United Nations Scientific Committee
on the Effects of Atomic Radiation

UNSCEAR

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The UNSCEAR Assessment of the Levels and Effects of Radiation Exposure due to the Nuclear Accident after the 2011 Great East-Japan Earthquake and Tsunami

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UNEP

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Background

Mandate of UNSCEAR

- **Scientific** Committee of UN General Assembly
- Assess **levels, effects & risks of ionizing radiation**
  - identify emerging issues
  - evaluate levels and effects
  - improve knowledge

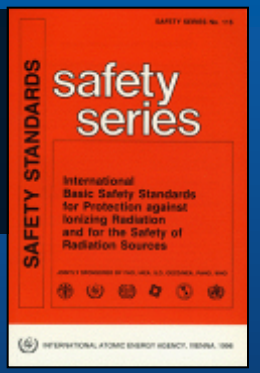
  for General Assembly, scientific community & public

Technical underpinning

1963 partial test ban treaty

1972 UN Conference on Human Environment

1996 reductions in international radiation exposure limits for workers and public



Recovery from Chernobyl accident

International action plans on worker, patient and environmental protection

Member States on UNSCEAR

Scientists from 27 UN Member States designated by General Assembly
UNEP provides secretariat

- Argentina
- Australia
- Belarus
- Belgium
- Brazil
- Canada
- China
- Egypt
- Finland
- France
- Germany
- India
- Indonesia
- Japan
- Mexico
- Pakistan
- Peru
- Poland
- Rep. of Korea
- Russian Federation
- Slovakia
- Spain
- Sudan
- Sweden
- Ukraine
- UK
- USA

Other States and international organizations provide relevant data

Evaluations are for all 193 Member States and
represent consensus of United Nations system on these matters

Fukushima assessment

Background

- 11 March 2011 earthquake 9.0 and tsunami
  - >500 square kilometres flooded
  - 20,000 lives lost

- Worst civil nuclear accident since Chernobyl in 1986
  - Three of six reactor cores severely damaged
  - Large radioactive releases (about 10-20% of Chernobyl)

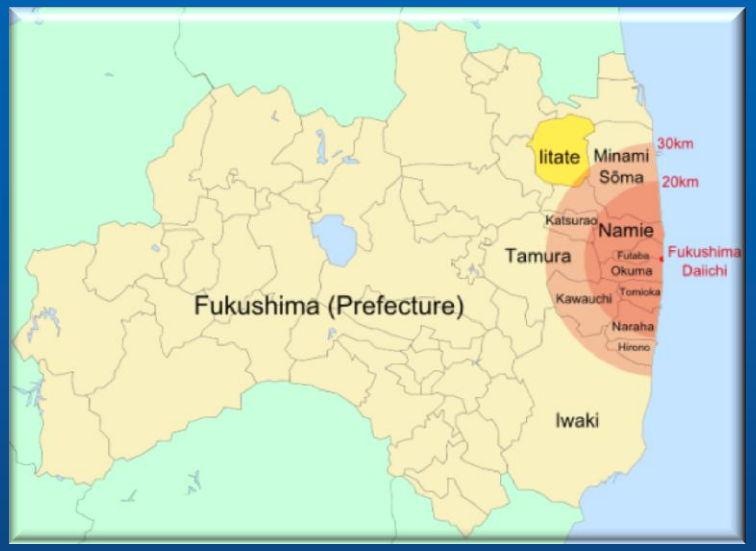
Actions taken by Government

~78,000 people within 20km evacuated

~62,000 people 20 - 30 km sheltered

April 2011: ~10,000 more people evacuated (ground radiation)

Reduced exposure by up to 90%



Other repercussions:

- Deaths from evacuation itself
- Socio-economic (e.g. loss of livelihood)
- Impact on mental and social well-being

Objectives and scope

Source term:
- Amount and nature of releases with time to air and to sea

Environmental dispersion and deposition
- Dispersion and deposition patterns

Public exposure:
- Key exposure pathways
- Effect of protective actions
- Effective doses and absorbed doses to key organs
- Adults, children, infants, foetus in Japan
- Doses for first year based primarily on measurements and projected for future

