

**Preparedness for Future Nuclear Emergencies
-Based on Lessons Learned from TEPCO
Fukushima Daiichi NPP Accident-**



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Deliberation and Review by Expert Meeting

1 Objectives of the establishment of the expert meeting

- Consideration of long-term healthcare for emergency workers at the TEPCO Fukushima Daiichi Nuclear Power Plant exposed beyond regular dose limits.
- Deliberation of adequate medical and health care systems, dose control and special education in the case of future nuclear emergencies.

2 Deliberated issues at the meeting

- A) Management of long-term healthcare of former emergency workers
 - B) Medical examinations during the emergency works
 - C) Adequate mid- to long-term dose control for the emergency workers exposed beyond the regular dose limit during emergency works
 - D) Adequate healthcare during the emergency works
 - E) Special education provided to exceptional emergency workers
- (Note) Underlined items are those related to the revision of the ministerial ordinance.

1. Dose Control during Emergency Works (Objectives)

Experience at the Fukushima Daiichi NPP Accident

- **After the nuclear emergency declaration, an emergency dose limit of 250 mSv was stipulated in the exemption of the Ministerial Ordinance** while balancing health risks of the workers and the benefits of protecting life and property of the neighboring residents.
- In light of the principle of optimization, the application of the limit was limited in a step-by-step manner and **the exemption of the Ministerial Order was abolished when the stability of the nuclear reactors was ensured.**

1. Dose Control during Emergency Works (Objectives)

Principles

● ICRP's Principles of Justification

- ◆ Emergency dose limit beyond 100 mSv needs a special justification.
 - Reason used in international documents is **“to avoid a catastrophic situation”**.
 - Application should be limited to those workers who can respond to such a situation (**with sophisticated knowledge and skills**).

● Concept of the emergency dose limit

- ◆ Base on the experience in the Fukushima Accident, **necessity** of limits **beyond 250 mSv** is **unforeseeable** at this point.
- ◆ For **ensuring prevention of depression of the immune function, it is conservative, yet appropriate to adopt 250 mSv , which certainly falls below the threshold value.**

● Emergency management for a nuclear disaster

- The “catastrophic situation” is defined in the Act as the case of a **“state of nuclear emergency”** or a **“situation highly likely to lead to the state”**.
- For emergency management, **emergency responses need to be taken immediately.**

● ICRP's Principles of Optimization (minimize the dose)

- ◆ **Limit the application of the emergency limit and conduct the step-by-step reduction of the limit** as early as possible, depending on the work progress.
- ◆ **Lift the exceptional emergency limit immediately if** the stability of the nuclear facility is secured.

1. Dose Control during Emergency Works (Ordinance)

(1) Setting of the exceptional emergency dose limit

- In consideration of the situation of emergencies and other circumstances, **the MHLW may set a special dose limit (exceptional emergency dose limit)** not exceeding 250 mSv in the case that the Minister acknowledges that **it is difficult to observe the dose limit of 100 mSv for completion of the emergency works.**
- In a **state of a nuclear emergency** or **a situation highly likely to lead to the state***, the MHLW shall **immediately determine the exceptional emergency dose limit 250 mSv.**
- The MHLW shall **lift the limit as early as possible** by taking into consideration the dose of the emergency workers, and further required works to control the accident.
- When the MHLW has determined, changed or lifted the exceptional dose limit, the MHLW shall **issue a public notice** to that effect.

1. Dose Control during Emergency Works (Ordinance)

(2) Limitation of exceptional emergency workers

- The exceptional emergency workers should be selected from among the nuclear **disaster prevention workers*** specified in the Act on Special Measures Concerning Nuclear Emergency Preparedness.

* **This refers to those workers specified in the nuclear operator disaster prevention plan. The nuclear disaster prevention workers are the workers under the nuclear facility employer, in principle.** In the case that a nuclear facility employer **outsources**, in accordance with the laws and regulations, **part of the works (e.g. remediation of damaged equipment), the workers belonging to the outsourced operator shall be included among the nuclear disaster prevention workers.**

1. Dose Control during Emergency Works (Ordinance)

(3) Optimization of dose control for exceptional emergency workers

- Employers **shall ensure that the dose of workers will not exceed the exceptional dose limit** during the exceptional emergency works.
- Employers **shall make efforts,** depending on the circumstances of the accident, **to minimize the dose to which exceptional emergency workers are exposed.**

(4) Monitoring and recording of dose, and reporting to the MHLW

- Employers shall conduct **internal and exposure measurements once within one month.**
- Also, employers shall calculate and record the **cumulative effective doses monthly, annually and in every 5 years,** and preserve records for 30 years.
- Employers shall **periodically report** the dose distribution and **records of medical examinations and the dose** of individual emergency workers to the MHLW.
 - These records are stored in the **database operated by the MHLW** for long-term healthcare management of the former emergency workers.⁶

2. Special Education Provided to Exceptional Emergency Workers

Principles

- The purpose of special education is to **reduce doses of the workers** during the exceptional emergency works by **ensuring their understanding of risks** such as **potential health effects of radiation exposure** as well as giving **knowledge and skills** for emergency works and wearing **personal protective equipment**.
 - Target of the education is **those workers who have already had the special education for regular radiation workers**
- Limited to those workers who have **sophisticated knowledge and skills to respond to emergencies**.

