

# **JAEA Activities on Decontamination toward Environmental Restoration of Fukushima**

**Shinichi NAKAYAMA**

**JAPAN ATOMIC ENERGY AGENCY**



# JAEA Activities for Environment Restoration

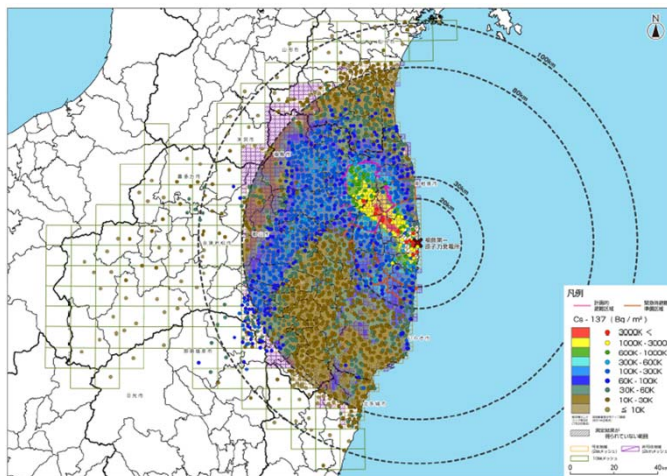
1. **Assessments of Radiological Contamination Situation**
  - monitoring and mapping
2. **Demonstration of Decontamination**
  - schoolyard and swimming pool
  - decontamination pilot projects
3. **R&D on Environmental Restoration**
  - monitoring system using AUH
  - computer simulation for dose reduction.
4. **Communication Activities for Reliable Information**



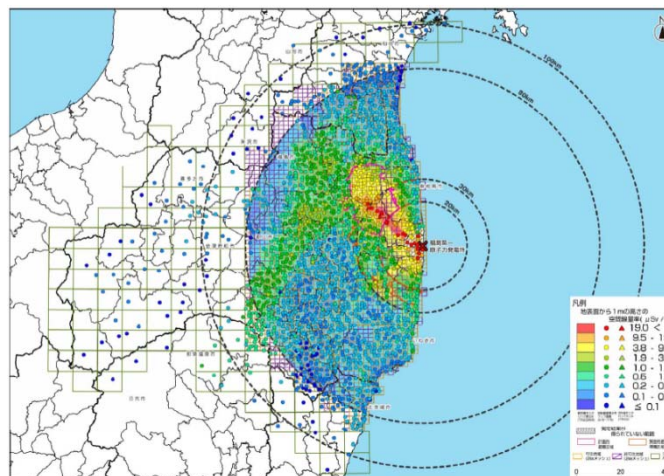
# 1. ASSESSMENTS OF RADIOLOGICAL CONTAMINATION SITUATION

## Surface survey

- ◆ Detailed measurements and mapping of ground surface deposition distribution of radionuclides
  - ◆ Wide area radiation dose-rate distribution measurements and mapping using monitoring vehicles
- ↓
- ◆ The results provides the source term for predictive models of future radioactive spread.



Cs-137 deposition distribution map



Dose-rate measurement at each mesh elements



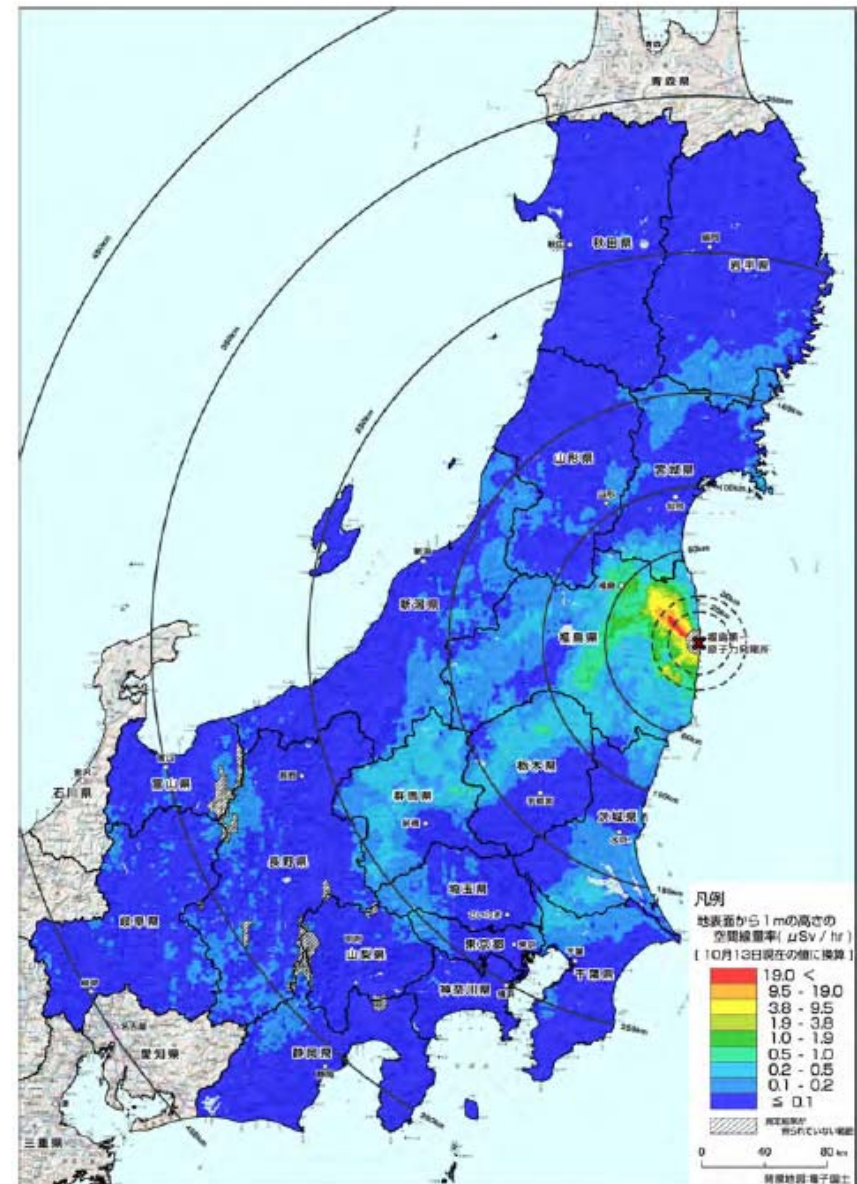
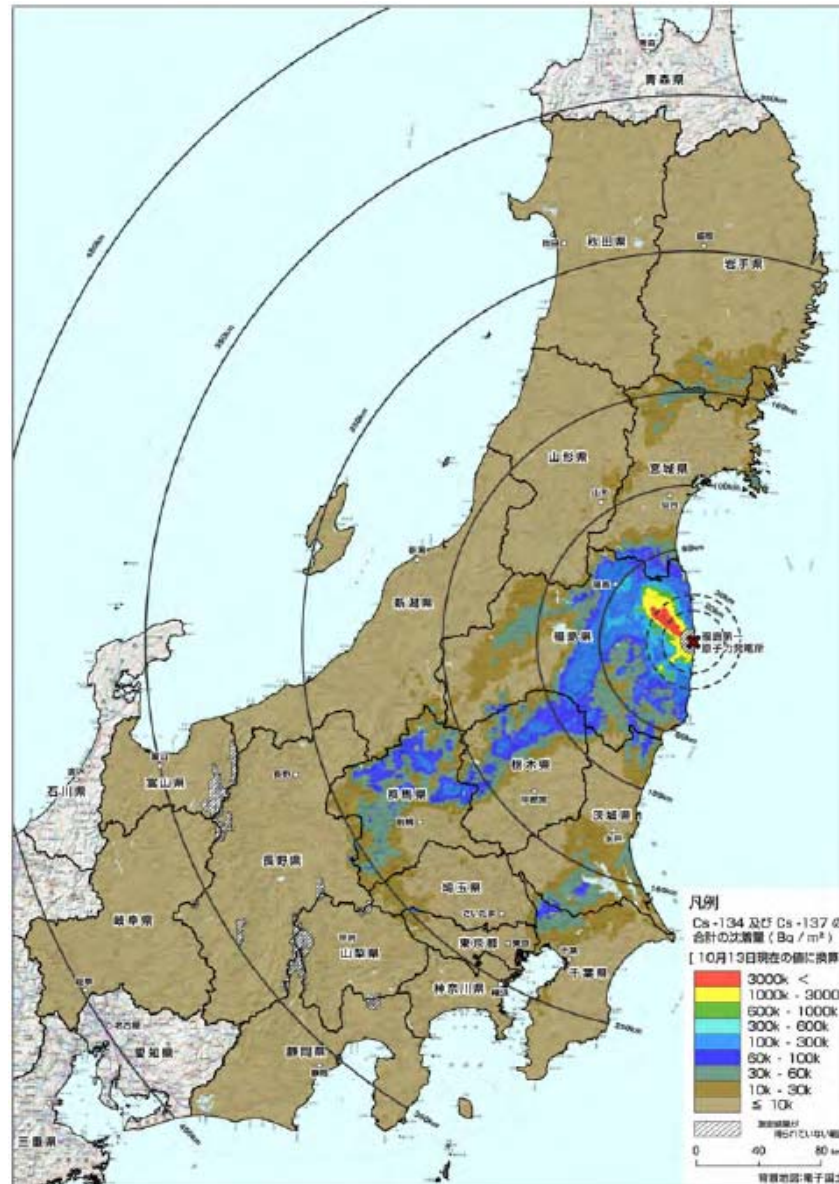
Measurement using survey vehicles

