Annex 2

Report from the Expert Meeting on Radiological Protection for Decontamination and Related Works

28 November 2011

Expert Meeting on Radiological Protection for Decontamination and Related Works

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I Outline of the expert meetings and the participants

1. Objective

The "Act on Special Measures Concerning the Handling of Environmental Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District Off the Pacific Ocean Earthquake That Occurred on 11 March 2011" requires the Ministry of the Environment (MOE) to prescribe the criteria for decontamination related works and treatment of waste to remove radioactive materials discharged by the accident of TEPCO Fukushima Daiichi Nuclear Power Plant associated with the Tohoku-Pacific Ocean Earthquake on 11 March 2011 (hereinafter referred to as "the nuclear accident"). To be consistent with the criteria, it is necessary to study measures for radiological protection of workers who are engaged in decontamination related works.

Therefore, the Ministry of Health, Labour and Welfare (MHLW) invited experts to hold study meetings regarding proper measures for radiological protection of workers engaged in decontamination related works, such as exposure control, actions for radiological protection, and medical examinations.

2. Issues studied

(1) Work

a. Decontamination related works associated with radioactive materials discharged by the nuclear accident

b. Treatment, disposal, and transportation of waste contaminated with radioactive materials discharged by the nuclear accident

c. Any other relevant work

(2) Actions for radiological protection

a. Exposure control methods

b. Actions to reduce external exposure

c. Actions to prevent spread of contamination and protect against internal exposure

d. Education for workers

e. Actions for health care

f. Others

3. Organizational constitution

(1) The director of the Industrial Safety and Health Department., the Labour Standards Bureau, MHLW (Director of the Office for Radiation Protection of Workers at Fukushima Daiichi

NPP) invites experts listed in the attachment to hold the expert meetings.

(2) The chair is assigned and facilitates discussion in the expert meetings.

(3) Participants in the expert meetings can be added as required.

(4) This working group is entitled to ask individuals other than the participants for participation.

4. Others

(1) The expert meetings should be basically open to the public. It should be noted, however, that the working group is entitled to conceal personal and confidential business information that is handled in the meetings.

(2) Administration of the expert meetings are handled by the Industrial Health Division, the Industrial Safety and Health Department., the Labour Standards Bureau, and MLHW.

Participants (in Japanese alphabetical order)

Masahiro Osako	Director, Research Center for Material Cycles and Waste Management, National Institute for Environmental Studies
Shinji Kaneko	Researchers for impact assessment of radioactive material, Forestry and Forest Products Research Institute
Kyo Kobayashi	Director, Farm Mechanization Division, Agricultural Research Center, National Agriculture and Food Research Organization
Nobuyuki Sugiura	Director, Research Center for Radiation Emergency Medicine, National Institute of Radiological Sciences
Shinichi Nakayama	Deputy Director, Fukushima Environmental Safety Center, Japan Atomic Energy Agency
Shunji Nagoya	Professor, Faculty of Science and Engineering, Waseda University
Sadaaki Furuta	Director, Radiation Protection Department, Nuclear Fuel Cycle Engineering Laboratories, Tokai Research and Development Center, Japan Atomic Energy Agency
Yoshimi Matsumura	Councilor, Technology Institution of Industrial Safety
Koji Mori (Chair)	Professor, Occupational Health Training Center, University of Occupational and Environmental Health, Japan

Observer

Masashi Hiroki	Director, Industrial Waste Management Division, Waste Management and Recycling Department, Ministry of the Environment

Toru Nagahama (The 1st and 4th meetings)	Deputy Director, Soil Environment Management Division, Environment Management Bureau, Ministry of the Environment
Kensuke Mizuhara (The 2nd and 3rd meetings)	Deputy Director, Water Environment Division, Environment Management Bureau, Ministry of the Environment

II Schedule of the expert meetings

The 1st expert meeting: 21 October 2011
The 2nd expert meeting: 31 October 2011
The 3rd expert meeting: 14 November 2011
The 4th expert meeting: 21 November 2011

III Contents that need to be incorporated into the measures

Part 1 Objectives

Necessary measures should be taken for the radiological protection of workers who are engaged in decontamination related works, in accordance with the "Act on Special Measures Concerning the Handling of Environmental Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District Off the Pacific Ocean Earthquake That Occurred on 11 March 2011" which applies to decontamination related works and treatment of waste to remove radioactive materials discharged from the accident of TEPCO Fukushima Daiichi Nuclear Power Plant associated with the Tohoku-Pacific Ocean Earthquake on 11 March 2011 (hereinafter referred to as "the nuclear accident").

These measures specify provisions of dose control, actions for work and medical examinations, which will be required for protecting workers from radiation hazards when employers assign them to decontamination related works. The measures include not only restrictions that will be specified in laws and regulations, but also guidelines that should be actively used to address issues. These measures aim for the radiological protection of workers engaged in decontamination related works, and at the same time, are intended to be used for residents and voluntary workers as well.

As these measures were studied with limited information in a limited period of time, they should be reviewed if necessary, while additional information and findings will continue to be collected.

Part 2 Workers subject to exposure dose control and methods for exposure dose control

1. General Principle

   Employers should strive to minimize the amount of ionizing radiation that workers may receive.

2. Dose measurement

   (1) Employers conducting decontamination of soil, etc. or treatment of waste [(Note 1)] (hereinafter such employers works are referred to respectively as "employers of decontamination works, etc." and "decontamination related works") should measure the effective exposure doses of workers engaged in the decontamination related works, according to the cases described in items a and b below using a specified method for each case.

   (Note) See Annex 1 for determination on the applicability of the Ordinance on Prevention of Ionizing Radiation Hazards (Ionizing Radiation Ordinance) and new measures. It should be noted, however, that waste treatment facilities such as water supply and sewerage treatment facilities, incineration facilities, interim treatment facilities, and landfill disposal sites where significant exposure is expected from sludge in water and sewage facilities and ashes (these are radiation sources under control) should be subject to the Ionizing Radiation Ordinance even if the facility is located in the decontamination area. Furthermore, when conducting work such as cutting trees, trimming branches, and digging soil, it is recommended that employers take necessary action such as exposure dose control among those actions for each activity prescribed in the Annex1.

   (Note 1)"Work such as decontamination of soil, etc. and treatment of waste" means the work associated with: (a) decontamination of soil, etc. [(Note 2)], (b) collection, transportation, storage and disposal of removed soil (whose total concentration of Cs-134 and Cs-137 exceeds 10,000 Bq/kg) and; (c) treatment [(Note 3)] of waste contaminated by radioactive materials discharged by the accident (whose total concentration of Cs-134 and Cs-137 exceeds 10,000 Bq/kg), conducted in areas where the average ambient dose rate of the workplace exceeds 0.23 μSv/h (equivalent to 1 mSv/y assuming that workers work outdoors for 8 hours and indoors for 16 hours).

