Fukushima Daiichi Accident

Integration of Science in Decision Making

Horst Monken-Fernandes, Ph.D.

Decommissioning and Environmental Remediation Section
Division of Nuclear Fuel Cycle, Waste Technology and Research Reactors

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Presentation Outline

- Starting from the Definitions
- The Framework
- What Science tells us and its role in decision-making?
- IAEA Missions to Japan – Issues Raised
- The Research Community – TERRITORIES Project
- The IAEA Conference on D&ER – Madrid 2016
- The MAESTRI Project

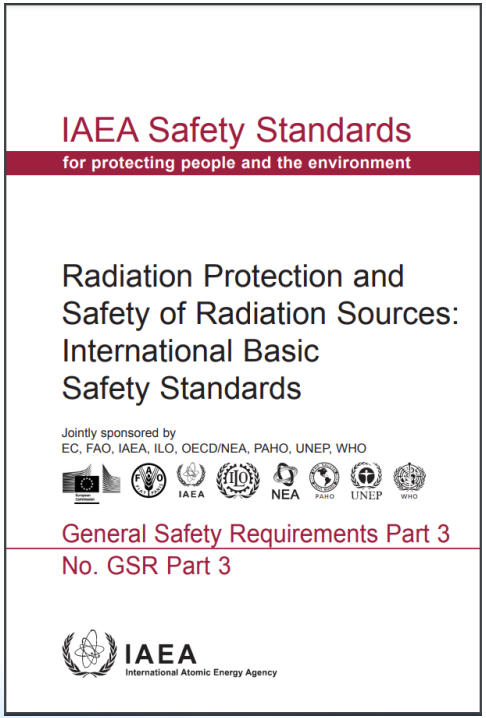
Starting from the definitions

- The IAEA Safety Glossary defines and explains technical terms used in IAEA safety standards and other safety and security related IAEA publications, and provides information on their usage.

- **Remediation**
  - Any measures to **reduce the radiation exposure** due to existing contamination of land areas through actions applied to the contamination itself (the source) or to the exposure pathways to humans.
  - **Complete removal of the contamination is not implied.**
  - The use of the terms **clean-up, rehabilitation and restoration as synonyms for remediation is discouraged**.
  - Often remediation is used to restore land areas to conditions suitable for limited use under institutional control.
  - In some contexts, the terms remediation and restoration are used to describe different parts of overall recovery.
  - The term **clean-up** is used in the context of decommissioning.

- **Contamination**
  - Radioactive substances on surfaces, or within solids, liquids or gases (including the human body), where their presence is unintended or undesirable, or the process giving rise to their presence in such places.
  - Contamination does not include residual radioactive material remaining at a site after the completion of decommissioning.
  - **The term contamination may have a connotation that is not intended. The term contamination refers only to the presence of radioactivity, and gives no indication of the magnitude of the hazard involved**.
- Decontamination
  - The complete or partial removal of contamination by a deliberate physical, chemical or biological process.

