Risks and Effects of Radiation: Putting Fukushima in Context

March 1, 2012
National Press Club
Washington, DC
Howard Dickson, CHP, CSP, CIH
Past President, HPS
Robert Peter Gale, MD, PhD, DSc (Hon)
Imperial College, London
Japan Deaths

Tsunami
20,000

Fukushima 0
## Atmospheric Release (PBq)

<table>
<thead>
<tr>
<th></th>
<th>$^{131}I$</th>
<th>$^{137}Cs$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chernobyl</td>
<td>1,800</td>
<td>80</td>
</tr>
<tr>
<td>Fukushima</td>
<td>130-160</td>
<td>6-15</td>
</tr>
</tbody>
</table>
Fukushima External Doses (10,000 people)

<table>
<thead>
<tr>
<th>Count</th>
<th>Dose Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,800</td>
<td>&lt; 1 mSv</td>
</tr>
<tr>
<td>4,100</td>
<td>1-10 mSv</td>
</tr>
<tr>
<td>71</td>
<td>&gt; 10-&lt; 20 mSv</td>
</tr>
<tr>
<td>2</td>
<td>20-23 mSv</td>
</tr>
<tr>
<td>Location</td>
<td>Effective Collective Dose (personSv)</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Chernobyl</td>
<td>225,000</td>
</tr>
<tr>
<td>Fukushima</td>
<td>3,000-8,000</td>
</tr>
</tbody>
</table>
Marshall Ferdinand Foch

“Airplanes are interesting toys but of no military value.”
### Increased Fukushima Cancer Risk

<table>
<thead>
<tr>
<th>Incidence</th>
<th>0.002%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>0.001%</td>
</tr>
</tbody>
</table>
Lifetime Cancer Risk

Smoker

Certainty

1 chance in 10

Childhood exposure to $^{131}$I in NTS fallout

1 in 100

Indoor radon never smoker

1 in 1000

Negligible Individual Dose

1 in 10,000

Single abdominal CT scan

1 in 100,000

Indoor radon smoker

1 in 1 million

Baseline
Lifetime Cancer Risk

- Indoor radon smoker
- Single abdominal CT scan
- Negligible Individual Dose
- Smoker
- Baseline
- Childhood exposure to $^{131}I$ in NTS fallout
- Indoor radon never smoker
- Fukushima

Certainty:
- 1 chance in 10
- 1 in 100
- 1 in 1000
- 1 in 10,000
- 1 in 100,000
- 1 in 1 million
1 in 100,000 Chance of Death

Smoking 14 cigarettes
Eating 25 cups of peanut butter
Spending 20 days in New York
Driving 600 km in a car
Flying 40,000 km in a plane
Kayaking 15 minutes
Receiving 1 mSv radiation
John Boice, ScD
Vanderbilt–Ingram Cancer Center
Health Physics Society Panel on Risks and Effects of Radiation following Fukushima National Press Club

Ongoing Health Effects Surveys
National and International Initiatives

John D. Boice Jr.
National Council on Radiation Protection and Measurements
Vanderbilt University Medical Center
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March 1, 2012
Population Exposure

Quick action taken to minimize adverse health consequences

- Evacuation
- Recommend to stay indoors
- Food restrictions
- Monitoring, masks
- Extensive population screening (200,000)

- 1,080 children examined for thyroid dose – lower than the screening level.
Worker Exposure

- Number of workers (30 Nov 2011) 17,671
- Average effective dose ~ 9 mSv
- Number > 100 mSv (none > 200) (external) 37
- Number > 100 mSv (external + internal) 99
- Number > 250 mSv (external + internal) 6
- Lifetime risk of developing cancer may be increased 1-2% for those > 100 mSv (external)

Above 50 mSv (external + internal) 410
U.S. Military Exposure
Internal Monitoring Preliminary

- Number monitored (2 Aug) 7,740 of 61,000
- Number > MDA 183 (2.4%)
- Average internal dose .04 mSv
- Highest internal dose 0.25 mSv

Operation TomoDachi (Operation Friends)

Stars and Stripes, July 20, 2011
Population exposures appear low -- but

- To show compassion, provide assurance, and reduce anxiety, health surveys are being conducted
- Provide medical care
- Mental health problems most likely consequence
Health Survey – Fukushima Residents

BASIC STUDY

- 2 million residents sent 10-page questionnaire
- To learn location, intake of food, baseline data
- 30 year follow-up planned, first year to cost 96 billion yen
- Purpose stated to alleviate anxiety

KOSHU EISEI JOHO (Public Health Information) 41(6):18-21, Sep 2011
Health Survey – Fukushima Residents

DETAILED STUDIES

1. Thyroid study of 360,000 < 18y, 2½ y started Oct 2011
2. Health exam, including blood samples of ~80,000 in the evacuation zone
3. Mental health, counseling of those in evacuation zone
4. Pregnant women and nursing mothers ~ 20,000

KOSHU EISEIJ HOHO (Public Health Information) 41(6):18-21, Sep 2011
Normile D. Newsmaker interview: Seiji Yasumura.
Science 333:684-5, 2011
Task Group 84 of the ICRP Main Commission
Initial Lessons Learned from the NPP Accident in Japan vis-á-vis the ICRP System of Radiological Protection

- This Task Group (TG) will compile lessons learned related to the efforts carried out to protect people against radiation exposure during and after the emergency exposure situation caused by the Nuclear Power Plant accident in Japan.

