HOW TO FACE CONCERNS OF RADIATION EFFECTS

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CONCEPT OF RADIATION PROTECTION
Radiation effects on the human body

- Non-cancerous (tissue reaction, deterministic effects)
  Infertility, skin erythema, hair loss, cataracts, etc.
- Non-cancer and Non-genetic effects

- Cancer and genetic effects (probabilistic effects)
Basic concept of radiation protection (1)

- Concept of radiation protection of the International Commission on Radiological Protection
  - Deterministic effects
    If the annual dose increases to nearly 100 mSv, the introduction of protective measures is justified at almost any time (prevention is possible if at the threshold dose or below).
  - Probabilistic effects
    For radiation doses that are under 100 mSv annually, there is a low probability of an increase in probabilistic effects, and it is assumed to be proportional to an increase in radiation dose exceeding the background dose. (LNT model).
    The protection level is determined after taking into account other risks and social factors.

The LNT model is the most practical approach to manage the risks of radiation exposure and appropriate as a precautionary principle. It is considered to be the basis for careful judgment regarding low-dose and low dose rate radiation protection.

Radiation is never considered to be zero risk. Uncertainty with low-dose and low dose rate is also taken into consideration.
Concept of radiation protection (2)

- **Justification**: Benefits > Harm

- **Optimization of protection**: Lower the possibility of exposure, the number of people exposed, and the individual dose as much as reasonably possible, taking into consideration social and economical factors. (ALARA principle)

- **Application of dose limits**: The total dose to any individual from a regulated radiation source should not exceed the limit.
Concept of dose limits

- Effective dose limits of workers in planned exposure situations:
  
  Average of 20mSv/y in a period of 5 years. The dose should not exceed 50mSv in any year.

  **Annual death probability**: Should not exceed $10^{-3}$

- Effective dose limits of the general public in planned exposure situations:

  1mSv per year

  **Annual death probability**: Should not exceed $10^{-4}$
EFFECTS OF THE FUKUSHIMA DAIICHI NUCLEAR POWER STATION ACCIDENT ON HEALTH AND THE ENVIRONMENT
Release of radioactive materials into the environment

- Total amount of radioactive materials released into the atmosphere
  - Iodine 131: $1.6 \times 10^{17}$ Bq
  - Cesium 137: $1.5 \times 10^{16}$ Bq
  - Strontium, plutonium: Extremely low

From the Results of Airborne Monitoring Survey by MEXT

Contamination of atmosphere, soil, ocean, rivers, agriculture and livestock products, and marine products, etc.
Exposure dose

- Collective dose: 99,000 man-mSv
  - Thyroid: 1/30 of the Chernobyl accident
  - Full body: 1/10 of the Chernobyl accident
- Thyroid dose: Tens of mSv (Mainly iodine131. Decreases in a few weeks)
  - (Child: 33 - 66mSv Adult: 8 - 24mSv)
- Effective dose: Less than about 10mSv/year (Mainly cesium 134, 137)
- Exposure through food ingestion: Approx. 0.2mSv /year
  - (United Nations Scientific Committee on the Effects of Atomic Radiation)
  - 0.003(Tokyo)-0.02mSv(Fukushima) in a year (Ministry of Health, Labor, and Welfare)
  *Low compared to exposure through natural radiation (2.1mSv/year).
Viewpoint of the UNSCEAR

- Based on the experiences of the Chernobyl accident, special attention is required in addition to physical and social effects.
- Many people are suffering and had no choice but to leave their homes, and are concerned about long-term effects regarding their lives, the future, and their children’s health, etc.
- Long-term medical follow-up is important in order to understand the future health conditions of people who were exposed to radiation.
- Exposure dose to people in Japan is low or extremely low, and the radiation health risks in their future lives are low.
- Protective measures (sheltering, evacuation) reduces potential exposure to 1/10.
Handling of concerns regarding health effects

- Fukushima Health Management Survey
  Implementation of continuous long-term health survey management for all prefectural residents, including care on mental health as well as radiation effects.
  - Dose evaluation
  - Thyroid tests
  - General health examinations
- Nation-wide test of radioactive material concentration in food
Evacuees and earthquake-related deaths

- Number of evacuees: Inside Fukushima Prefecture: 92,770 people
  Outside Fukushima Prefecture: 53,277 people  (As of July 4, 2013)
- Number of earthquake-related deaths: 2,688 people in 10 prefectures
  (As of March 31, 2013)