   (Note 2)"Decontamination of soil, etc." includes work for removing soil, fallen leaves and branches, and sludge accumulated in waterways which came from soil, plants, structures and others contaminated by radioactive materials discharged by the accident, and works for preventing spread of such contamination.

(Note 3)"Treatment of waste" includes collection, transportation, storage, interim treatment, and landfill disposal of waste.

a. The case when workers are assigned to decontamination related works in areas where the average ambient dose rate (Note) exceeds 2.5 μSv/h (5 mSv/y under 40 hours/week and 52 weeks/y)

(Note) See Annex 2 for the criteria for measuring and evaluating average ambient dose rates.

- External exposure dose: measured with personal dosimeters (Note)

(Note) The measurement method should be the same as that specified in the Ionizing Radiation Ordinance.

- Internal exposure dose: measured according to specific work and the concentration of radioactive material in soil to be handled

b. The case when workers are assigned to decontamination related works in the areas where the average ambient dose rate is equal to or below 2.5μSv/h (5mSv/y under 8 hours/week and 16 weeks) and exceeds 0.23μSv/h (1mSv/y under 8 hours for outdoor works and 16 hours for indoor works)

- It is desirable to measure external exposure with personal dosimeters; however, evaluation based on ambient dose measurement of a representative worker is also acceptable.

(2) When conducting decontamination related works in their own sites or facilities, employers except those of decontamination work, etc. should assign workers to the work only in the workplace where the average ambient dose rate is equal to or below 2.5 μSv/h (5 mSv/y under 8 hours/week and 52 weeks/y) and within a few dozen times (days) per year (Note 1). It is recommended that this be applied in the same manner to those who are self-employed workers, residents (Note 2) and voluntary workers (Note 3).

(Note 1) The radiation exposure dose is substantially below 1 mSv/y, when decontamination work is conducted a few dozen times (days) per year in the areas where the average ambient dose rate ranges from 0.23 μSv/h to 2.5 μSv/h.

(Note 2) Decontamination work may be conducted as per community in the areas exceeding 2.5 μSv/h if it is necessary for residents and self-employed workers to decontaminate their own houses, offices, agricultural lands and others.

(Note 3) When recruiting volunteers from outside of decontamination areas, organizers of volunteer groups should note that ICRP specifies the limit of exposure to radiation sources as 1 mSv/y for the public under a deliberate exposure situation.

Additionally, if the organizers of volunteer groups are obliged to recruit volunteers for work that may cause exposure exceeding 1 mSv/y, they should note that they need to take actions (dose control, education, preventive measures against spread of contamination) for their volunteers in the same manner that employers do.

(3) The following methods should be used to measure internal exposure stated in (1) a.

	Soil with high radioactivity concentrations (Note 2) (> 500,000 Bq/kg)	Soil other than the soil with high radioactivity concentrations (≤ 500,000 Bq/kg)
Work under high dust concentration (Note 1) (> 10 mg/m^3)	Measure internal exposure once every three months (Note3)	Screening (Note4)
Work other than the above (10mg/m^3 ≤)	Screening (Note4)	Screening (Note4) (Note 5)

(Note) See Annex 3 for how to determine the lower limit of work under high dust concentration and soil with high radioactivity concentrations. It is desirable that dust with high radioactivity concentrations should be determined by qualitative type of work in order to avoid measuring dust. However, numerical values are the only indication at this moment due to lack of such data. By accumulating measurements of dust concentration during work, we will strive to collect data to indicate work under high dust concentration by qualitative type of work in the future.

(Note 1) See Annex 4 for the method for determining of work under high dust concentration. The screening of work under high dust concentration is to understand whether dust concentration exceeded the lower limit of high-level dust concentration during the activity. Thus, measurement is not required when it is obvious that concentrations are below the lower limit. Measurement is only required for the work which is expected to generate a certain amount of dust (e.g., scraping of soil, grinding and chipping of asphalt/concrete surface, weeding, removed soil packing, demolition of structures).

(Note 2) See Annex 5 for the method for measuring concentrations of radioactive materials in the objects to be decontaminated such as soil. Almost no soil that exceeds 500,000 Bq/kg has been found in the areas except the deliberate evacuation area and the restricted area. Therefore, in the areas below 2.5 μSv/h,

soil in which the concentration of radioactive material is considered to be high should be carefully selected and measured. A simplified method (details are separately under review) by calculating the concentration of radioactive material in soil from the surface dose rate (μSv/h) is acceptable to measure the concentration.

(Note 3) See Annex 6 for the concept of internal exposure measurement. All the workers who handle soil with high radioactivity concentrations and are engaged in work under high dust concentration are required to take internal exposure measurement once every three months. Screening specified in (Note 4) should be also conducted every time, at the end of the work.

(Note 4) In the primary screening, the count per minute (cpm) on the surface of a dust mask is measured. The count of 10,000 cpm should be used as the contamination limit value (equivalent to approximately 0.01 mSv supposing that 50% of radioactive material attaches on the mask surface while the rest is inhaled under a strict assumption that defines 2 as the Working Protection Factor, although 3 is expected normally. If the measurement exceeds the contamination limit in the primary screening, a nasal smear test should be conducted as the secondary screening. 10,000 cpm (equivalent to the internal exposure effective dose of approximately 0.3mSv) should be used as the limit specified in the criteria. If the measurement exceeds the limits specified in the criteria, internal exposure should be measured once every three months (by the method prescribed in the Ionizing Radiation Ordinance). It should be noted that if measurement of a woman who can be pregnant from a medical standpoint exceeds the limit specified in the criteria of the secondary screening, internal exposure should be measured immediately.

(Note 5) This screening test is conducted when one is suddenly exposed to dust with a high radioactivity concentration.

3. Radiation exposure dose limit (Note)

(1) Employers of decontamination work, etc. should ensure that the sum of the effective doses of workers which are measured by each method specified in the cases of 2 (1) a and b does not exceed limits below.

a. For men, and women with no possibility of pregnancy: the effective dose limits are 100 mSv per five years, and 50 mSv per year.

b. For women with possibility of pregnancy: the effective dose limit is 5 mSv per three months.

c. For pregnant women: the effective dose from internal exposure – 1 mSv, and the equivalent dose received on the surface of her abdomen – 2 mSv

(Note) The equivalent exposure dose of eye lens will not exceed the limit (150 mSv/y) during decontamination related works as long as the effective dose of the entire body is below the limit 50 mSv because it is unlikely that only eyes are exposed to high radiation. The equivalent exposure dose of skin will not exceed the limit (500 mSv/y) as long as the effective dose of the entire body is below the limit (50 mSv) because the equivalent dose of skin due to beta ray exposure is unlikely to exceed ten times higher than that of gamma ray exposure during normal work.