2. Special Education Provided to Exceptional Emergency Workers

Subjects of Special Education

- When assigning workers to the exceptional emergency work, employers shall provide workers with the special education for the following subjects.

< Lectures (6.5 hours) >

- (1) Structures and operation of facilities and equipment to be used in exceptional emergency works (2 hours),
- (2) Work methods involved in exceptional emergency works (3 hours),
- (3) Health effects of radiation exposure and the dose control method (1 hour)
- (4) Relevant laws and regulations (0.5 hours)

< Practices (6 hours) >

- (1) Operation of the facilities and equipment to be used for exceptional emergency works (3 hours)
- (2) Work methods involved in the exceptional emergency works (3 hours)

3. Healthcare during Emergency Works

Emergency Ionizing Radiation Medical Examinations

- Employers shall provide medical examinations for the following items* to the emergency workers once within one month periodically, when workers are transferred from emergency works to other works or at the time of termination of their employment.
 - a. Subjective and objective symptoms
 - b. White blood cell (WBC) count and differential WBC count
 - c. Red blood cell count and hemoglobin content or hematocrit
 - d. Thyroid stimulating hormone (TSH), free triiodothyronine (T3) and free thyroxine (T4)
 - e. Eye examination for cataract
 - f. Skin examination

* Employers can **omit the medical examinations** for items other than a) in the case that **physicians recognized those examinations are unnecessary.**
- Employers shall conduct recording, hearing of opinions from the medical doctor, and notifying workers, and employers shall take aftercare measures in accordance with the medical examination results.

4. Long-term Healthcare after the Emergency Works (Ministerial Guideline)

Principles

- Medical examinations of emergency workers such as cancer screening in accordance with the Ministerial guideline were reviewed based on the state of the art knowledge.

Healthcare after the emergency

- Newly added screening items for workers exposed to more than 100 mSv
 - Cancer screening items (Chest CT and colonoscopy)
 - Infectious disease tests (pylori antibody test and hepatitis screening), and mandated neck ultrasound test for thyroid gland inspection
 - Chronic kidney disease test (renal function test) and antismoking education
- Implementation of a stress check
 - To be provided to all emergency workers as much as possible
 - Support by nuclear facility employers and primary contractors to related contractors in implementing the check.

5. Dose Control for Workers Exposed beyond the Dose (Ministerial Guidelines)

Principle

- For the dose control term including the time of accident occurrence (5-year term), the concept that allows **a certain margin** should be adopted regarding application of the dose limit for regular radiation works only if it is inevitable to do so in order to guarantee safe operation of the nuclear facility.

Workers exposed beyond dose limits in the 5-year period including the outbreak of accidents

- Employers may assign regular radiation works to a worker whose total dose (the emergency dose and the regular dose) exceeds 100 mSv/5-year period, where radiation exposure is additionally being controlled under **5 mSv/year, only if he/she is a member of the essential human resources needed to guarantee safe operation of the nuclear facility**

5. Dose Control for Workers Exposed beyond the Dose (Ministerial Guidelines)

Principles

- Employ lifetime dose of 1 Sv as used by the ICRP as a base for setting dose limit
 - **Mid- to long-term dose control not to be exposed beyond the dose limit for regular radiation works (100 mSv/5 year and 50 mSv/1 year) as well 1 Sv for the lifetime for cumulative dose (total of emergency dose and regular dose)**

Workers exposed beyond the dose limits during subsequent 5-year periods

Employers shall set the additional dose limit in the following manner

- Dose limit for 5 years* = **(Remaining dose/Remaining working period) x 5 years**
 - **Remaining dose**: Dose for the lifetime (1 Sv) minus cumulative dose (total of emergency dose and regular dose)
 - **Remaining working period**: Age when he/she is to retire (68 supposing that a worker starts working at age 18 and works for 50 years) minus the current age
- Example: Emergency dose = 500mSv, regular dose = 100 mSv (cumulative dose = 600mSv); age = 45
 - $(1000 \text{ mSv} - 600 \text{ mSv}) / (68 - 45) = 17.4 \text{ mSv/year}$
 - Dose limit per 5-year period: $17.4 \text{ mSv/year} \times 5 \text{ years} = 87 \text{ mSv} \Rightarrow 85 \text{ mSv}$ (by rounding down)

* The dose limit for regular works (100 mSv/5 years) shall not be exceeded.