Radiation dose-rate distribution maps



# 1. ASSESSMENTS OF RADIOLOGICAL CONTAMINATION SITUATION

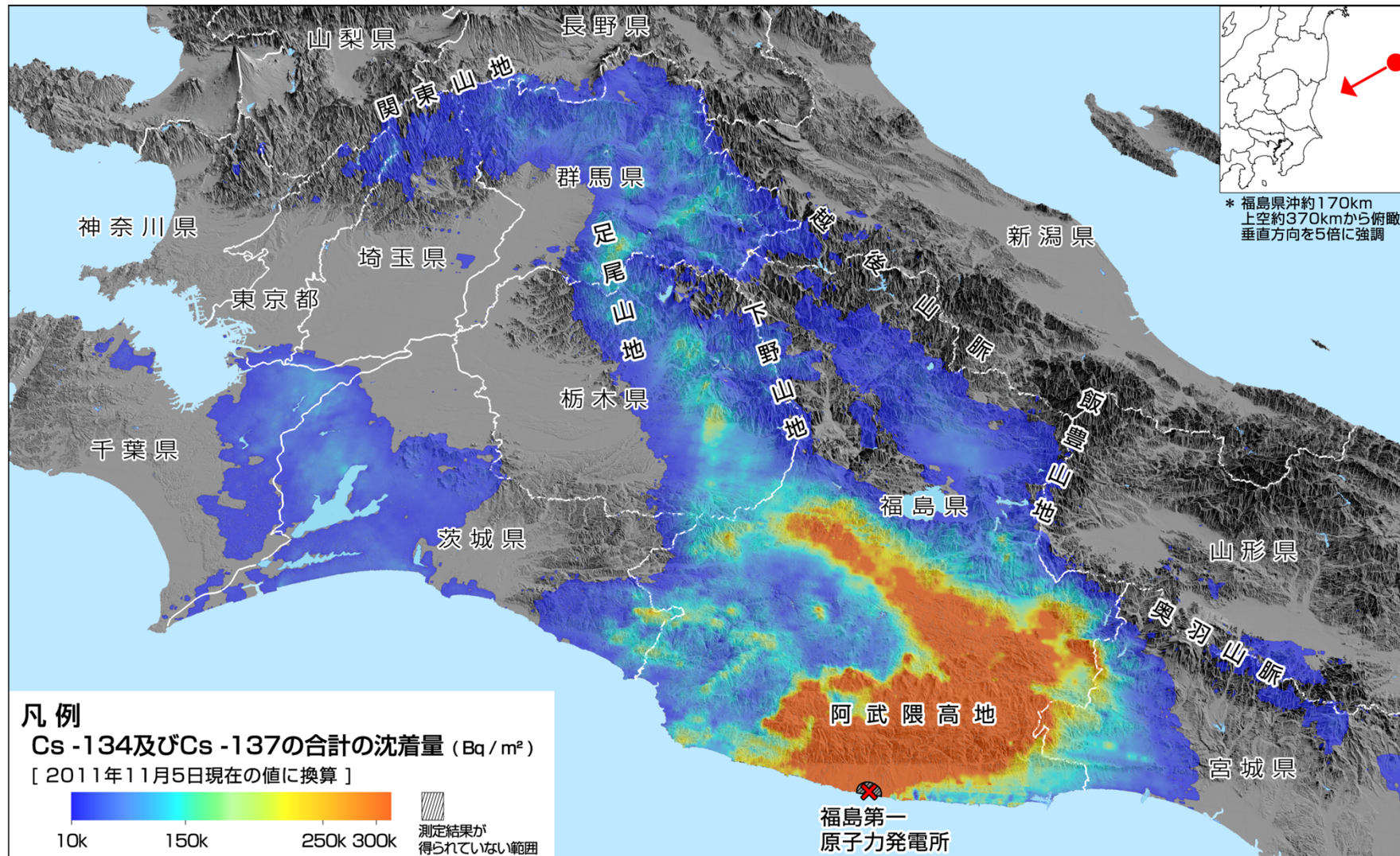
## Aircraft radiation monitoring around Fukushima