4. Recording dose measurement results

(1) Employers of decontamination work, etc. should determine exposure doses of the workers below based on the measurement results in Section 2 or calculation results by using the method specified in the Ionizing Radiation Ordinance, and record and keep them for thirty years. It should be noted however, that this should not apply when the records are transferred to the organization specified by the Minister of Health, Labour and Welfare after saving them for five years.

a. The sums in every three months, every year, and every five years of the effective doses for men, or women who have no possibility of pregnancy from a medical standpoint (the sums in every three months and every year for those whose annual effective doses have not exceed 20 mSv/y for five years)

b. The sums in every month and every three months of the effective doses for women who have possibilities of pregnancy from a medical standpoint (the sums in every three months and every year for those whose monthly effective doses may not exceed 1.7 mSv for a month)

c. The sums of effective dose from internal exposure and equivalent dose that a pregnant woman receives on the surface of her abdomen in every month and during pregnancy

(2) Employers of decontamination work, etc. should notify workers of the records regarding (1) without delay.

(3) Employers of decontamination work, etc. should transfer the records stated in (1) to the organization specified by the Minister of Health, Labour and Welfare when intending to terminate its business.

(4) Employers should issue a copy of the record stated in (1) to workers engaged in decontamination related works at the time of his resignation.

Part 3 Actions to reduce radiation exposure

1. Preliminary investigation
   (1) Employers of decontamination work etc. should investigate the following items regarding the workplace and record the results before decontamination related works are undertaken.
      a. Condition of the workplace
      b. Average ambient dose rate (μSv/h) at the workplace (Note 1)
      c. Concentration of radioactive material in the objects to be decontaminated, such as soil (Note 2)

      (Note 1) See Annex 2 for the criteria of measuring and evaluating average ambient dose rates.
      (Note 2) See Annex 5 for the method for measuring concentrations of radioactive materials in the objects to be decontaminated such as soil.

2. Development of work plans and implementation of the work plans
   (1) Employers of decontamination work, etc. should develop a work plan for decontamination-related works beforehand based on the preliminary investigation, and undertake the work according to the work plan.
   (2) The work plan should include:
      a. Method for measuring exposure doses of workers
      b. Workplace
      c. Type and capabilities of machines and tools to be used.
      d. Work methods
      e. Actions to reduce exposure
      f. Emergency actions in case of occupational accidents
   (3) Workplace includes:
      a. Rest area where workers can eat, drink and/or smoke (Note 1)
      b. Screening point (contamination inspection area for workers leaving the workplace and items to be taken out) (Note 2)

      (Note 1) See Annex 7 for the criteria for setting a place for eating, drinking and smoking.
      (Note 2) See Annex 8 for the criteria for setting a contamination inspection area and determining the contamination inspection method.
   (4) Work methods include:

      Organizational structure of workers, how to use machines or tools, work procedures, working environment, etc.

(5) Actions to reduce exposure include:
   a. Method for measuring average ambient dose rate
   b. Methods for mitigating exposure, such as shortening work duration
   c. Setting a target value of radiation exposure dose based on its estimate

3. Operation leader
   (1) Employers of decontamination works, etc. should assign a person to take leadership in decontamination related works and to perform the actions below.
      a. Decide work procedures and allocate workers based on the work plan, and directly supervise the work.
      b. Hold a meeting regarding work procedures prior to work.
      c. Inspect machines and tools to be used prior to work to remove defective ones.
      d. Prohibit anyone except those required from entering the workplace.
      e. Monitor the status of use of radiation survey meters.
   (2) Work procedures should include:
      a. Method for managing working hours
      b. Working method, workplace, and place for standby as per work procedure

4. Submission of work notification
   (1) When conducting decontamination work etc. at a workplace where the average ambient dose rate exceeds 2.5 μSv/h, employers of decontamination work, etc., who were assigned work directly by an orderer (primary contractor), should submit a "decontamination work notification" (Note) to the relevant Labour Standards Inspection Office.
   (Note) The work notification should be submitted as per order in principle. However, it can be submitted as per place when the order includes several kinds of decontamination work in distant places.
   (2) Decontamination work notification includes:
      a. Name of the employer (primary contractor)
      b. Name of the orderer
      c. Name of the work (name of the work ordered)
      d. Workplace
      e. Work period
      f. Name of the operation leader
      g. List of involved subcontractors and estimate number of workers

Part 4 Actions to prevent spread of contamination and protect against internal exposure

1. Preventing spread of contamination

(1) When conducting work such as scraping soil that may disperse dust with high radioactivity concentrations during decontamination-related works, employers of decontamination work, etc. should take actions to control dust dispersion such as by maintaining removed soil in a wet state beforehand.

(Note) It is recommended that making soil wet is done by spraying water instead of sprinkling it with a hose in order to reduce the amount of contaminated water.

(2) When collecting, transporting, and storing removed soil or waste (hereinafter referred to as "removed soil, etc.") during decontamination related works, employers of decontamination work, etc. should use containers (Note) to prevent dispersion or discharge of removed soil. Note however, that this should not be applied when effective measures were taken to shield external radiation or prevent spread of contamination from the removed soil, which is extremely difficult to put in containers.

(Note) The standard for containers should be consistent with the ordinance of the Ministry of the Environment.

(3) Employers of decontamination work, etc. should take the actions below when storing removed soil in decontamination related works.

a. Take necessary actions to prevent dispersion or discharge of removed soil.

b. Indicate with signs that removed soil is stored.

c. Take actions to keep out all except those required, such as by building fences.

(Note) "Fences" can mean simple objects such as safety cones.

2. Preventing spread of contamination by workers

(1) Employers of decontamination work, etc. should set a contamination inspection area (Note 1) near the workplace for decontamination related works, and inspect the contamination levels of workers' bodies and their gear when they leave the workplace.

(2) When the inspection result shows that a worker's contamination level exceeds the contamination limit (Note 2), the employers should make him or her stay until the following actions are taken:

a. Contaminated body should be washed until the contamination level falls to the surface contamination limit or below.

b. Contaminated gear should be taken off or detached.

(Note 1) See Annex 8 for where to set a contamination inspection area.

(Note 2) The contamination limit should be 40 Bq/cm^2 (13,000 cpm as a count value).

(3) Employers of decontamination work, etc. should set a contamination inspection area near the workplace for decontamination related works, and inspect the contamination levels of workers' items when they are taken out of the workplace. It should be noted however, that this should not be applied when such items are transported to a workplace for other decontamination related works after measures were taken to prevent the spread of contamination, such as by putting them in a container.