The Framework



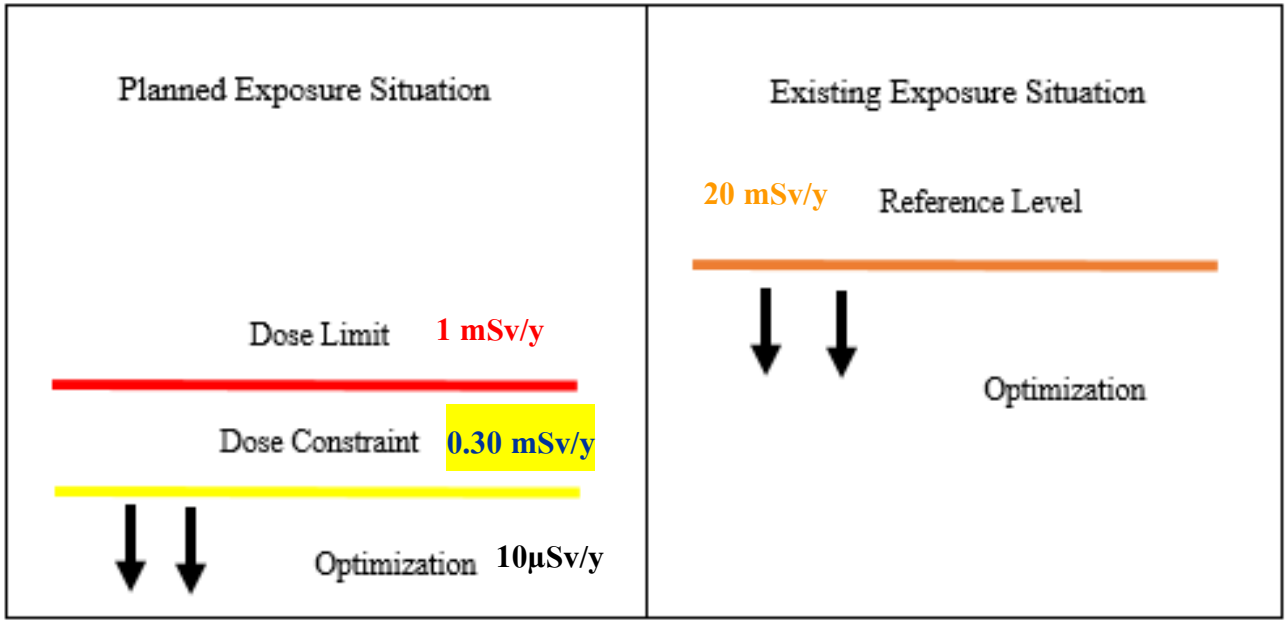
- These Standards reflect continuing efforts over several decades towards the harmonization of safety standards internationally. They embody the international benchmark for radiation safety requirements, with major implications for policy making and decision making.

EXISTING EXPOSURE SITUATIONS

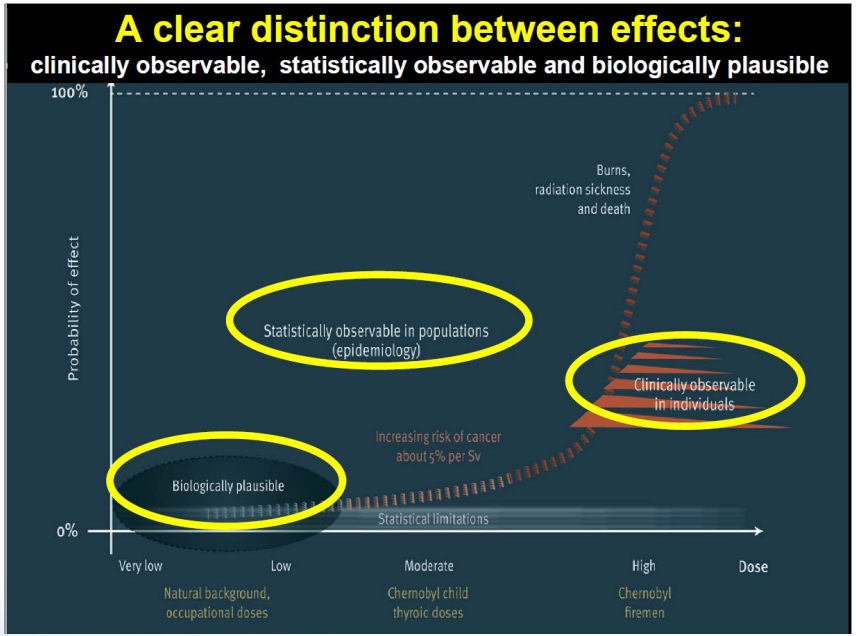
- Exposure due to contamination of areas by residual radioactive material deriving from (among other situations):
  - A nuclear or radiological emergency, **after an emergency has been declared to be ended**
  - **Reference levels** are used for optimization of protection and safety in emergency exposure situations and **in existing exposure situations**
  - Reference levels shall typically be expressed as an annual effective dose to the representative person in the range of **1–20 mSv** or other corresponding quantity, the actual value **depending on the feasibility of controlling the situation** and on experience in managing similar situations in the past