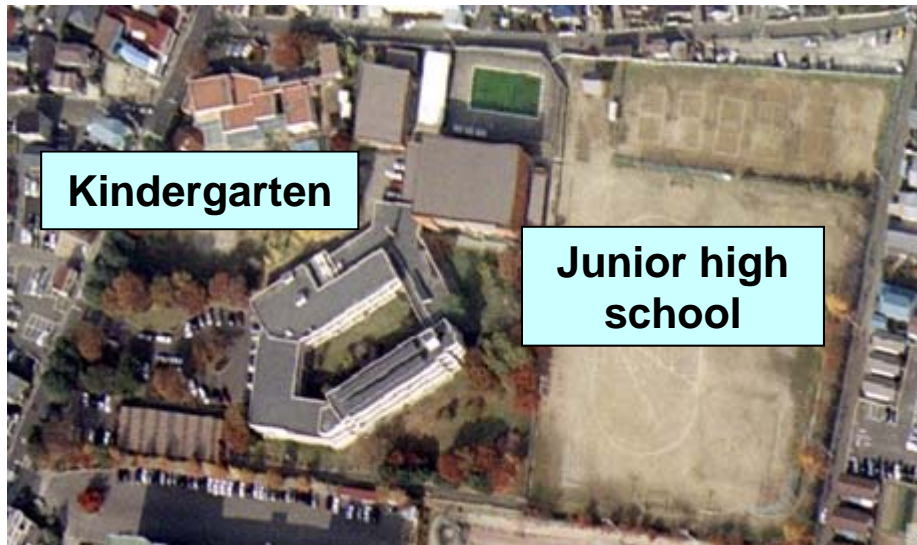
# 1. ASSESSMENTS OF RADIOLOGICAL CONTAMINATION SITUATION

## Aircraft radiation monitoring around Fukushima



## 2. DEMONSTRATION of DECONTAMINATION

### School and kindergarten playground



◆ First aid: “Decrease the playground dose rate and store the removed soil in-situ.”

- ◆ JAEA team;
  - ✓ performed precise dose rate measurements,
  - ✓ identified **the cesium intrusion depth**, and
  - ✓ estimated the safety of underground trench storage of the removed soil. .



◆ **Contaminated surface soil of 5-cm thick** was removed and put into trenches in a corner of the schoolyard.

- ◆ Dose rate significantly reduced by **factors of 10 to 20**;
  - ✓ School: (avg.)  $2.5 \rightarrow 0.15 \mu\text{Sv/h}$  at  $1 \text{ m}^{\text{H}}$
  - ✓ Kindergarten : (avg.)  $2.8 \rightarrow 0.22 \mu\text{Sv/h}$  at  $50 \text{ cm}^{\text{H}}$

◆ The results underlies the government, MEXT, announcement to apply the remove-and-trench work as a tentative dose reduction to Fukushima schools.



## 2. DEMONSTRATION of DECONTAMINATION

### School swimming pool

- ◆ Not a few outdoor swimming pools still hold **Cs rich water**.
- ◆ **The flocculation method was** applied for purification of water.
- ◆ Radioactive sludge was collected and stored at a temporary storage space.
- ◆ A user-friendly handbook; “Guide for Decontaminating School Swimming Pools” was published.
- ◆ Fostered a trustful relationship with school officials, municipality and residents through dialogue and decontamination work.



“**Kizuna**” (絆: bond) team and JAEA staff for school pool decontamination

## 2. DEMONSTRATION of DECONTAMINATION

### Demonstration Pilot Projects

#### ◆ Purpose

To acquire technical data and knowledge, and provide integrated expertise for the coming large scale decontamination project.

- Check the availability and efficacy of proven and new techniques
- Investigate cost, work period, workforce, waste generated, and workers' radiation exposure
- Establish waste management including volume reduction of wastes and treatment of the secondary waste
- Workers' safety and radiation protection
- Establish optimal radiation monitoring
- Record the public communication

