Fukushima lessons and the UNSCEAR project

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NKS SEMINAR ON THE FUKUSHIMA ACCIDENT AND PERSPECTIVES FOR NORDIC REACTOR SAFETY AND EMERGENCY PREPAREDNESS
Finlandhuset, Snickarbacken 4, Stockholm, Sweden, January 8-9, 2012
Mandate

- **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
UNSCEARs Chernobyl experience

Recent scientific findings
Attribution of effects for an individual

• Certain tissue reactions *can* be attributed to radiation exposure
  – High acute absorbed doses
  – Other possible causes eliminated

• Cancer *cannot* be unequivocally attributed to radiation exposure
  – Other causes possible
  – No biomarker for radiation
Attribution of increased cancer rates

• **Increased rates of cancer** in a population **can** be attributed to radiation exposure:
  – If increase more than statistical uncertainties

• **At natural background levels, increased rates cannot be attributed reliably**
  – High uncertainties at low doses
Radiation health effects

- **Certain (100%)**
- **Likelihood**
- **Dose (mSv)**
- **Likelihood**
- **Statistical limit of epidemiology**
- **Biologically plausible**
- **Natural background, occupational doses, radioactive waste**
- **Chernobyl child thyroid doses**
- **Chernobyl firemen**
- **Burns, radiation sickness & death**
- **Limit of pathology**
- **Clinically observable in individuals**

Disease statistics for populations (epidemiology)

Increasing risk of cancer
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.
UNSCEARs Fukushima assessment
Timetable

58th session (May 2011)
- Plan to assess levels, effects and risks of exposure

59th session (May 2012)
- Preliminary findings
- Report to Assembly

60th session (May 2013)
- Final report
- Report to Assembly and publish

Anticipate follow-up reports in later years
- Refined dose assessments
- Epidemiological studies
Environmental impact
Chernobyl - Fukushima

CTBTO-Radioisotope-Measurement (Selection):

- 38 (Japan)
- 63 (Azores)
- 81 (Russian West)
- 73 (Hawaii)
- 70 (USA West coast)
- 75 (USA east coast)
- 83 (Stockholm)
- 33 (Schauерland)

maximal daily average in Germany after Chernobyl (1.6.1986, Bavarian Wood)

$^{131}$Jod

www.bfs.de
Environmental impact
Chernobyl - Fukushima

Wakeford, 2011
Organization of Work

- Over 80 experts offered as contributions-in-kind
- Attendance at meetings and work – cost-free to UN
- Project Manager and Coordinating Lead Writer engaged
- Channels to Japanese experts
- Trust Fund contributions provide buffer
- International Organizations contributing: CTBTO, FAO, IAEA, WHO, WMO
The aim of the assessment is to develop a comprehensive report with scientific annexes for the General Assembly, the scientific community and the public that evaluates information on the levels of radiation exposure due to the nuclear accident following the Great East-Japan earthquake and tsunami, and the associated effects and risks.
General aspects

How confident is UNSCEAR in the representativeness and quality of the information, and of their assessment? What is the likely impact on human health and environment? For what time period are effects expected and of what type? What are the unknowns and needs for future research or follow-up?
Specific objectives

Source term
Environmental dispersion and deposition
Doses to members of the public
Doses to occupationally exposed persons
Effects on the natural environment
Comparison of thyroid doses

Comparison of thyroid dose between Chernobyl and Fukushima NTT accidents

Shandala, 2012
No radiation health effects observed among public or workers

Six workers received doses above 250 mSv; 170 received doses above 100 mSv; thyroid doses being estimated

Six workers died in first year – not due to radiation

Thyroid monitoring of 1,080 children: maximum dose reported was 35 mSv

Highest exposures of wildlife in marine environment
Status of data submission from Japan

• Source term, dispersion
  - Answers/Questions: 100%
  - Had discussed source-term dataset

• Public doses, biota
  - A/Q: 100%
  - Discussing aquatic dispersion & marine biota

• Worker doses
  - A/Q: 94%
  - additional confidential data received
Answered (24 countries):
Argentina, Australia, Belarus, Belgium, Canada, China, Finland, France, Germany, India, Indonesia, Mexico, Pakistan, Poland, Republic of Korea, Russia, Slovakia, Spain, Sweden, UK, USA, Philippines, Malaysia, Singapore

Not answered (6):
Brazil, Egypt, Peru, Sudan, Ukraine, Thailand
United Nations Scientific Committee on the Effects of Atomic Radiation

Status of assessment November 2012

The data management procedures have been established and shared with all experts. Gross checks with data from NGOs are under way. The source term analyses have been completed. Atmospheric dispersion simulations have been performed in close co-operation with WMO. The development of the methodology and marine dispersion simulations are ongoing.
Inhalation and ingestion dose evaluations for the public are ongoing.
Data analyses für worker exposures are underway after all relevant data have been provided.
A Health Implication Task (HIT) Group has been established to assess health risks to workers and the public.
Progress has been made with the analyses of non-human biota.
Submissions international organizations