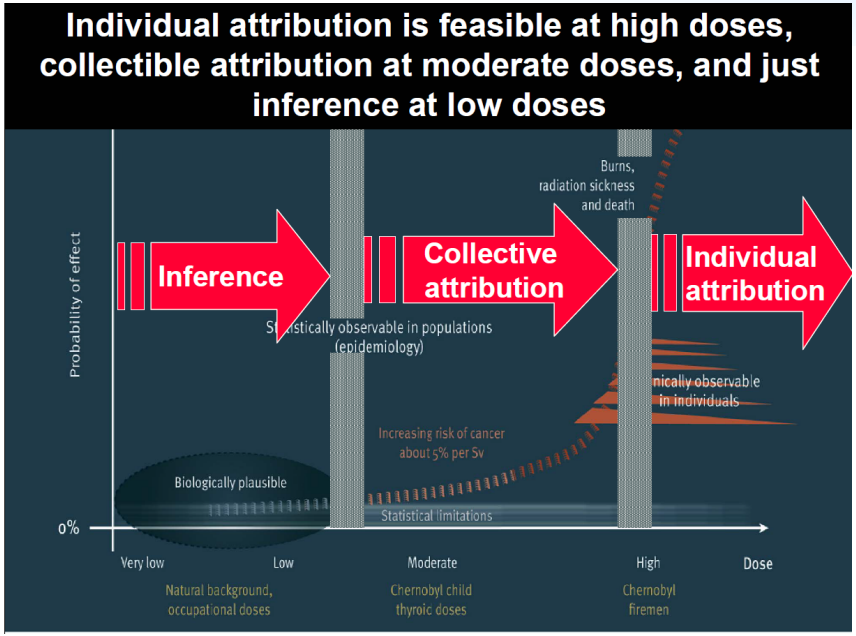
Principles to be applied

- Justification
  - More “good” than harm
- Optimization
  - ALARA
- Dose Limitation



What Science tells us?





Source: Abel Gonzales (former NSRW-IAEA Director)

Many concepts to deal with; and so the confusion starts

Evacuation

External Dose

Dose

Zoning

Risk

Decontamination

ICRP

Radioactive Waste

Dose Limit

Cs-137 Cs-134 I-131

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Stochastic Effect

Deposition

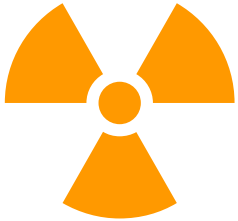
UNSCEAR

Site Characterization

Deterministic Effect

Expert

So what is the role of Science in the Decision-Making Process?



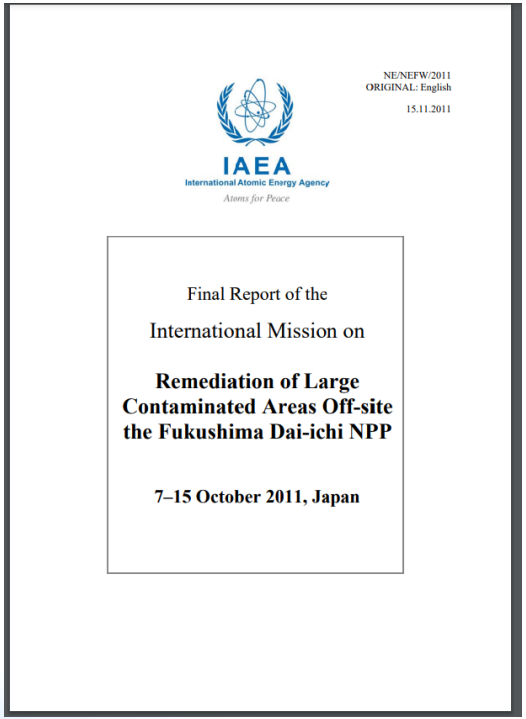
Does it drive the process?

Decisions to be made with scientific evidence (radiation protection) as the main driver?

Does it inform the process?

Decisions to be made having scientific evidence as one of the components to support the decision-making?