#### ◆ Decontamination Pilot Projects at Model Sites;

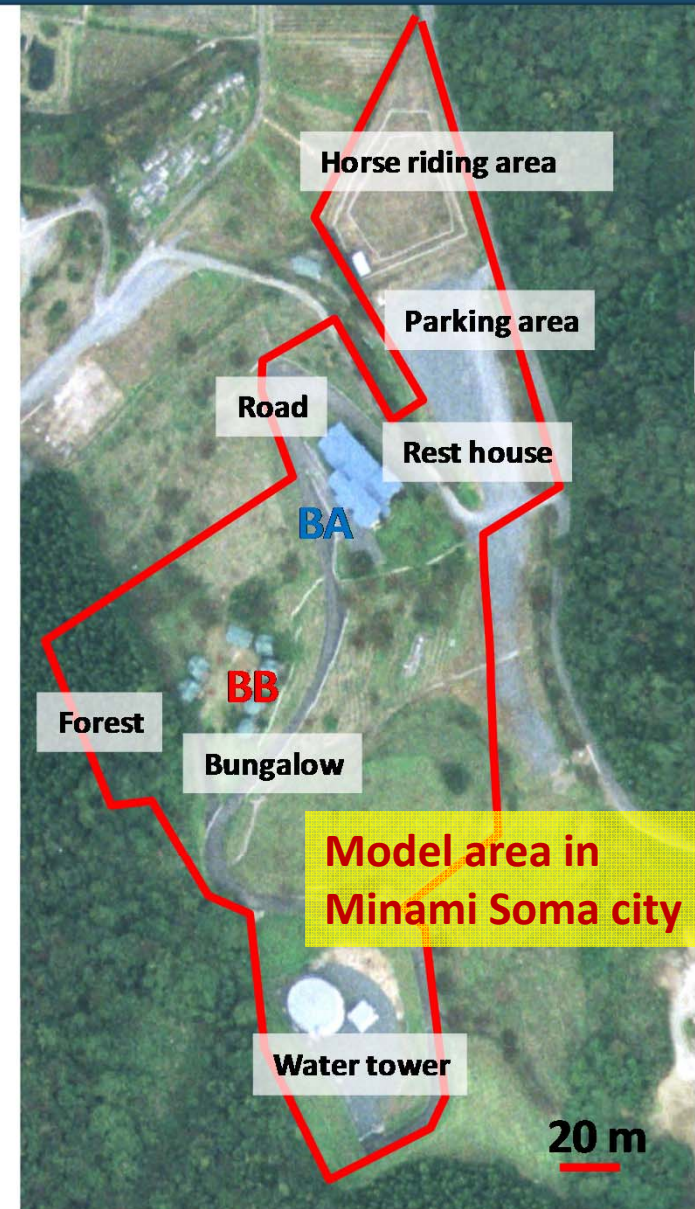
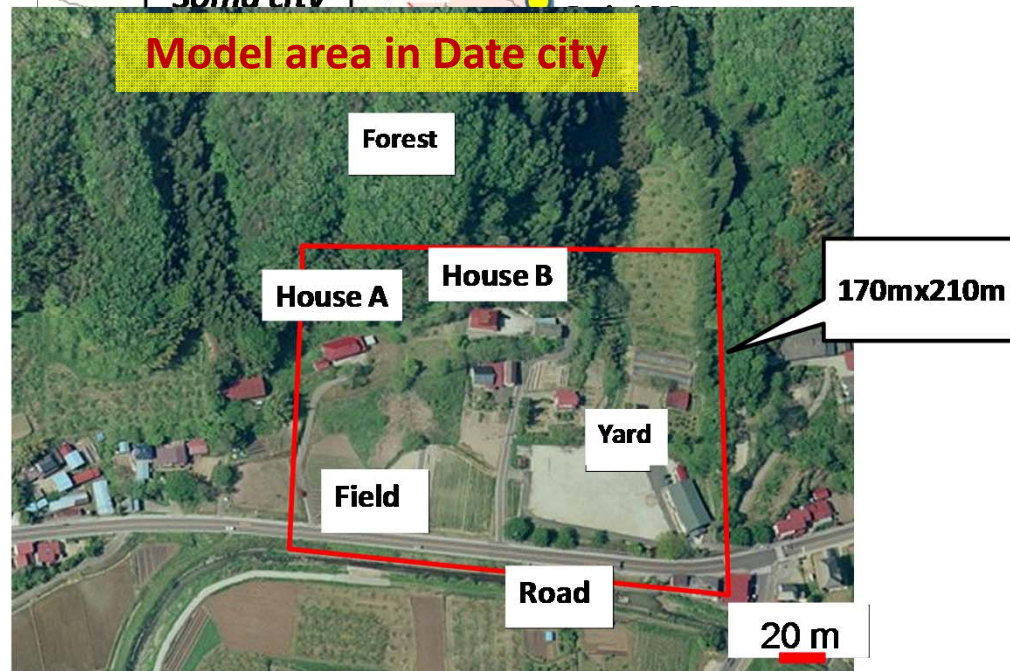
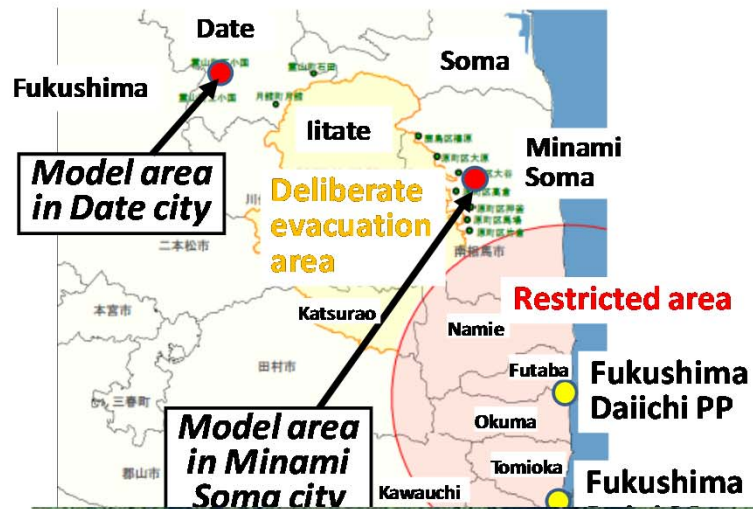
- **Project-1:** Areas including "Specific Spots recommended for Evacuation" (2 sites)
- **Project-2:** Areas including "Deliberate Evacuation Area" & "Restricted Area" (19 sites in 11 municipalities)



## 2. DEMONSTRATION of DECONTAMINATION

# Decontamination Pilot Project -1

- City of Date and City of Minami Soma -



## 2. DEMONSTRATION of DECONTAMINATION

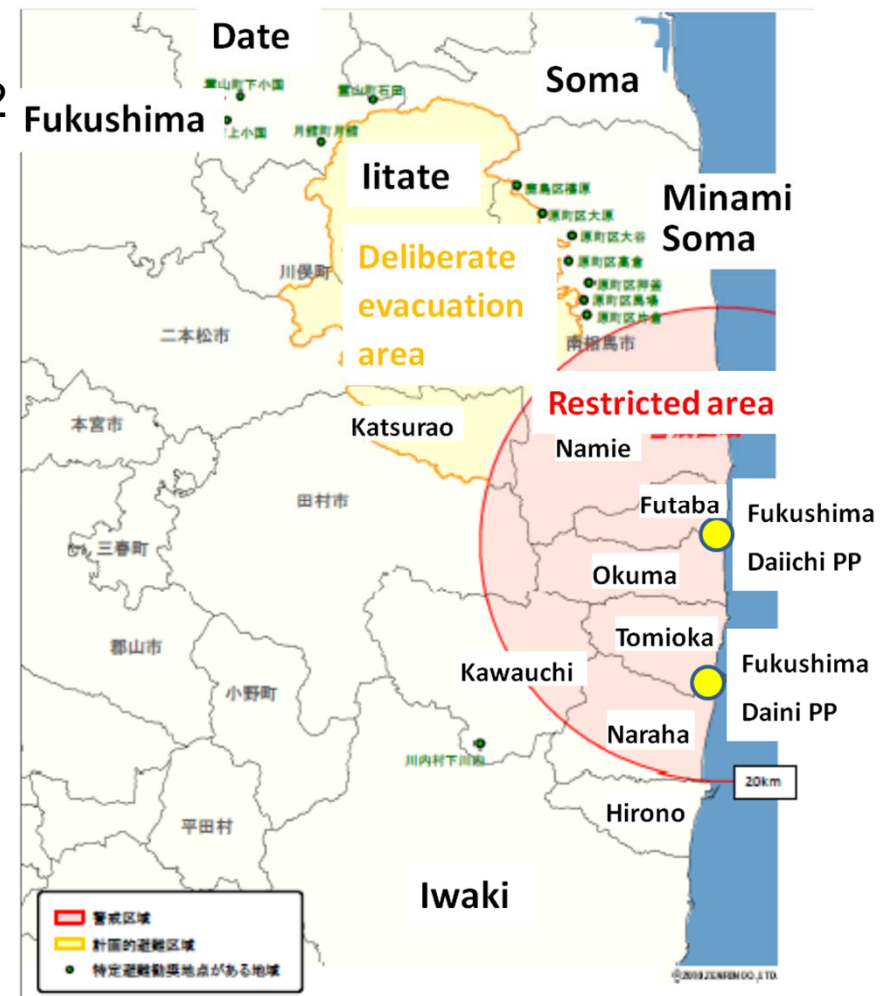
# Decontamination Pilot Project-2

### Demonstration of areal decontamination

- ◆ Decontamination at model areas in Restricted / Deliberate Evacuation Areas in 19 sites in 12 municipalities, totaling 221 ha in size
- ◆ The model areas include;
  - ✓ **various components** such as forest, farmland, building, road and playground
  - ✓ **various dose rate levels**; high ( $> 100$  mSv/y), intermediate (20 – 100), and low (5 – 20)
- ◆ Evaluation of efficiency, generation of wastes, cost, safety.