- CTBTO
- FAO
- IAEA
- WHO
- WMO

Database on Radionuclides
Concentrations in Foodstuffs affected by the Fukushima Dai-ichi NPP Accident
Ingestion dose estimates

- The first year dose estimated using the measurement database – this has been calculated and checked.
- Database is food as marketed, so 100% of food assumed produced in the region of interest.
- The regions considered are Fukushima Prefecture, the five neighbouring prefectures combined, the rest of Japan.
- Key doses are for a 1 y old infant and adult but 10 y old children are also available.
Preliminary first year effective dose estimates for external exposure

UNSCAR assessment

WHO assessment

First year effective dose, mSv

- Date City
- Naraha Town (South trace)

- Wooden house
- Brick house
- Multistorey house

- Adult (indoor)
- Adult (outdoor)
- Child 1y
- Infant 1y
- Adult (indoor)
- Adult (outdoor)
- Child 10y
- Infant 1y
- Adult
- Child 10y
- Infant 1y
Dose assessment:
• Collected raw measurement data and comprehensive information on instrumentation and methods used for assessing the dose received to workers
• Performed internal dose assessment for the 12 workers with highest internal exposure and for 55 workers randomly selected in lower dose bands

Observed health effects:
• Collected comprehensive information about the 7 died workers (age, date and precise cause of the death, dose received before and after the accident, including external exposure and internal exposure)
• Collected comprehensive information on injuries observed in both contaminated and non-contaminated workers.
Background cancer mortality in Japan

Deviation of cancer mortality

Radiation risk 0.5%/100mSv

- Increase of lifetime risk due to radiation exposure, 100mSv: 0.5%, is estimated by ICRP, and 10mSv: 0.05%, 1mSv: 0.005% are assumed for RP.

- Japanese lifetime risk in cancer mortality. In 2009, it was 10% (averaging 25% for male and 16% for female). Therefore, the increase of lifetime risk means:
  - 20% → 20.5% (100mSv)
  - 20% → 20.05% (10mSv)
  - 20% → 20.005% (1mSv).

- On the other hand, there is a deviation due to location, approximately 15%, in annual cancer mortality in 2009. If the similar deviation is also observed in the lifetime risk in cancer mortality, the deviation would be equivalent to approximately 3% (20% x 0.45), which results in a deviation, such as 17% - 20% (average) - 23%, 90%.

- The main cause of the deviation due to location is supposed to be in the differences of daily lifestyle, e.g., dietary habits.

1) Lifetime risk due to radiation exposure defined by ICRP is obtained by taking into consideration loss of lifetime and the reduced quality of life associated with living with a serious illness, in addition to fatal cancer risk. This indicates that the lifetime risk is a little higher than the lifetime risk in cancer mortality.

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United Nations Scientific Committee on the Effects of Atomic Radiation
Preliminary dose and risk estimates

Preliminary dose estimation
from the nuclear accident
after the 2011 Great East Japan
Earthquake and Tsunami

Few people
in few areas \( \Rightarrow \sim 100 \)

VERY HIGH

TYPICALLY HIGH

AVERAGE

MINIMUM

Gonzales 2012

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Outlook
### Session document for 59th Session

- **Cover page** (1 page) – note by secretariat
- **Interim report**: progress and preliminary findings (1 page) → GA 2012

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### Session document for 60th Session

- **Cover page** (1 page) – note by secretariat
- **Key findings** (4 pages) → GA 2013

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### Extended

- **Detailed scientific report** (100~150 pages)
2013 (60th session)
- Radiation levels/effects from Fukushima accident
- Radiation risks and effects on children

2014 (61st session)
- Biological effects of selected internal emitters
- Revised methodology for assessing discharges
- Radiation exposure from electricity generation
- Epidemiology of low dose rate radiation risks

2015 (62nd session)
- Radiation exposures in medicine
The experience from both the Chernobyl and Fukushima accidents has clearly demonstrated the importance of distress and anxiety among the public and the workers, and concerns about the long-term implications of the accident. The work of UNSCEAR will be very important to provide an independent authoritative assessment of the long-term implications of radiation exposure from the radionuclides in the environment.
Epilogue

I also believe that UNSCEAR can contribute much to providing better background information to help improve understanding of the public and decision-makers about radiation and its effects. The effects of long-lived radioactive material in the environment will likely continue to be of concern long after the physical recovery from the tsunami is complete. The global community will need to respond in a coordinated and thoughtful manner in the coming years.
Thank you for your attention

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