Advice provided by to Japan on Off-Site Areas Remediation - IAEA Mission October, 2013



NE/NEFW/2011
ORIGINAL: English
15.11.2011

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Final Report of the

International Mission on

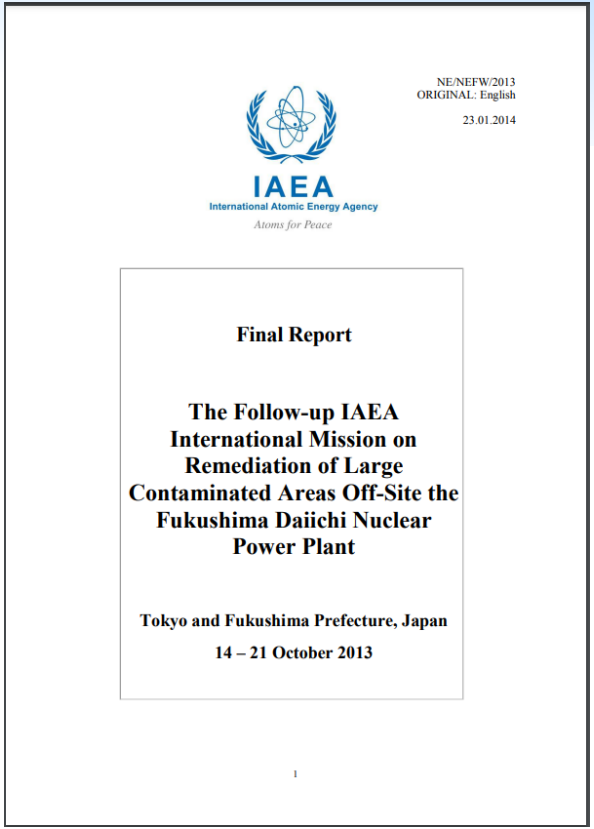
Remediation of Large Contaminated Areas Off-site the Fukushima Dai-ichi NPP

7–15 October 2011, Japan

- Cautiously balance the different factors that influence the net benefit of the remediation measures to ensure dose reduction
- Avoid over-conservatism which could not effectively contribute to the reduction of exposure doses
- Avoid classifying as “radioactive waste” waste materials that do not cause exposures that would warrant special radiation protection measures.
- Potential risk of misunderstandings that could arise if the population is only or mainly concerned with contamination concentrations [surface contamination levels (Bq/m^2) or volume concentrations (Bq/m^3)] rather than dose levels

Advice provided by to Japan on Off-Site Areas Remediation - IAEA Mission October, 2013

- In remediation situations, any level of individual radiation dose in the range of 1 to 20 mSv per year is acceptable and in line with the international standards
- Were the decisions justified? Optimized? The 1 mSv/y level to be seen as a “long-term” goal
- Communicate the entire remediation and reconstruction programmes and how the various components interact (for example, trade-offs between reducing exposure and increasing waste volumes) could reduce some uncertainties and provide greater confidence in the decisions being made. Remediation to be understood in its overall life-cycle
- Promoting a holistic view would also facilitate opportunities to plan key stakeholder engagement activities in advance, allowing the process to be proactive rather than reactive
- Continued movement towards the use of the individual doses, as measured with personal dosimeters, to support remediation decisions
- Waste generation to be integrated in the overall planning



NE/NEFW/2013
ORIGINAL: English

23.01.2014

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Final Report

The Follow-up IAEA International Mission on Remediation of Large Contaminated Areas Off-Site the Fukushima Daiichi Nuclear Power Plant

Tokyo and Fukushima Prefecture, Japan

14 – 21 October 2013

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Uncertainties

- To Enhance unceRtainties Reduction and stakeholders Involvement TOwards integrated and graded Risk management of humans and wildlife In long-lasting radiological Exposure Situations

- Site Characterization/Monitoring
  - Appropriate characterization of natural variability.
  - Uncertainties associated with sampling.
  - Uncertainties related with the correct interpretation of the data.
  - Uncertainties of measurements (both in laboratory and in situ)
- Model Predictions – “The uncertainties that can be reduced in a model depend on the model you are considering and input data you would need”
  - Model Parameters/Inputs
- Behaviour of Radionuclides in the Environment