- Physical/mental fatigue from life at evacuation centers, etc.
- Physical/mental fatigue while being transported to an evacuation center, etc.
- Delay in initial treatment due to shutdown of hospitals, etc.
Response to prevent earthquake-related deaths

- Implementation of recovery-related measures to accelerate the recovery and reconstruction of Fukushima and reconstruct the lives of the victims, etc.
  - Supporting residents in returning home, anti-devastation measures of the regions, forming a living base for long-term evacuees
  - Early restoration of infrastructure and treatment of disaster waste
  - Industry development and job security
  - Development of disaster-recovery public housing for long-term evacuees
- Preventing isolation and mental healthcare, such as activities to watch over victims, etc.
- Coordination between relevant prefectural departments and agencies and the prefectural police headquarters
- Projects to support the health of victims and create a network for elderly citizens, projects to support the recovery of local communities, etc.
Budget for recovery from the nuclear disaster
(Reconstruction Agency)

Total amount: 2013 726.4 billion yen (2012 465.5 billion yen)

Decontamination, etc.
• Decontamination of soil, etc., contaminated by radioactive material 497.8(372.1) billion yen
• Treatment of waste contaminated with radioactive material 97.1(77.2) billion yen
• Efforts to install interim storage facilities 14.6(2) billion yen

Accelerating the return of residents/preventing the deterioration of the region
• Accelerating the recovery of and return of residents to Fukushima nuclear evacuation zones, etc. 4.8(—) billion yen
• Development of living conditions in regions where the Fukushima evacuation order was lifted, etc. 2.4(4.2) billion yen

Supporting long-term evacuees
• Subsidies to form living bases for long-term evacuees 50.3(—) billion yen

Environmental development for permanent residence
Emergency support subsidies for permanent residence in Fukushima 10(—) billion yen

Recovery of the local economy
• Renewable energy support 10.3(—) billion yen
• Countermeasures against harmful rumors 1.3(0.6) billion yen
CONCERNS ABOUT RADIATION (OPINIONS OF THE GENERAL PUBLIC)
Concerns regarding the lives of Fukushima residents

Typical questions in local dialogue forums, etc.

- Food and drinking water standards and safety
- Epidemiological study results (atomic bomb, India, Chernobyl)
- Concept of radiation risks and dose standards
- Exposure dose to oneself and residents
- Information on emission sources and environmental behavior of radioactive materials
- Requests
- Other

Interim Report, Radiation Effects Subcommittee, Committee for Investigation of Nuclear Safety, Atomic Energy Society of Japan (September 2012)
Concerns of the public (including Fukushima residents)

Question handling method: Response to questions on academy websites
Number of questions: 1,870 questions
Location of people asking questions: Tokyo, Chiba, Fukushima, Kanagawa, Saitama, etc.
Gender of people asking questions: Women 43%, Men 17%, undisclosed 40%
Age of people asking questions: Teens - 60s (21% in their 30s)

- Representative questions
- Health effects on themselves and on children
- Hot-spots
- Food and beverages (contamination and health effects caused by ingestion)
- Decontamination, contamination, etc.

Some comments claim that there is a tremendous amount of information on the mass media and the Internet, not all the information is not credible, and experts, operators and the government cannot be trusted.

From the HP of the Q&A regarding radiation in our lives answered by experts of the Japan Health Physics Society
Handling the public’s concerns

- Respond to all questions
- Provide accurate scientifically-based knowledge on radiation
- Explain that there is no such thing as zero risk and there is always uncertainty
- Make an effort to achieve two-way conversation, rather than enlightenment.
- View things from the perspective of the people asking questions (understand the difference in awareness between experts and the public)
- Be accountable for responses.

It is extremely difficult to have the public understand the risks. Messages from operators, the government, and experts are difficult to be accepted.

In order to promote intellectual interaction, a neutral facilitator is necessary.
Summary

- It is thought that the health effects (risks) of radiation on the public due to the Fukushima Daiichi Nuclear Power Station accident is small.
  
  → However, even if small, this is a big concern for the public.

- Evacuation, etc., is a big burden both physically and mentally. Factors other than radiation increase health risks.

- Long-term follow-up is required for health effects.

- Long-term response is required for decontamination.

- Response to the nuclear accident and recovery of the environment involve enormous costs.

- Human resource development is indispensable to promote public understanding and tolerance towards radiation risks.