### R & D of decontamination technologies

- ◆ 25 proposals funded for improved/innovative decontamination technologies
- ◆ Required in situ operation
- ◆ Evaluation of efficiency, generation of wastes, cost, safety.





## 2. DEMONSTRATION of DECONTAMINATION

### Decontamination Pilot Projects: Building





## 2. DEMONSTRATION of DECONTAMINATION

### Decontamination Pilot Project: Concrete, Asphalt

#### ◆ high pressure water



road cleaner

#### ◆ surface stripping



#### ◆ blasting



Iron shot blasting



Ice blasting



## 2. DEMONSTRATION of DECONTAMINATION

### Decontamination Pilot Project: Farmland

#### ◆ plow



#### ◆ turf stripping



#### ◆ topsoil removal



fixation





## 2. DEMONSTRATION of DECONTAMINATION

### Decontamination Pilot Project: Trees, Forest

- ◆ weeding
- ◆ removal of leaf mold
- ◆ clipping
- ◆ water hosing



curing



clipping



clipping



removal of leaf mold



water



## 2. DEMONSTRATION of DECONTAMINATION

### Volume reduction of radioactive waste

#### ◆ water treatment

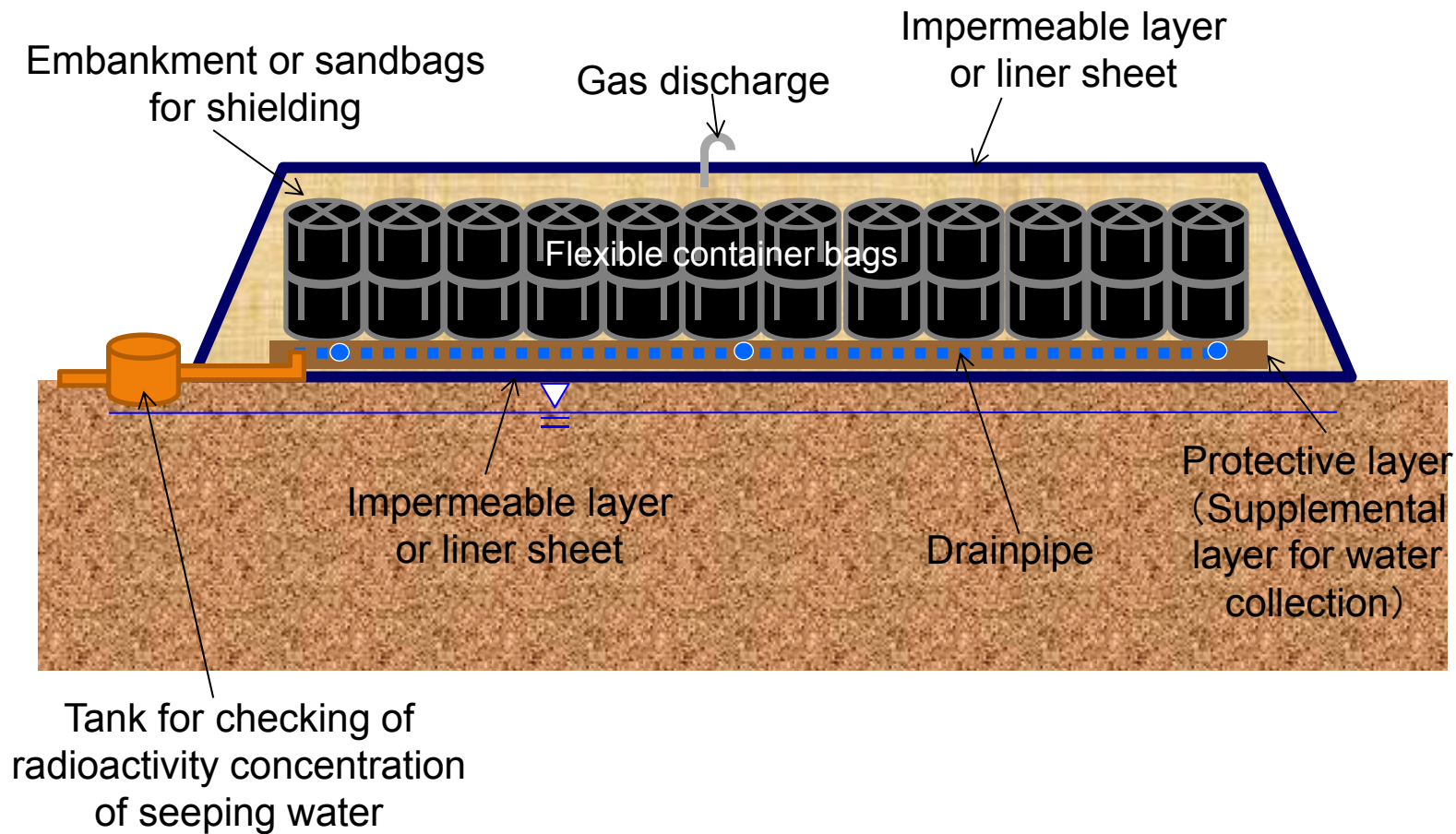


#### ◆ chipping – pruning and sticks



## 2. DEMONSTRATION of DECONTAMINATION

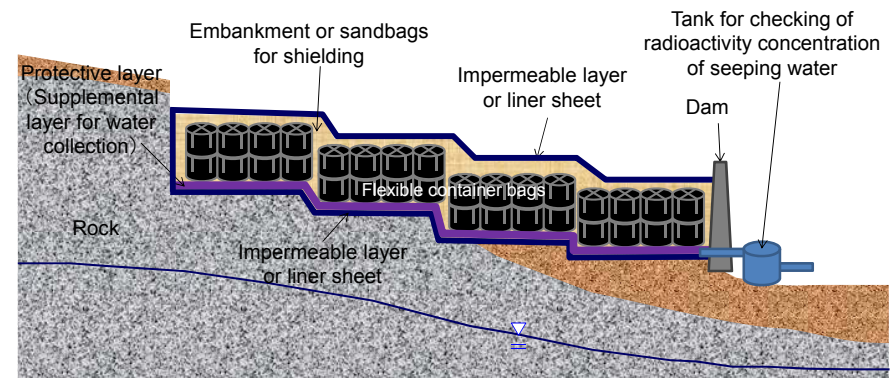