Conclusions from TERRITORIES Project

Clarify	Clarify the role and responsibilities of actors and enhance coordination between actors to improve the decision process in a post-accident context
Engage	Engage dialogue with local stakeholders to better address the notion of “affected territory/community” and anticipate the related management protocols
Understand	Better understand the financial mechanisms that can help to revitalize the “affected territory/community”
Develop	Develop decision support tools to enlighten decision and choices of remediation strategies and options
Anticipate	Anticipate waste management difficulties in building a strategy in relation with populations
Sustain	Sustain long-term citizen awareness with the creation and intergenerational transmission of a radiological protection culture
Encourage	Encourage an integrated radiological monitoring system and the implementation of a joint database platform
Develop	Develop hubs of co-expertise for monitoring data interpretation and analysis
Use	Use measurements and/or radioecological modelling in a fit-for-purpose approach for characterizing the contamination
Establish	Establish an early dialogue about (quantifiable) uncertainties and their propagation in impact assessment

Recommendations of the IAEA Madrid Conference on D&ER

- The need to develop national policy, strategies and means of national dialogue for remediation of legacy and post-accident sites containing residual radioactivity was emphasized
- Guidance on selection and implementation of reference levels for existing exposure situations i.e. in remediation programmes;
- Today, there is a greater expectation of integrated engagement of policy makers, regulatory authorities, industry and the public in the decision making process. These expectations are high and growing - both in terms of information needs and involvement in decision making

Decision-Making: Complex Process

- Integrating public engagement into decision making concerning D&ER, particularly concerning desired end states, is extremely complex.
  - **Limited technical knowledge and understanding of science leading to risk perception based predominantly on emotion and fear;**
  - Lack of trust among the many stakeholders in the process, particularly between affected public and government authorities and/or industry
  - Waste disposal concerns
  - Insufficient government commitment
  - Limited budget or technical resources to meet stakeholder demands;

What IAEA is doing to address these issues?

IAEA ENVIRONET

- **MAESTRI Project - Management Systems Supporting Environmental Remediation Projects**

Chair of the Project: Catrinel Turcanu

sck cen
Belgian Nuclear Research Centre

Objectives of MAESTRI

- **Structured framework** that considers, in an **integrated manner,**
  - **the different dimensions and activities** relevant to the management of sites contaminated by ongoing or past activities (including accidents)
  - with a view to bringing them to sustainable end-states suitable for beneficial use

- **Case studies** and **practical guidance** demonstrating the use of the framework

MAESTRI

Management Systems Supporting Environmental Remediation Projects

ENVIRONET Technical Meeting 2017

Need for an integrated framework for decision-making

- Inclusion of social and economic considerations
- Stakeholder engagement
- Sustainability

ENVIRONET Technical Meeting 2018, 2019

Basis for the terms of reference established

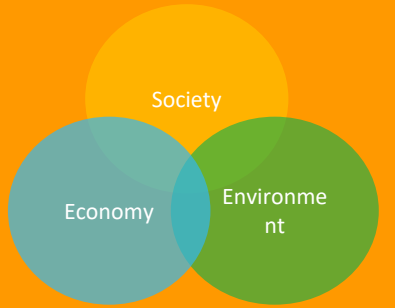
Project start

2020-2021 two-years plan

TG1. Framework for social multi-criteria evaluation

Integration of technical and non-technical factors
Participatory aspects
Development of improved decision support tools

TG2. Evaluation of environmental management dimensions



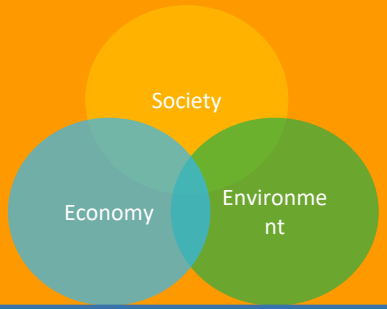
Case studies of methodological approaches for the evaluation of socio-economic impacts

TG3. Engaging communities of practice

Validation of framework and models developed
Illustration of best practice
Training materials

