



United Nations Scientific Committee
on the Effects of Atomic Radiation

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Understanding the Long-Term Implications of Severe Radiological Accidents (including Infrastructure and Resource Needs)

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What is remediation?

Any measures that may be carried out 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

(IAEA Safety Standards No. GSR Part 3)



Characteristics of the Process

During the remediation process, the application of the radiation protection principles „justification“ and „optimization“ has to be conducted with great care to deploy remediation actions which are the result of a balance between **objective** elements (exposure, costs, etc.) and **subjective** elements (public perception, anxiety, political pressure, etc.).

Emergency Management Timeline

Preparedness	Response				Recovery
	Early		Intermediate		Late
Planning Stage	Event/Response Initiation	Crisis Management	Consequence Management	Transition to Recovery (including recovery planning)	Recovery/Long-term Rehabilitation
	Emergency Exposure Situation				Existing Exposure Situation

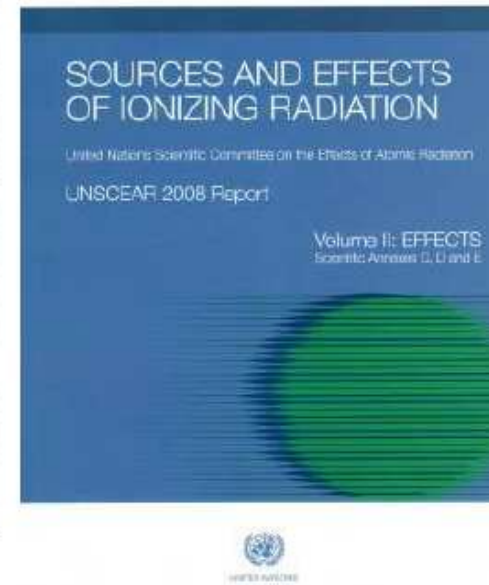
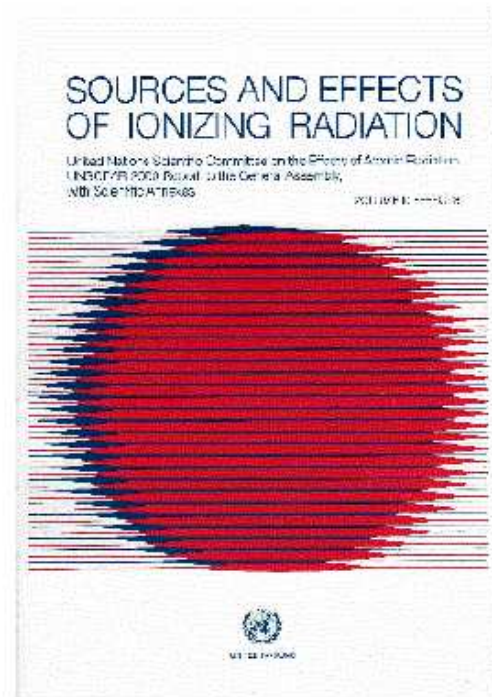
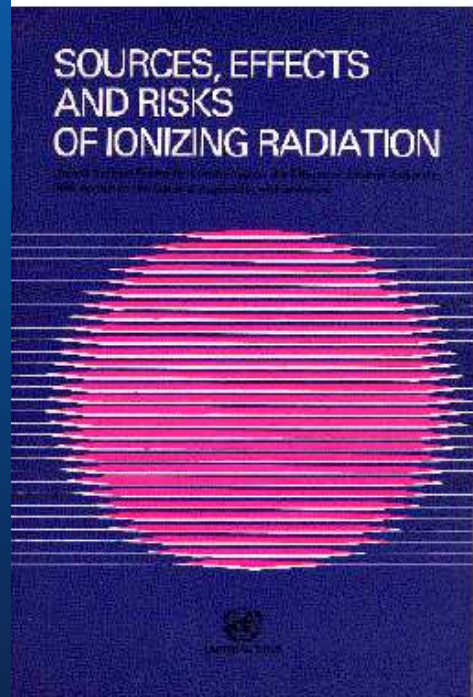
Available information or Stakeholder involvement