- A report is expected within a year, as are recommendations to the ICRP Main Commission on any other follow-up actions including potential improvements to the system of radiological protection.

- Approximately half of the members of the Task Group are experts from Japanese authorities, operators, and nongovernmental organizations.

**Membership**

| Abel González (Chair) (MC) | J aiki Lee (MC) |
| Makoto Akashi (NIRS) | Hans Menzel (MC/C2) |
| John Boice (MC) | Ohtsura Niwa (MC) (Kyoto University) |
| Masamichi Chino (J AEA) | Wolfgang Weiss (C4) |
| Toshimitsu Homma (C4) (J AEA) | Shunichi Yamashita (Nagasaki University and Fukushima Medical University) |
| Nobuhito Ishigure (C2) | |
| Michiaki Kai (C4) (Oita University) | Yoshiharu Yonekura (NIRS) |
| Shizuyo Kusumi (NSC) | |
Concerns/Issues to Consider

- Misuse of Risk Coefficients and Collective Dose
- Confusion over Quantities and Units
- Concern about Internal Doses
- Protection of Rescuers
- Level of Doses for Public Protection
- Radioactivity in Consumer Products
Concerns/Issues to Consider – 2

- Protection of Children
- Stigma (disgrace associated with being from Fukushima)
- Disposing Contaminated Rubble and Water
- Monitoring Policy
- What Is “Safe”
- Risk Communication and Perception
UNSCEAR Fukushima assessment: an honour and a challenge

Wolfgang Weiss, Chair of UNSCEAR

1st All-Expert Meeting for UNSCEAR Fukushima Assessment
30 January 2012
Four Expert Groups

A. Data compilation, quality assurance
   Compilation, screening, quality assurance, critical review

B. Radionuclide releases and dispersion
   Source term, atmospheric/marine dispersion/deposition

C. Dose and risk assessment
   Doses, effects and risks for public and non-human biota

D. Worker doses and health effects
   Doses for workers and rescuers, and health effects/risks
March 12-13, 2012 Annual Meeting, Bethesda

EMERGING ISSUES IN RADIATION PROTECTION IN MEDICINE, EMERGENCY RESPONSE, AND THE NUCLEAR FUEL CYCLE

Implications of the Fukushima Daiichi Accident for Radiation Protection - 8 Sessions including:

Childhood Exposure: An Issue from Computed Tomography Scans to Fukushima
Fred A. Mettler, Jr., New Mexico Federal Regional Medical Center

Reference Levels in the Context of Fukushima: Lessons Learned and Challenge to Radiation Protection System
Kazuo Sakai, National Institute of Radiological Sciences, Japan
March 11-12, 2013 Annual Meeting, Bethesda

RADIATION DOSE AND IMPACTS ON EXPOSED POPULATIONS

Including presentation on:

Two Year Results from the Fukushima Health Surveys
Shunichi Yamashita, Vice President, Fukushima Medical University

Scientific Committee 5-1, “Approach to Optimizing Decision Making for Late-Phase Recovery from Nuclear or Radiological Terrorism Incidents”
- Emphasizing lessons being learned from the Fukushima NPP accident
  -- Chair, SY Chen. Argonne National Laboratory
Kathryn Higley, PhD, CHP
Oregon State Univ.
Dept. of Nuclear Engineering
Today’s Panelists

- **John Boice, ScD** – Vanderbilt-Ingram Cancer Center
  - Member of the International Commission on Radiation Protection Task Group on Fukushima
  - U.S. delegation to the United Nations Scientific Committee on the Effects of Atomic Radiation

- **Howard Dickson, CHP, CSP, CIH** – Past President, Health Physics Society
  - Formerly Deputy Director of Technical Planning for TMI 2 Recovery

- **Robert Emery, DrPH, CHP, CIH** – University of Texas Health Science Center at Houston
  - Appointed member of Texas Radiation Advisory Board

- **Robert Peter Gale, MD, PhD, DSc (Hon)** – Imperial College, London
  - Medical consultant involved in Chernobyl and Fukushima accidents

- **Kathryn Higley, PhD, CHP** – Oregon State University, Dept. of Nuclear Engineering
  - Former Reactor Supervisor for the Reed College TRIGA reactor

- **Richard Vetter, PhD, CHP** – Mayo Clinic, Professor of Radiobiology and Radiation Protection
  - Former Radiation Safety Officer
  - Congressional and Agency Liaison, Health Physics Society
Thank You

Panelists are available for additional comment