(4) When the inspection (Note 1) result shows that the contamination level of the item exceeds the contamination limit (Note 2), the item should not be taken out of the workplace. It should be noted however, that this should not be applied when such items are transported to a facility and other places for removing contamination after measures were taken to prevent the spread of contamination such as by putting them in a container.

(Note 1) See Annex 8 for how to inspect item contamination.

(Note 2) The contamination limit should be 40Bq/cm^2 (13,000cpm as a count value).

(5) Employers of decontamination work, etc. should take the following actions which are effective to prevent contamination of bodies, equipment, or items from exceeding the limit:

a. Replacement of shoes, replacement and/or disposal of clothes, gloves, protective equipment
b. Curing of machines and/or tools and other systems before use and decontamination of those after use
c. Curing during transportation of removed soil
d. Maintaining cleanliness at workplaces.

3. Protection against physical and internal contamination

(1) Employers of decontamination work, etc. should prepare effective respiratory protective equipment such as dust masks according to the following work category and concentration of soil to be handled, and make workers engaged in decontamination and treatment use them. Workers should use effective respiratory protective equipment while engaged in decontamination related works.

	Soil with high radioactivity concentrations, etc. (> 500,000Bq/kg)	Soil other than the soil with high radioactivity concentrations, etc. (≤ 500,000Bq/kg)
Work under high dust concentration (> 10mg/m^3)	Dust collection efficiency: > 95% (Note 1)	Dust collection efficiency: > 80%
Work other than the above (≤ 10mg/m^3)	Dust collection efficiency: > 80%	Dust collection efficiency: > 80% (Note 2)

(Note 1) See Annex 9 for the criteria for selecting the proper dust collection efficiency of dust masks.

(Note 2) Surgical masks can be used for works (exposed to only non-mineral dust) that do not fall under Article 27 (use of respiratory protective equipment) of the Ordinance on Prevention of Hazards Due to Dust.

(2) When assigning workers to decontamination related works that may cause them to be contaminated in excess of the limit, employers of decontamination work, etc. should prepare effective protective clothing, gloves, or shoes according to the following work category and concentration of soil to be handled, and make workers engaged in the said work use them. Workers should use effective protective clothing while engaged in the said work.

	Soil with high radioactivity concentrations, etc. (> 500,000Bq/kg)	Soil other than the soil with high radioactivity concentrations, etc. (≤ 500,000Bq/kg)
Work at high levels of dust concentration ($> 10mg/m^3$)	Long sleeve shirt with a chemical protective suits (e.g., air-tight Tyvek suits) on top, rubber gloves (Note 1) (with cotton gloves), rubber boots (Note 2)	Long sleeve shirt, cotton gloves, and rubber boots (Note 2)
Work other than the above ($\leq 10mg/m^3$)	Long sleeve shirt, rubber gloves (two-ply with cotton gloves), and rubber boots (Note 2)	Long sleeve shirt, cotton gloves, and rubber boots (Note 2)

(Note) See Annex 10 for the criteria for selecting protective clothing and others.

(Note 1) A worker may develop an allergy to material used for rubber gloves. If such case occurs, consideration should be given such as by providing other gloves which are less likely to cause allergy.

(Note 2) As decontamination work often requires use of water, workers need impermeable shoes such as rubber boots in order to prevent contamination from penetrating into bodies and clothes, and to make decontamination easier when contaminated. If the nature of the work makes it difficult to use rubber boots, other actions such as covering shoes with plastic bags will be necessary.

(3) When it was found that protective equipment or clothing to be used by workers who are engaged in decontamination-related works were contaminated in excess of the contamination limit, employers of decontamination work, etc. should not provide them such equipment or clothing unless the contamination is washed off in advance to reduce the contamination level to the limit or below.

(4) Employers of decontamination work, etc. should prohibit workers from smoking, drinking or eating in a workplace where they may inhale or ingest soil contaminated by radioactive material during decontamination-related works. Workers should not smoke or eat/drink in the said location.

Part 5 Education of workers

1. Education of operation leaders
   (1) Employers of decontamination work, etc. should provide education regarding the following contents to a person who will be assigned as an operation leader for decontamination-related works.
      a. Decision of work methods and allocation of workers
      b. Methods for leading workers
      c. Actions in case of abnormal events
   (2) "Decision of work methods and allocation of workers" should include the following contents:
      a. Structure of and how to use radiation survey meters
      b. Methods for preliminary investigation
      c. Formulating work plans
      d. Developing work procedures
   (3) "Methods for leading workers" includes the following contents:
      a. How to take leadership in the inspections and meetings prior to work, and educate workers
      b. How to give instructions during work
   (4) "Actions in case of abnormal events" includes the following actions:
      a. Emergency actions in case of occupational accident
      b. Method for transporting patients to a hospital

2. Special Education for workers
   (1) Employers of decontamination work, etc. should train workers with the following courses before assigning works of decontamination of soil, etc.:
      a. Impact of ionizing radiation on living organisms, and exposure dose control methods
      b. Methods for decontamination-related works
      c. Structure of and how to use machines and/or tools and other systems to be used during decontamination-related works
      d. Relevant laws and regulations
      e. Method for conducting decontamination-related works and handling of devices and/or components to be used (practical training)
   (2) Employers of decontamination work, etc. should train workers with the following courses before assigning collection, transportation, or disposal of removed soil:
      a. Impact of ionizing radiation on living organisms, and exposure dose control methods

b. Methods for collecting, transporting, or disposing of removed soil
c. Structure of and how to use machines and/or tools and other systems to be used during collection, transportation, or disposal of removed soil
d. Relevant laws and regulations
e. Methods for collecting, transporting, or disposing of removed soil and handling devices and/or components to be used (practical training)

(3) Employers of decontamination work, etc. should train workers with the following courses before assigning treatment of waste:
a. Impact of ionizing radiation on living organisms and exposure dose control methods
b. Methods for treatment of waste
c. Structure of and how to use machines and/or tools and other systems to be used during treatment of waste
d. Relevant laws and regulations
e. Methods for conducting treatment of waste and handling of devices and/or components to be used (practical training)

(4) When assigning workers to work such as decontamination of soil, etc. and treatment of waste of their own sites in the areas where the average ambient dose rate ranges from over 0.23 μSv/h to 2.5 μSv/h, it is recommended that employers other than those of decontamination works, etc. should provide them with necessary education among the items (1) to (3) to conduct the corresponding work. It is recommended that these be applied in the same manner to those who are not employed by others, such as self-employed workers and voluntary workers.

(5) It is recommended that whoever orders decontamination related works order the work after making sure that the necessary number of trained operation leader and workers to conduct the work are employed.