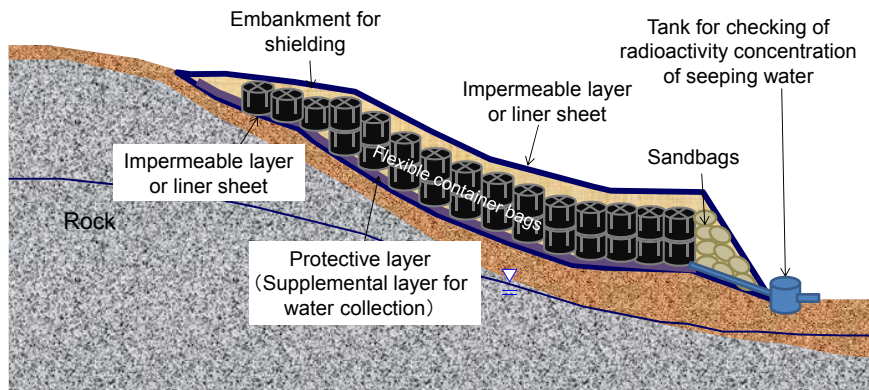
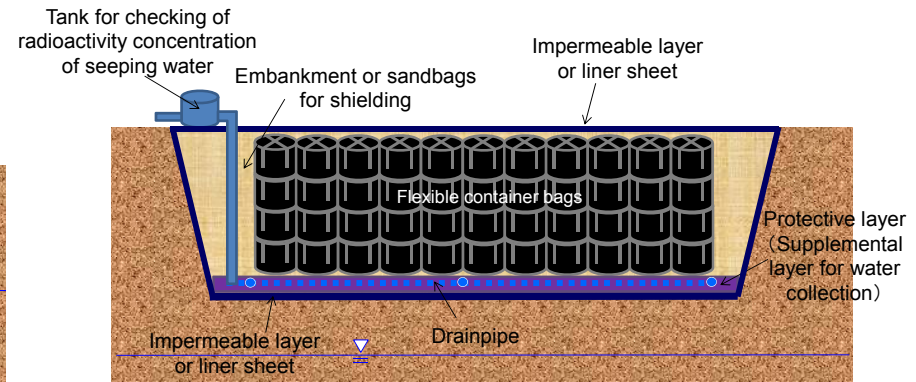
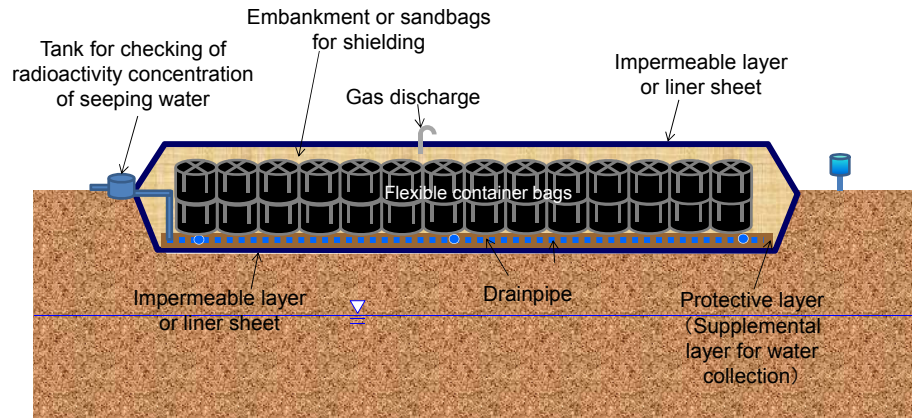
### Temporary storage for radioactive waste: mound type





## 2. DEMONSTRATION of DECONTAMINATION

# Temporary storage for radioactive waste



### 3. R&D on ENVIRONMENTAL RESTORATION

## Autonomous Unmanned Helicopter (AUH) Monitoring System

### Monitoring system using AUH



The AUH and the detector (below)



Grand station

Air dose rate (1 m high) can be measured from an altitude of 30 m

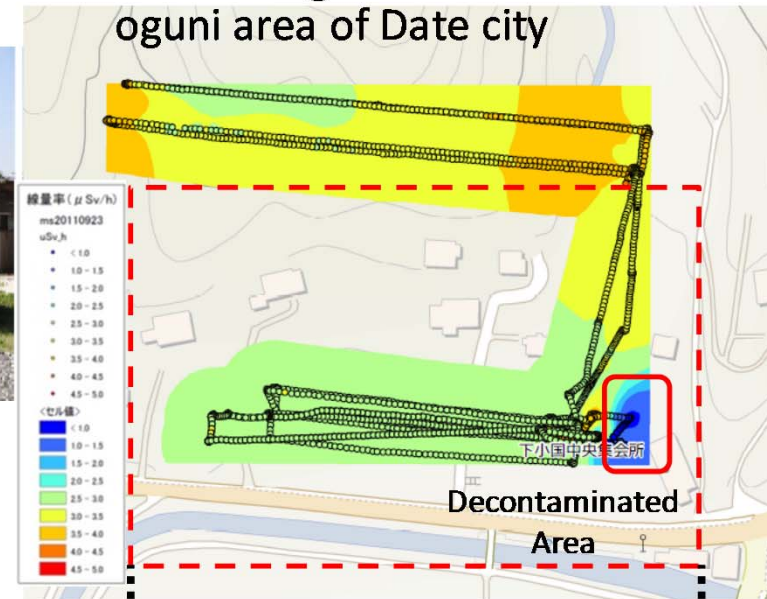
### Monitoring above rice paddy/forest



Monitoring above Shimo oguni area of Date city



Monitoring results for Shimo oguni area of Date city



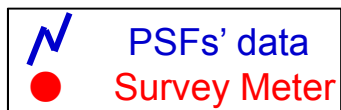
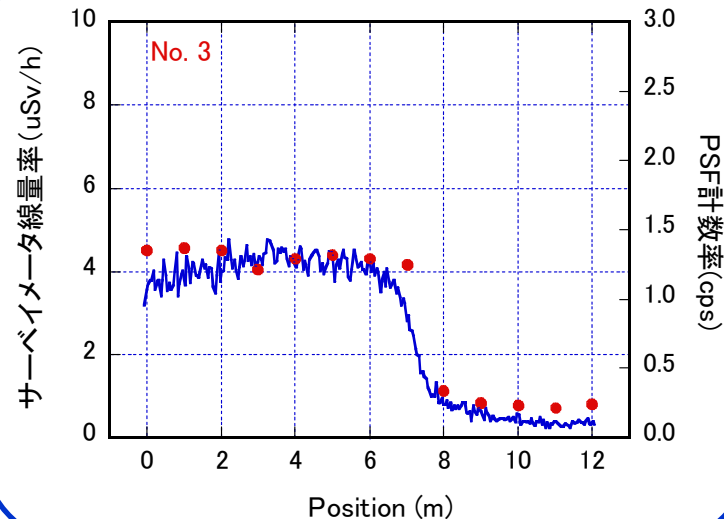


### 3. R&D on ENVIRONMENTAL RESTORATION

## Measurement of radiation distribution by Plastic Scintillation Fibers (PSFs)



- ◆ Two-dimensional measurement
- ◆ Rolling and contoured surface, due to the bendable nature.
- ◆ Underwater surface such as brook bed and pond settlement, due to the waterproofness.