Homma 2012

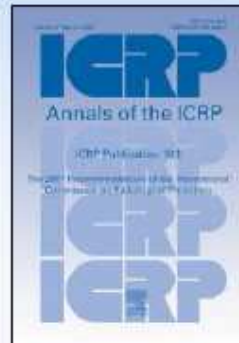
Past experience

Long-term experience of chronic exposure situations is readily available from **nuclear test sites** (Bikini, Maralinga), **nuclear accidents** (Kyshtym, Palomares, Chernobyl, Fukushima), or **radiological source accidents** (Goiaânia).

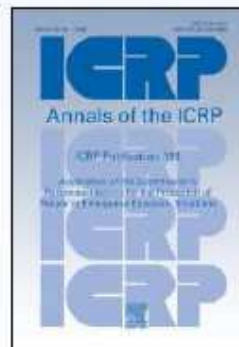
Chernobyl-related UNSCEAR reports: 1988, 2000, 2008



ICRP Publications

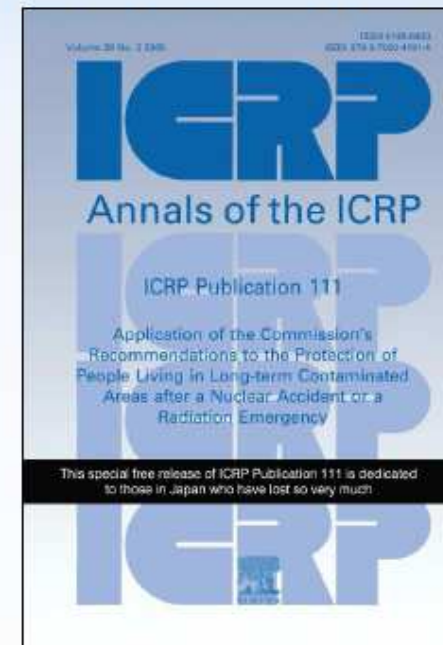


Publication 103
**Fundamental
Recommendations**



Publication 109
**Emergency
Situations**

Publication 111
Post-Accident Recovery



Challenges

The available experience clearly shows that **all dimensions of the daily life** of the inhabitants within contaminated areas, as well as the social and economic activities, are affected resulting in complex situations which cannot be managed with radiation protection considerations alone.

Multiple dimensions

Remediation actions must address all relevant dimensions such as **health, environmental, economic, social, psychological, cultural, ethical, political, etc..**

Following WHO's definition health is:
"A state of complete physical, mental and social well-being, and not merely the absence of disease".