Occupational exposure:
- Exposures of plant workers and emergency personnel

Health implications of exposure:
- Effects observed if any
- Characterization of groups most at risk
- Health implications of estimated exposures

Effects on natural environment
- Exposures of plants and animals
- Effects observed if any
- Environmental implications of estimated exposures

General aspects:
- Quality of information and confidence in evaluation
- Needs for future research

Organization

Groups with over 80 experts

- **Coordination: Coordination of work**
  - **A: Data compilation and quality**
  - **B: Releases and dispersion**
  - **C: Exposures of public & environment**
  - **D: Worker exposures**
  - **HIT: Health implications**
  - **Final QA: Integration of work**
- **26 countries provided data**
- **Formally data up to end September 2012 (some later)**
- **IAEA, WHO, FAO, WMO, CTBTO**

Over 80 scientists cost-free

January 2012

Scientific findings

Source term - main radioisotopes

Two relevant for exposure:

1. **Iodine-131 (^{131}I):**
   Accumulates in thyroid; delivers mainly beta-ray dose for few weeks

2. **Caesium-137 (^{137}Cs):**
   Distributes in whole body; continues to deliver gamma-ray dose over many years

Source terms

Reviewed published source terms

Accident progression

Reverse modelling from measurements

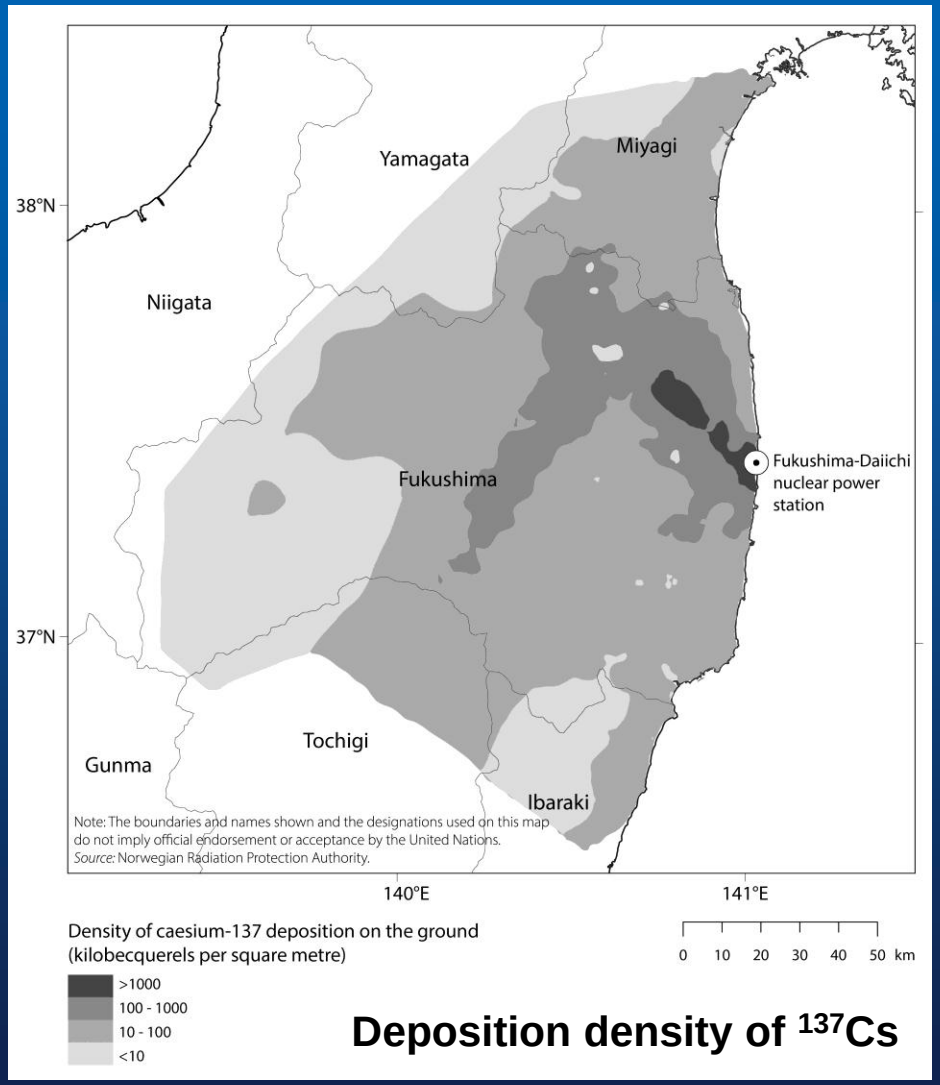
1. Release to the atmosphere

- **^{131}I : 100 to 500 PBq**
- **^{137}Cs : 6 to 20 PBq**
- **10-20% of Chernobyl accident**
- **Release pattern very different (e.g. small release ^{90}Sr)**

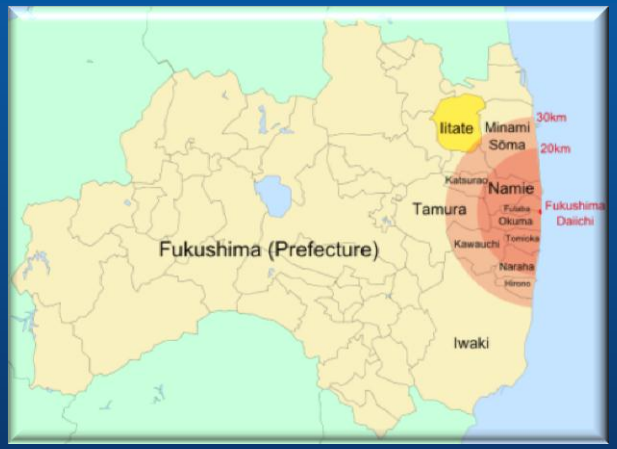
2. Direct discharge to the sea

- **^{131}I : about 10% of the atmospheric release**
- **^{137}Cs : about 50% of the atmospheric release**
- **Still ongoing with potential**

External dose estimation



Deposition density of ^{137}Cs



Internal dose estimation

- **Few direct in vivo measurements of internal exposures were available for general public early on**
- **Committee relied on environmental measurements and various models to estimate doses**

Dose estimates for the public

1. For evacuees:

Average effective doses

Adults: up to about 10 mSv

Infants: twice that of adults

Average absorbed dose to thyroid