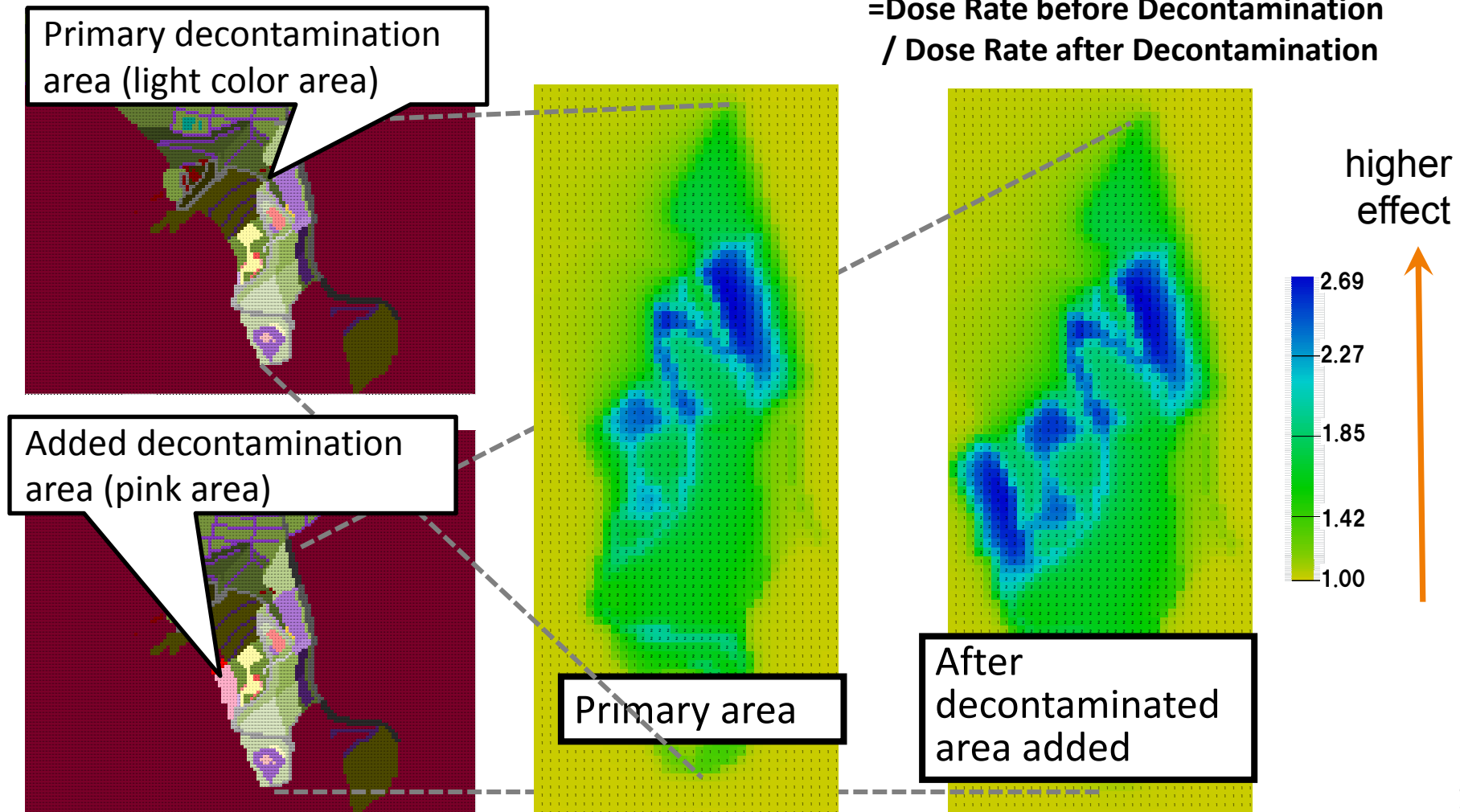
### 3. R&D on ENVIRONMENTAL RESTORATION

## Computer Simulation for Dose Reduction

The computer simulation helps planning of decontamination projects by providing information including effective decontamination measures, **spatial priority**, and waste generation.

*Decontamination effect* : Ratio of dose rate

$$= \text{Dose Rate before Decontamination} / \text{Dose Rate after Decontamination}$$