Part 6 Actions for health care

1. Medical examination

(1) Employers of decontamination work, etc. should provide full-time workers engaged in decontamination-related works with medical examinations on the tests below by medical doctors at the time of employment or being transferred to the work, and once within every 6 months thereafter on a regular basis.
a. Investigation and evaluation on whether workers have exposure histories
b. White blood cell count and differential

c. Red blood cell count and hemoglobin content test or hematocrit test
d. Cataract eye test
e. Skin test

(2) Regardless of the provision of (1), the tests stated in items b to e will be unnecessary if a medical doctor considers so, for a worker whose medical examination (provided on a regular basis) of the previous year shows that his/her effective dose was equal to or below 5mSv and whose effective dose of the present year is unlikely to exceed 5mSv.

(3) Employers of decontamination work, etc. should prepare for medical examination cards based on the medical examination results and keep them for 30 years. It should be noted however, that this should not apply when the records are transferred to the organization specified by the Minister of Health, Labour and Welfare after saving them for five years.

(4) Employers of decontamination work, etc. should transfer the records stated in (3) to the organization specified by the Minister of Health, Labour and Welfare when intending to terminate its business.

(5) Employers of decontamination work, etc. should issue a copy of the record stated in (3) to workers engaged in decontamination related works at the time of his resignation.

(6) Collecting medical doctor's opinion regarding the medical examination results (as with the Ionizing Radiation Ordinance)

(7) Notification of the medical examination results (as with the Ionizing Radiation Ordinance)

(8) Report on the medical examination results (as with the Ionizing Radiation Ordinance)

(9) Actions based on the medical examination results (as with the Ionizing Radiation Ordinance)

Part 7 Occupational safety and health management system

1. Organizational structure for occupational safety and health management
   (1) In Chapter 3 of Industrial Safety and Health Act (organization for occupational safety and health management) (including delegated governmental and ministerial ordinances), the provisions applied to employers of decontamination works, etc. should be specified in the guidelines.
      a. Safety officer and health officer (safety and health promoter)
      b. Industrial physician, etc.
      c. Safety committee and health committee (safety and health committee)
      d. Operation leader
   (2) The case in which subcontractors conduct work should be included in the guidelines.
      a. Person in the position of general safety and health manager and/or the primary contractor's safety and health manager
      b. Person in the position of safety and health manager

2. Provisions regarding implementation of risk assessment should be included in the guidelines.

Annex 1 How to determine applicability of the Ordinance on Prevention of Ionizing Radiation Hazards and new regulations

○ Basic concept

- The Ionizing Radiation Ordinance is based on the concept that exposure dose is controlled within a controlled area centered on controlled radiation sources, on the premise of a deliberate exposure situation (i.e., the state that radiation sources are controlled, supposing normal areas as opposed to decontamination areas).
- By contrast, as decontamination related works are conducted under an existing exposure situation (i.e., supposing the state that radiation sources cannot be controlled, and in decontamination areas), it is difficult to apply the concept of controlled area in the same way that applies to a deliberate exposure situation.
- Therefore, additional regulations are prescribed to specify actions that should be taken when works such as decontamination works, collection of removed soil, and treatment of waste are conducted under an existing exposure situation (i.e., supposing the state that radiation sources cannot be controlled, and in decontamination areas).
- This means that the scope of the new regulations should be limited to within decontamination areas.

○ Applicability to waste treatment facilities

- Waste treatment facilities such as water supply and sewerage treatment facilities and incineration facilities where significant exposure is expected from sludge in water and sewage facilities and ashes (they are radiation sources that are under control) should be subject to the Ionizing Radiation Ordinance, even if the facility is located in the decontamination area.

○ Applicability to work similar to decontamination-related works

- When conducting works such as cutting trees, trimming branches, and digging soil in areas exceeding 2.5 μSv/h, it is recommended that employers take necessary actions such as exposure dose control among those actions for each activity prescribed in these measures.

Annex 2 Criteria for measuring average ambient dose rate

○ Objective

- The objective of measuring and evaluating average ambient dose rate is for employers to check if it exceeds 2.5 μSv/h in the workplace and decide how they conduct dose control when assigning workers to decontamination of soil, etc., collection, transportation, and treatment of removed soil, and treatment of contaminated waste.

○ Basic concept

- Average ambient dose rate should be measured before starting the work.
- It is recommended that the measurement be conducted by commissioned experts.
- Measurements should be able to indicate workers' exposure situations.
- Measurement and calculation of measured data should be simple.

○ Measurement and evaluation of average ambient dose rate

- Common conditions
  - ✧ Ambient dose rate should be measured at 1 meter above the ground.
  - ✧ Measurement instruments should be subject to Article 8 of Standards on Working Environment Measurement.
- When variation of ambient dose rates is expected to be small:
  - ✧ The ambient dose rate that Government or others measured for formulating their decontamination plans can be used as the average ambient dose rate of the workplace if it was measured near the place.
  - ✧ Dose rates should be measured as per approximately 1,000 m^2. Five points in total at each corner and the intersection point of the diagonals in the unit area should be measured and its average defined as its average ambient dose rate. If the workplace is irregularly shaped, four measurement points should be specified at even intervals on the circumference of the unit area. These four and the intersection point of the diagonals - five points in total - should be measured.
  - ✧ If the work area exceeds 1,000 m^2, five points should be measured at every 1,000 m^2, and the average of ambient dose rates at all of the measurement points should be defined as the average ambient dose rate.
- When variation of ambient dose rates are expected to be large:
  - ✧ Using the measurement method described above, calculate the average of the ambient dose rates at each measurement point. (Measurement A) In this case, exclude the measurement points at which the ambient dose rates are expected to be high.

✧ Measure ambient dose rates at the points which possibly indicate high measurements within and near the area where work is to be conducted for a certain amount of time. Choose several measurement points as per 1,000 m^2. (Measurement B)

✧ Calculate average ambient dose rate based on the following formula:

(Note) Calculate data of a representative person whose exposure dose is expected to be the largest.

(Note) If the activity continues more than one day at the same place, calculate the average ambient dose rate supposing the day on which the activity that causes the highest exposure dose is conducted.

✧ Average ambient dose rate

$$= \left(\sum_{i=1}^{n} (B^{i} \times WH^{i}) + A \times (WH - \sum_{i=1}^{n} (WH^{i})) \right) \div WH$$

n: Number of measurement points

A: Ambient dose calculated by No.3 in Section 1 (μSv/h)

B^i: Ambient dose rate (μSv/h) at the measurement point B

WH^i: Working hours per day (h) near the measurement point B

WH: Total working hours per day (h)

Annex 3 The lower limit of work under high dust concentration and soil with high radioactivity concentrations

○ Objective

- The lower limit of work under high dust concentration and soil with high radioactivity concentrations is a key for employers to select a required method for measuring internal exposure, type of dust masks, and protective clothing, and determine the management method when an employer assigns workers to work in such combined conditions.