Adults: up to about 30 mGy

Infants: up to about 70 mGy

2. Other districts - considerably lower doses on average

3. But higher for individuals

Worker exposures

About 25,000 workers (mitigation & other activities)

1. **Average effective dose:**
   about 12 mSv
2. **High dose population:**
   170+ workers (0.7 % workforce) with more than 100 mSv
3. **Absorbed dose to thyroid:**
   12 workers assessed with 2-12 Gy thyroid doses (mostly from ^{131}I); considerable uncertainty

Health implications

- **No radiation-related deaths or acute disease observed**
- **Discernible increase in cancer not expected generally**
- **Infer increased risk of cancer for 170+ workers with doses over 100 mSv, though any change in cancer incidence not expected to be discernible**
- **Significant impact on mental and social well-being; depression and post-traumatic stress symptoms**

Thyroid cancer among children

- **Models imply increased risk of thyroid cancer, especially for children**
- **Major thyroid screening programme of 360,000 children in Fukushima Prefecture**
- **Increased detection of thyroid abnormalities and cancer reported; confounded by use of highly-sensitive ultrasonography**
- **Radiation-related cancers indistinguishable from other cancers**
- **Early results compatible with screenings in unaffected areas**

Environment (non-human biota)

- **Exposures generally too low for acute effects**
  - **effects in marine environment confined to radioactive release points**
  - **biomarker changes for terrestrial species cannot be ruled out, but significance for populations unclear. Limited to highest deposition areas**
- **Protective actions and remediation have significant impact**

Summary remarks

- **Models imply small cancer risks, but increases in incidence generally not expected discernible against background rates and natural variability**
- **Some groups need following carefully (children who received higher thyroid doses and workers)**
- **Environmental effects transient and localized**
- **Indirect impact on social and mental well-being considerable**

- *Report to General Assembly (A/68/46) issued 2013*
- *Detailed scientific annex will be launched in April 2014*

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