The responsibilities of authorities

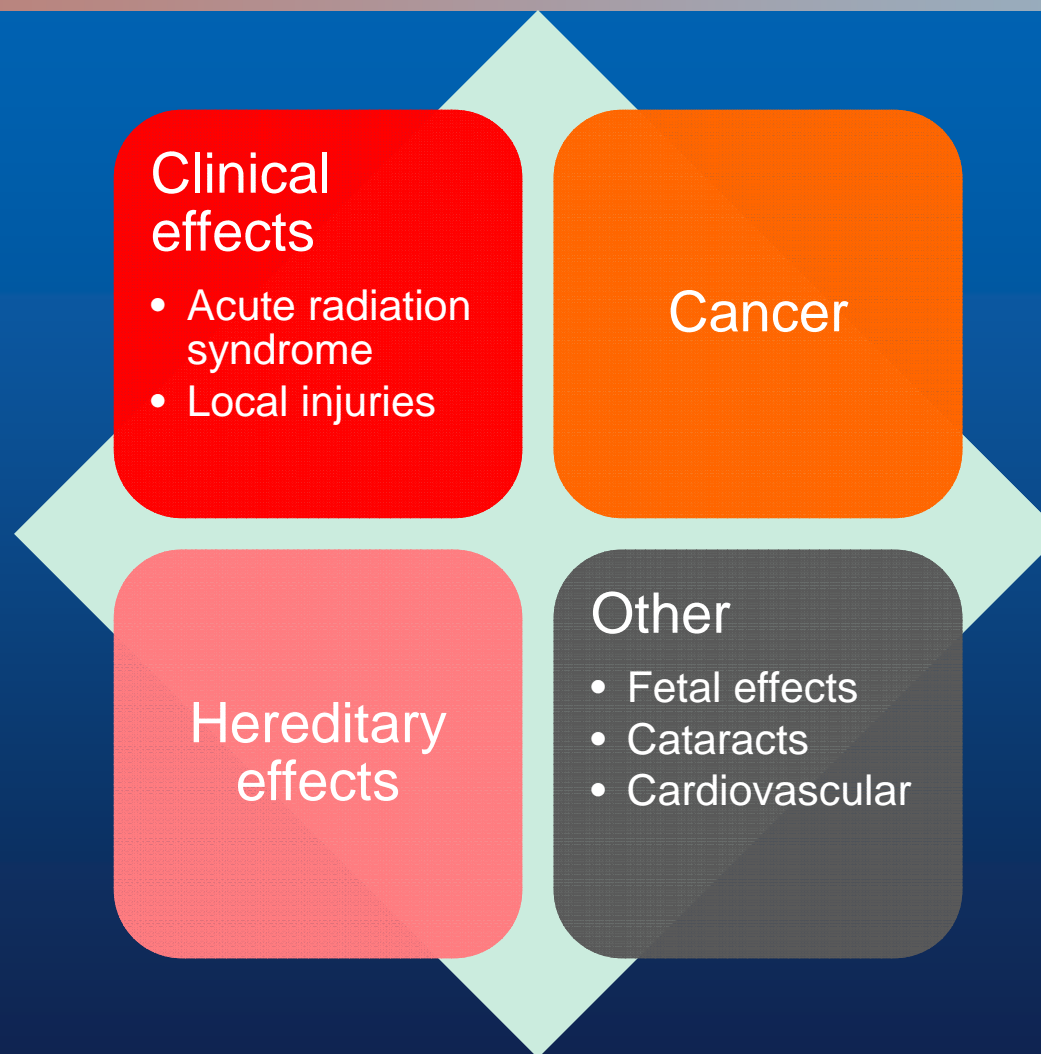
The first priority of strategies implemented by authorities is to protect people with the highest exposures, and in parallel to reduce all individual exposures to as low as reasonably achievable. This implies assessments of the dose distribution, comparison of the doses with the reference level, and subsequent optimisation of protection.

There is a strong need for transparency of the underlying processes.

Key elements of implementation strategies

Clean-up of buildings, remediation of soils and vegetation, changes in animal husbandry, monitoring of the environment and produce, provision of clean foodstuffs, managing of waste (resulting from clean-up or from unmarketable contaminated goods), provision of information, guidance, instruction and equipment (e.g. for measurements), health surveillance, education of children, information for particular exposed groups and the public at large, etc..

Dose-dependent health effects



Late health effects – Chernobyl

The major health consequences from the radiation exposure of the **ARS survivors** remain skin injuries and radiation-induced cataracts. A high prevalence of nervous system diseases among the survivors has been registered. Similarly, there have been reports of a high percentage of cardiovascular and gastrointestinal diseases. Among the ARS survivors there have been a few confirmed cases of solid cancer.

Late health effects – Chernobyl

A substantial increase in the incidence of **thyroid cancer** has occurred in the three republics since the Chernobyl accident among those exposed as children or adolescents. The increase of thyroid cancer among children and adolescents began to appear about **5 years** after the accident and persisted up until 2005.