### 3. R&D on ENVIRONMENTAL RESTORATION

## Surface cleaning by high-pressure water



before

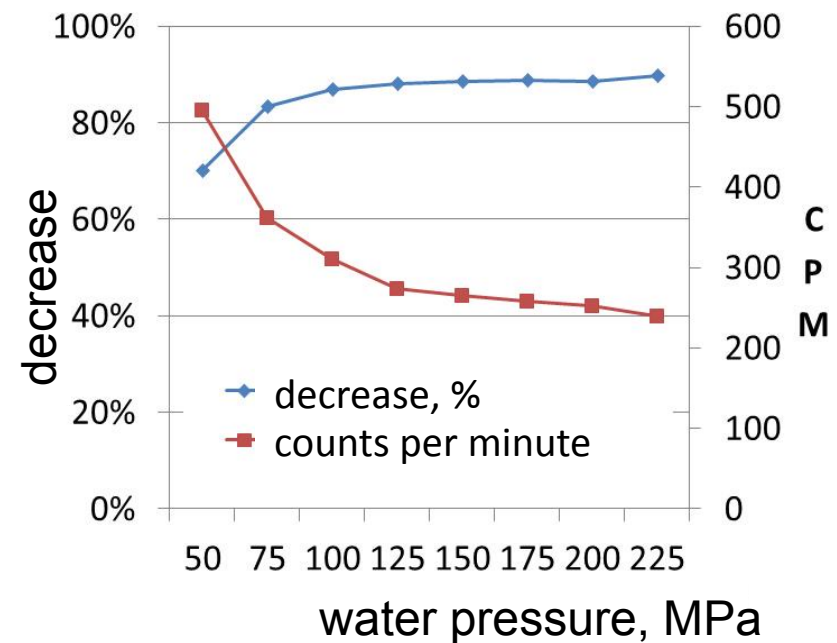
after



after



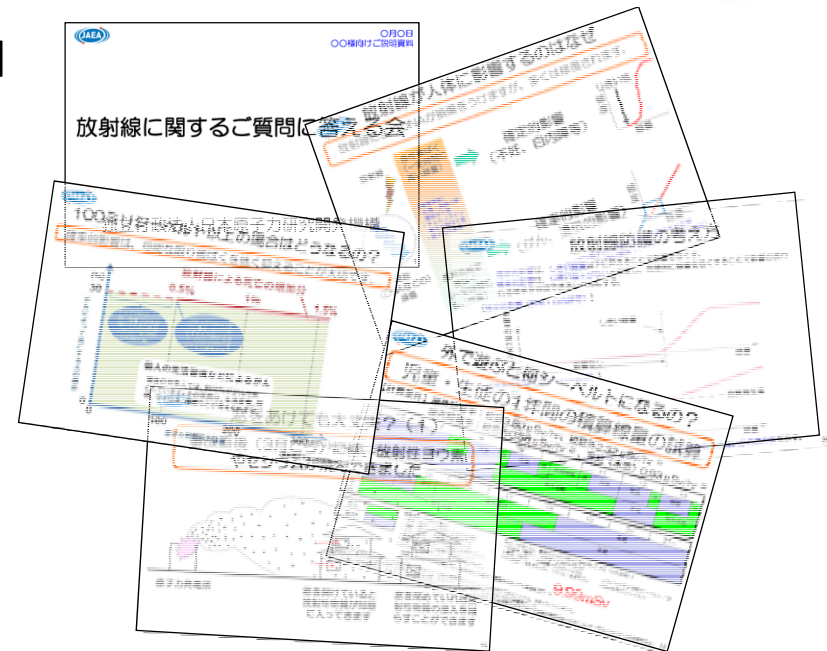
water purification



## 4. COMMUNICATIONS and INSTRUCTIONS

# Question-and-answer session on radiation and health

- ◆ JAEA technical staff are dispatched to Fukushima prefecture schools (from kindergartens to junior high schools) upon their request
- ◆ After briefings on radiation, JAEA staff members **talk face-to-face with parents and teachers**, answering their questions on radiation and its health effects.
- ◆ 132 sessions have been held since July, and a total of 142 sessions are scheduled as of December 4.



Briefing materials

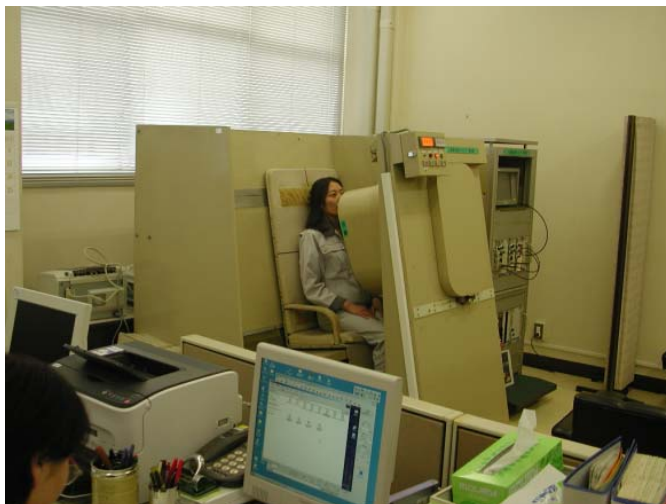


## 4. COMMUNICATIONS and INSTRUCTIONS

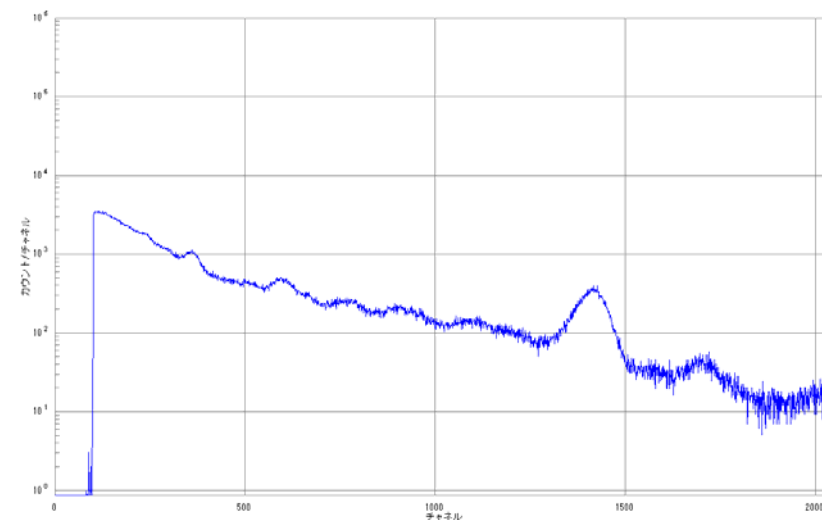
# WBC measurement for Fukushima pref. residents

JAEA has measures internal exposure of people within the restricted area and deliberate evacuation area using the **Whole Body Counter** (WBC) in Tokai Laboratory

- ✓ About 100 persons are measured per day
- ✓ About 7,300 have been measured by last November, and a total of 8,000 persons are scheduled by the end of December, 2011.
- ✓ **15 minute-to-1 hour Q & A per person** is welcomed after each measurement



Measurement by Whole Body Counter

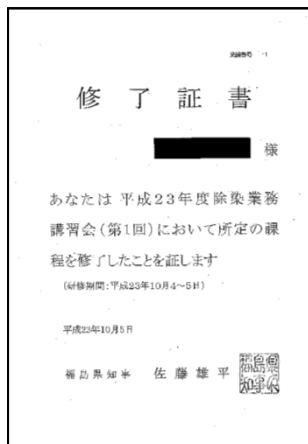


Energy spectrum measured

#### 4. COMMUNICATIONS and INSTRUCTIONS

### Dispatch of supervisors to training sessions on “Certified Decontamination Workers/Operators”

- ◆ JAEA dispatches its experts to **official training course of decontamination works** planned by Fukushima pref., as supervisors to ensuring safety and enhancing the skills of workers and operators engaging in decontamination works.
- ◆ Participants completed are certified by the governor of Fukushima.
- ◆ 3,000 workers and operators (equivalent to half of constructors in Fukushima) will be anticipated by the end of FY2011.



Completion certificate

#### Curriculum of training session

Day 1	Day 2
Opening	5. Safety management during decontamination works
1. Overview of the accident	
2. Fundamental knowledge on radiation	6. Radiation effects on human health
3. Radiation safety management	7. Demonstration and practice
4. Decontamination method	8. Exam.
	Closing