○ Basic concept

- Adequate protective measures should be taken against internal exposure that is assumed according to the work under high dust concentration and soil with high radioactivity concentrations.

- The committed dose of internal exposure should be substantially below 1 mSv/y based on the most conservative evaluation of protective measures, including those against dust and percentage of inhalation.

○ Concentration values derived from work under high dust concentration and soil with high radioactivity concentrations

- According to the simplified calculation results of the maximum estimated internal exposure to radioactive material in dust (Reference 4, material submitted by Matsumura, a committee member), the work generates dust with a concentration of 10 mg/m^3, which is the upper limit of time-weighted average concentrations of dust in air, from soil containing radioactive material with a concentration of 500,000 Bq/kg. Supposing that a worker continues to work for 40 hours per week in 52 weeks, inhaling 100% of the dust, the effective dose of internal exposure is estimated to be 0.153 mSv/y. If the concentration is 30 mg/m^3, which is the upper limit of locally emerging dust concentrations, the effective dose of internal exposure is estimated to be 0.458 mSv/y. If it is 100mg/m^3, which is the highest possible limit, the dose is estimated to be 1.526 mSv/y. This means that the effective dose of internal exposure is substantially below 1 mSv/y, assuming the use of respiratory protective equipment (half-face mask with a dust collection efficiency of 95%) with a Working Protection Factor of 7 (i.e., concentration is reduced to one-seventh).

- Therefore, the lower limit of work under high dust concentration should be defined as 10 mg/m^3, which is the highest level of time-weighted average concentrations of dust in air, while the

lower limit of soil with high radioactivity concentrations is defined as 500,000 Bq/kg.

- It should be noted that 500,000 Bq/kg is a level that is not observed anywhere except deliberate evacuation areas and restricted areas. Furthermore, the measurements of airborne dust concentrations in agricultural land and waste disposal facilities are normally in the order of $\mu g/m^3$. Thus, 10 mg/m^3 is a considerably high level, considering that actions such as water spraying are taken to reduce generation of dust before work which generates dust.

Annex 4 Method for determination of work under high dust concentration

○ Objective

- The determination of work under high dust concentration is required to recognize whether dust concentration exceeds the lower limit of high-level dust concentration of 10 mg/m^3 during the activity, and determine necessary measurement methods to control internal exposure dose.

- It is desirable that dust with high radioactivity concentrations should be determined by qualitative type of work in order to save time for actually using measurement instruments. However, due to lack of data of dust concentration

- Corresponding to work, concentration is the only indication at this moment. Data should be accumulated to indicate work under high dust concentration by qualitative type of work in the future.

○ Basic concept

- The determination of work under high dust concentration is to understand whether dust concentration exceeded the lower limit of high-level dust concentration of 10 mg/m^3 during the activity. Thus, measurement is not required when it is obvious that concentrations are below the lower limit. Measurement is only required for work which is expected to generate a certain amount of dust (e.g., scraping of soil, grinding and chipping of asphalt/concrete surface, weeding, removed soil packing, demolition of structures).

○ Determination methods

- In order to determine whether the activity falls under work under high dust concentration, use a personal sampler during the activity, or basically follow the relative concentration indication method specified in Article 2 of Standards on Working Environment Measurement to measure concentration near workers during the activity that generates dust.

- During decontamination work, set a digital dust meter (e.g., LD-5) and inhalable dust concentration measurement instrument in parallel in the proximity of workers to the extent that it does not disturb the activity, and measure the concentration continuously for 10 minutes or more to calculate a mass-concentration transformation coefficient.

- After continuous measurement for at least a few minutes by a digital dust meters, determine dust concentration (mg/m^3) by using the relative concentration indication method, along with

the calculated mass-concentration transformation coefficient.

- ✧ As opposed to inhalable dust (4 μm, 50% cut) prescribed in Article 2-2 of the Standards on Working Environment Measurement which considers pneumoconiosis, this measurement of dust concentration focuses on inhalable dust (100 μm, 50% cut) which is inhaled through nose and mouth from air containing almost all kinds of dust, in light of internal exposure. (Presumably it is most likely that particles deposited above the respiratory tract with cilia move to digestive organs.)

- ✧ Inhalable dust can be determined by measuring at the face velocity of 19 (cm/s) on a sampling filter paper with an open-face type of sampler.

- ✧ Follow Article 2 of Standards on Working Environment Measurement except for the particle diameters and measurement positions of a dust particle separator.

Annex 5 Method for measuring concentrations of radioactive materials in the objects to be decontaminated such as soil

○ Objective

- Concentrations of radioactive materials in the objects to be decontaminated such as soil are measured in order for employers to determine whether such objects exceed the reference value (10,000 Bq/kg or 500,000 Bq/kg), and to decide what actions are required for radiological protection, when they assign workers to decontamination of soil, etc., collection, transportation, and disposal of removed soil, and treatment of contaminated waste.

○ Basic concept

- Concentration should be measured before starting the work.
- It is recommended that the measurement be performed by commissioned experts.
- Soil that will be handled during the work should be measured.
- The highest concentration in measurements should be selected as the representative value because the concentrations of radioactive materials fluctuate considerably.
- Measurement and calculation of measurements should be simple (A simplified method should be specified that can determine that the concentration is clearly not a level exceeding 500,000 Bq/kg).

○ Measurement of concentrations of radioactive materials in the objects to be decontaminated such as soil

- Simple measurement methods
  - ✧ After measuring ambient dose rates, measure surface dose rates (μSv/h) at places with high ambient dose rates. Then, estimate concentrations of radioactive materials in soil using the measured surface dose rates (the detail method is separately under review). If the estimated concentration is substantially below 500,000 Bq/kg, measurement by means of sampling is not required.
  - ✧ As for collecting and transporting soil, measurement by means of sampling is not required when the simplified method verifies that the concentration is substantially below 10,000 Bq/kg.

- Sampling
  - ✧ Where to take samples:
    - Take samples in the objects to be decontaminated such as soil where the concentration of radioactive material is expected to be the highest.

- Take several samples per workplace (1,000 m^2 if the workplace is larger than 1,000 m^2).

✧ How to select sampling objects:

Take samples based on the soil and others that will be actually removed.