Late health effects – Chernobyl

In order to guide decision-making on public health resource management, and given that there is a latent period between exposure and the appearance of any increased incidence in stochastic effects, attempts have been made to **predict the health impact** on populations exposed to radiation by applying radiation risk models to the estimates of population dose.

The interpretation and communication of radiation risk projections is fraught with many difficulties, and it is not easy to communicate the intrinsic **scientific limitations of attribution** of health effects adequately. There are **no biomarkers** specific to radiation available and **it is not possible to state scientifically that radiation caused a particular cancer in an individual**. This means that in terms of specific individuals, it is impossible to determine whether their cancers are due to the effects of radiation or to other causes.

Due to the great uncertainties in risk estimates at very low doses, UNSCEAR does not recommend multiplying very low doses by large numbers of individuals to estimate numbers of radiation-induced health effects within a population exposed to incremental doses at levels equivalent to or lower than natural background levels.

Two types of studies are considered by UNSCEAR when evaluating the cancer risk to populations exposed during the Chernobyl accident:

- **geographical correlation studies** relating aggregated rates of disease with average exposure and
- analytical studies (**case-control or cohort**) where individual information is used.

Other causes of health effects

The Chernobyl accident is known to have had major effects that are not related to the radiation exposure. They include effects brought on by **anxiety** about the future and **distress**, and any resulting changes in diet, smoking habits, alcohol consumption and other lifestyle factors, and are essentially **unrelated** to any actual radiation exposure.

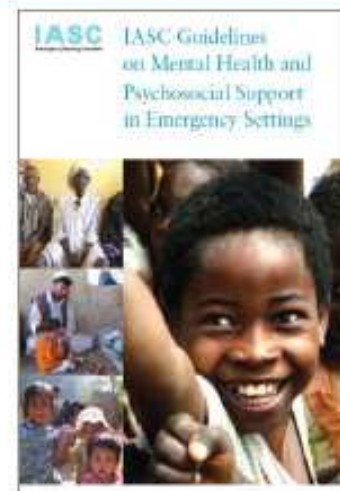
Other causes of health effects

The Chernobyl Forum concluded that stress symptoms, increased levels of depression, anxiety (including **post-traumatic stress symptoms**), and **medically unexplained physical symptoms**, have been found in the exposed populations compared to control groups. Mostly, these conditions were subclinical and did not meet the criteria for classification as psychiatric disorders.

Effects of similar nature have been observed after the Fukushima nuclear accident.

Risk Communication and Mental Health

- **Psychological impact can outweigh direct radiological consequences in terms of health risk**
- **Lack of clear, consistent information creates fears, anxiety, and aggravated psychological impact of nuclear accidents, as seen after Chernobyl**
- **Public may attribute various physical symptoms of fear and stress to the effect of radiation**
- **Communicating risk to the affected target groups, such as emergency workers, evacuees, parents of young children, etc. and conveying clear and reassuring messages is a key intervention to prevent negative mental health impact of a radiation emergency**
- **WHO recommends improving availability and access to normal community mental health services in the disaster affected areas of Japan**



Needs identified by ICRP

- a **monitoring record system** be established under the responsibility of the relevant authorities.
- **health registries** be established for the population residing in the affected areas.

Needs identified by ICRP

Quantification of the intrinsic uncertainties is an integral part of the estimation of the annual doses. Whenever possible, annual **doses** should be reported as a **distribution** of possible values rather than as single point values. Radioactive residues are usually unevenly distributed, creating situations of heterogeneous prolonged exposure. These need to be addressed on a case-by-case basis by making **realistic** assumptions about the pattern of people's exposure.

Needs identified by ICRP

In most cases in long-term exposure situations, the level of exposure is driven by **individual behaviour**.

It is an obligation of the authorities to facilitate processes to allow inhabitants to define, optimise, and apply their own („**self-help**“) protective actions.

Key aspects of self help



Christopher Clement, ICRP Scientific Secretary
Jacques Lochard, ICRP Main Commission

Thank you for your attention



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