TG1. Framework for social multi-criteria evaluation

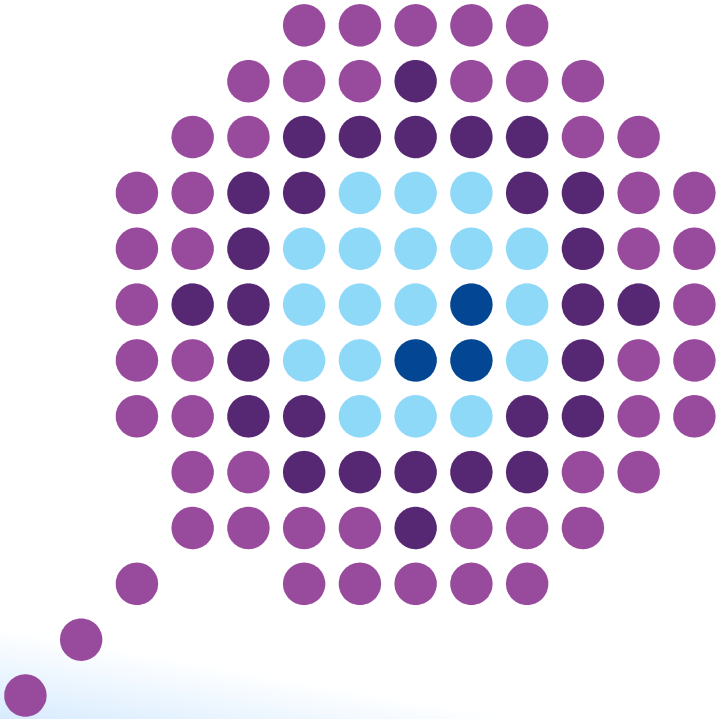
TG2. Evaluation of environmental management dimensions



TG3. Engaging communities of practice

BASELINE REPORT: state of the art and challenges in decision making for environmental remediation

Terms of Reference



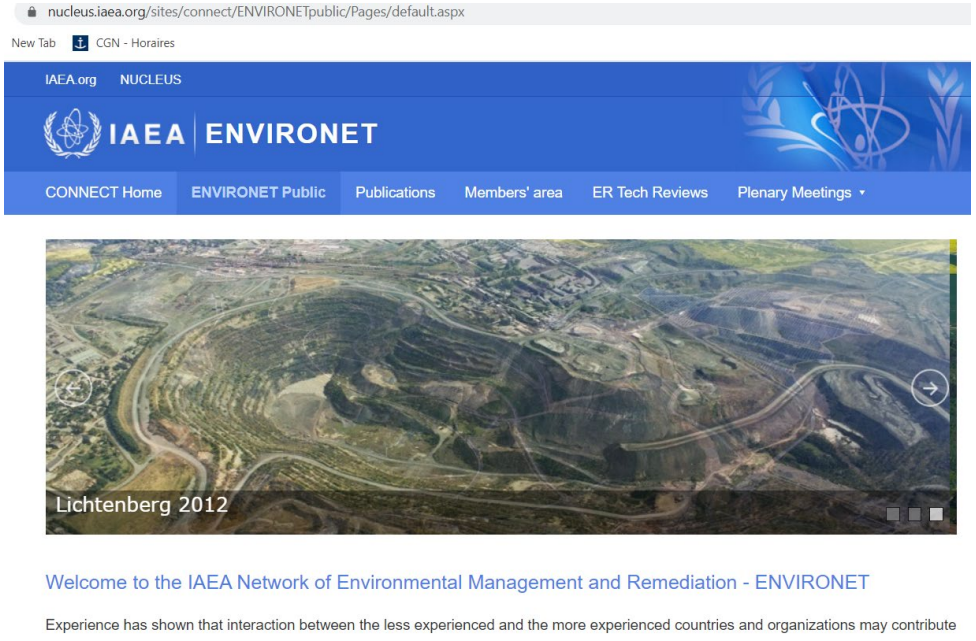
- Action oriented project
- Expected outcome
  - Solid basis for improving the process
  - Link to and build on activities at the level of IAEA and EU, as well as experience from Member States
- Target audience: regulatory bodies, implementers
- Multi-disciplinary
  - In particular, cooperation with social scientists acknowledged as beneficial and needed

Interested in participating in MAESTRI?

Register at:

- https://nucleus.iaea.org/sites/connect/ENVIRONETpublic/Pages/default.aspx

And Join Environet



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Thank you!