- Agricultural land
  - Soil at 5 cm in depth
- Forests
  - Representative spots on tree leaves, bark, fallen leaves, and fallen blanches
  - Spots at 3 cm in depth in litter layer (humus)
- Living area (structures such as buildings, near roads)
  - Spots where rain water gathers and their outlets, plants and their roots, spots in which rain water, mud, and soil can flow, and objects to be removed such as sewage near structures on which small particles can attach.

➢ Analysis methods

✧ Subject to Article 9 of Standards on Working Environment Measurement

Annex 6 Criteria for measuring internal exposure

○ Objective

- To determine what method should be taken to control internal exposure, it is necessary for employer to understand internal exposure based on the combination of dust concentration during work, and concentration of radioactive material in soil.

○ Basic concept

- According to the simple calculation results of the maximum estimated effective dose of internal exposure to radioactive material in dust (Reference 4, material submitted by Matsumura, a committee member), work generates dust with a concentration of 10mg/m^3, which is the upper limit of time-weighted average concentrations of dust in air, from soil containing radioactive material with a concentration of 500,000 Bq/kg. Supposing that a worker continues to work for 40 hours per week in 52 weeks, inhaling 100% of the dust, the effective dose by internal exposure is estimated to be 0.153 mSv/y. If the concentration is 30mg/m^3, which is the upper limit of generally emerging instantaneous dust concentrations, the effective dose of internal exposure is estimated to be 0.458 mSv/y. If it is 100mg/m^3, which is the highest possible limit, the dose is estimated to be 1.526 mSv/y.

○ Criteria for measuring internal exposure

- If workers work under high dust concentration (10 mg/m^3) and handle soil with high radioactivity concentration (500,000 Bq/kg) without wearing dust masks at all, their effective doses of internal exposure may exceed 1 mSv/y. Therefore, measurement of internal exposure should be required once every three months.

- For other cases, the screening should be conducted at the end of the activity every day. If an effective dose exceeds the limit, measure internal exposure once every three months.

- In the primary screening, count per minute (cpm) on the surface of a dust mask is measured. 10,000 cpm should be used as the contamination limit value (equivalent to 0.01 mSv supposing that 50% of radioactive material attaches on the mask surface while the rest is inhaled under a strict assumption that defines 2 as the Working Protection Factor, although 3 is normally expected.

- If the measurement exceeds the contamination limit in the primary screening, a nasal smear test should be conducted as the secondary screening. 10,000cpm (equivalent to the internal

exposure effective dose of approximately 0.3mSv) should be used as the limit specified in the criteria.

- If the measurement exceeds the limit specified in the criteria, internal exposure should be measured once every three months (by the method prescribed in the Ionizing Radiation Ordinance). It should be noted that if the measurement of a woman who can be pregnant from a medical standpoint exceeds the limit specified in the criteria of the secondary screening, internal exposure should be measured immediately.

- If workers do not work under high dust concentration (10mg/m^3) or handle soil with high radioactivity concentration (500,000 Bq/kg), their effective doses of internal exposure will not exceed 0.153 mSv/y, even by calculating with the highest estimate. Therefore, measurement may be conducted only when a worker is exposed to dust with unexpectedly high radioactivity concentrations.

	Soil with high radioactivity concentrations, etc. (> 500,000Bq/kg)	Soil other than the soil with high radioactivity concentrations (≤ 500,000Bq/kg)
Work at high levels of dust concentration (> 10 mg/m^3)	Measure internal exposure once every three months (using the method specified in the Ionizing Radiation Ordinance)	Screening
Work other than the above (≤ 10mg/m^3)	Screening	Screening (Note)

(Note) This screening test is conducted when one is suddenly exposed to dust with high radioactivity concentrations.

Annex 7 Criteria for setting a place for eating, drinking and smoking

○ Objective

- Criteria for setting a place for eating, drinking and smoking is necessary for employers to provide workers engaged in decontamination related works with a rest area where they can eat, drink, and/or smoke.

○ Basic concept

- To allow eating, drinking, and/or smoking, it is necessary to ensure that workers will be the least likely to receive internal exposure by inhalation or ingestion of radioactive materials in the eating, drinking, and/or smoking area.

○ Criteria for setting rest areas

- Inhalation
  - ✧ According to the simple calculation results of the maximum estimated internal exposure to radioactive material in dust (Reference 4, material submitted by Matsumura, a committee member), work generates dust with a concentration of 10 mg/m^3, which is the upper limit of time-weighted average concentrations of dust in air, from soil containing radioactive material with a concentration of 100,000 Bq/kg. Supposing that a worker continues to work for 40 hours per week in 52 weeks, inhaling 100% of the dust, the effective dose of internal exposure is estimated to be 0.031 mSv/y.

  - ✧ Therefore, if the preliminary measurement indicates that soil is not highly contaminated, internal exposure by inhalation will be substantially smaller than 1mSv/y once dust generated by work settles..

  - ✧ Dust generated by works settles at a speed of approximately 3 mm/s or 30 cm/s when the particle size is 10 μm or 100 μm respectively. As even particles as large as 10μm in size settle in approximately 20 minutes, the effect of dust will mostly disappear. Furthermore, workers are required to move upwind of the workplace because particles are carried by wind. Suppose that workers are unable to move upwind: Gentle wind at a speed of 0.2m/s would carry dust approximately 240 meters for 20 minutes. This means that the effect of dust will mostly disappear even when workers stay in the workplace, if the size of the workplace is roughly 1,000 m^2.

- Ingestion
  - ✧ Even under the assumption that one ingests 10 grams of soil with a concentration of 10,000 Bq/kg a hundred times in a year, his/her effective dose of internal exposure would be as low as 0.19 mSv, and substantially below 1mSv/y unless he or she is present near soil with high radioactivity concentrations.
    [1.9×10^{-5}mSv/Bq × 10g × 100 × 10Bq/g = 0.19mSv]

- Criteria for setting places for eating, drinking and smoking

✧ In principle, places for eating and drinking should have an environment isolated from outside air such as interior of vehicles. If such places are not available, workers should eat and drink at places that meet the following requirements. Smoking areas should be provided outside, and meet the requirements below.

- No soil with high radioactivity concentrations exists in the vicinity.
- Workers should take breaks altogether, and not eat, drink or smoke for 20 minutes after the completion of their work.
- The areas should be located upwind of the workplace. Workers should avoid downwind areas, unless they cannot move upwind.
- Contamination of workers' bodies and clothes should be inspected prior to eating, drinking, and/or smoking.
- Rehydration during work should be limited to unavoidable cases such as to protect workers from heat stroke. In such cases, workers should take actions to prevent contamination such as by moving upwind of the workplace and taking off their gloves before drinking fluids.
- The masks that workers used during works should be stored during eating, drinking, and/or smoking so that radioactive particles do not adhere inside of the masks, or disposed of (after measuring surface density of the masks for screening).

Annex 8 Criteria for setting a contamination inspection area and determining the contamination inspection method

○ Objective

- Criteria for setting a contamination inspection area are necessary for employers to implement contamination inspection in a proper manner.

○ Basic concept

- Contamination inspection aims to protect workers from physical contamination and protect other workers from secondary contamination due to contaminated workers' bodies or items.

- Therefore, the contamination inspection on items to be taken out is not required if it is obvious that these items will not be handled by workers without protective measures such as wearing protective clothing.

○ Criteria for setting contamination inspection areas

- A contamination inspection area should be built on a boundary between the place where employers of decontamination works, etc. contracted for decontamination related works and other place. If it is difficult due to its geographical feature, etc., the site should be built near the boundary.

- Regardless of the above, when one employer of decontamination work contracted for decontamination related works in multiple places, and when actions have been taken between these places and the contamination inspection area to prevent workers and items without protective measures from contacting with contaminated workers and items, the employer can build an integrated contamination inspection area responsible for the multiple workplaces. This should be applied to the case when multiple employers of decontamination work jointly setting an integrated contamination inspection area.

Considerations for contamination inspection on items

- Contamination inspection is not required if all of the following conditions are met: a) there is no risk of spreading contamination to workers without protective measures; b) employer manages multiple workplaces; c) an item that was used at a workplace will be used at other workplace and; d) measures have been taken on such item to prevent contamination during transportation.

- Even if contamination on vehicles' parts such as tires which directly contact on the ground were below the screening standard after decontamination at a contamination inspection area, these parts may be contaminated again on the subsequent routes. Therefore, contamination inspection is not required on vehicles' parts such as tires which directly contact the ground.
  It should be noted that the decontamination should be conducted on other parts than tires if the inspection results show that the contamination exceeds the limit.

Annex 9 Criteria for selecting proper dust collection efficiency of dust masks

○ Objective

- Protection efficiency of dust masks is a key factor for employers to determine which respiratory protective equipment is the best suited to the combination of dust concentration and concentration of radioactive material in soil.

○ Basic concept

- Determine a protective efficiency to ensure that the effective dose of internal exposure is substantially below 1 mSv/y, in accordance with the combination of dust concentration and concentration of radioactive materials in soil.

○ Criteria for selecting a proper dust collection efficiency of dust masks

- If workers work under high dust concentration (10 mg/m^3) and handle soil with high radioactivity concentration (500,000 Bq/kg), they need half-face type respirators with dust collection efficiency of over 95% which can be expected to practically have a Working Protection Factor of 7, even if leakage is taken into account. In other situations, dust masks with dust collection efficiency of over 80% can provide sufficient protection.

- It should be noted however, that it is vital that workers wear dust masks properly and thus should receive education on how to wear them, in order to achieve the specified protection efficient of dust masks.

- Use of surgical masks is acceptable for work (not exposed to mineral dust, such as handling plants and humus) that does not fall under the standard prescribed in Article 27 of the Ordinance on Prevention of Hazards Due to Dust. This article is provided from the view of preventing pneumoconiosis, because the effective doses of internal exposure will not exceed 0.153 mSv/y even by calculating with the highest estimate for such works that are not conducted under high dust concentration (> 10 mg/cm^3) or do not handle soil with high radioactivity concentration (> 500,000 Bq/kg).

- In summary, dust collection efficiency of dust masks to be used is described as follows:

	Soil with high radioactivity concentrations, etc.	Soil other than the soil with high radioactivity

	(> 500,000Bq/kg)	concentrations (≤ 500,000Bq/kg)
Work at high levels of dust concentration ($> 10mg/m^3$)	Dust collection efficiency: over 95%	Dust collection efficiency: over 80%
Work other than the above ($\leq 10mg/m^3$)	Dust collection efficiency: > 80%	Dust collection efficiency: > 80% (Note)

(Note) Surgical masks can be used for work (exposed to only non-mineral dust) that do not fall under Article 27 (use of respiratory protective equipment) of the Ordinance on Prevention of Hazards Due to Dust.

Annex 10　Criteria for selecting protective clothing and others

○ Objective

Criteria for selecting protective clothing and others based on the combination of dust concentration and concentration of radioactive material in soil are vital for employers to determine what protective clothing is necessary.

○ Basic concept

In order to protect workers from exposure to beta ray derived from cesium, protective equipment is selected based on dust concentration and concentration of radioactive material in soil.

○ Criteria for selecting protective clothing and others

Two-ply gloves with rubber gloves on cotton gloves are required to prevent spread of contamination when soil with high radioactivity concentration (> 500,000 Bq/kg) is handled.

High dust-proof protective clothes such as chemical protective suits (e.g., air-tight Tyvek suits) are required when workers conduct work under high dust concentration (> 10 mg/cm^3), in order to prevent spread of contamination.

A person may develop an allergy to material used for rubber gloves. If such a case occurs, consideration should be given such as by providing other gloves which are less likely to cause allergy.

Furthermore, as decontamination work often requires use of water, workers need impermeable shoes such as rubber boots in order to prevent contamination from penetrating into bodies and clothes, and to make decontamination easier when contaminated. If the nature of the work makes it difficult to use rubber boots, other actions such as covering shoes with plastic bags will be necessary.

In summary, necessary protective clothing is described as follows.

	Soil with high radioactivity concentrations, etc. (> 500,000Bq/kg)	Soil other than the soil with high radioactivity concentrations (≤ 500,000Bq/kg)
Work under high dust concentration	Long sleeve shirt with a chemical protective suits	A long sleeve shirt, cotton gloves, and rubber boots

(> 10mg/m^3)	(e.g., air-tight Tyvek suits) on top, rubber gloves (with cotton gloves), rubber boots	
Work other than the above (≤ 10mg/m^3)	Long sleeve shirt, rubber gloves (two-ply with cotton gloves), and rubber boots (Note 2)	A long sleeve shirt, cotton gloves, and rubber boots

IV References

1. Decontamination in Living Environment (material for the first expert meeting)
2. Announcement on appropriate decontamination methods of agricultural land (material for the first meeting)
3. Distribution of radioactive materials in forests and its analysis results (interim report) (material for the first meeting)
4. Estimated intake quantity of airborne dust and effective use of dust masks (material for the second, third, and fourth meetings)
5. Methods of sampling specimens for measuring radioactivity concentration in the soil (material for the third and fourth meetings)
6. Variation of the ambient dose rate in the forests (Cedar forest in Otama-Mura, Fukushima)(material for the third and fourth meetings)
7. Dispersion of dust during outdoor work at the waste landfill site (material for the third and fourth meetings)
8. Measured Dust Concentration in Air (material for the second, third, and fourth meetings)