# Japan's Activities for Environmental Remediation after Fukushima Daiichi Nuclear Power Plant Accident

Japan Radioisotope Association Kenkich ISHIGURE

1. Situation at Fukushima Daiichi NPP
2. Environmental Remediation Activities of the Central Government
3. Environmental Remediation Activities of Local Governments and Other Parties Concerned
4. International Cooperation
5. Decontamination Testing and Demonstration
6. Summary

# Situation at Fukushima Daiichi

## -from the view point of environmental remediation-

**2011**

**Mar. 11** Great East Japan Earthquake occurred and a devastating tsunami hit.
Loss of emergency core cooling function and then station blackout
The Government designated evacuation zones and stay-indoor zones.

**Apr. 17** TEPCO announced a roadmap toward restoration from the accident, and started Step 1.

**Apr. 22** The Government revised the evacuation zones, and designated alert, planned evacuation and emergency evacuation preparation zones.

**Jun. 30 and onward** The Government designated recommended evacuation areas (227 areas, 245 households).

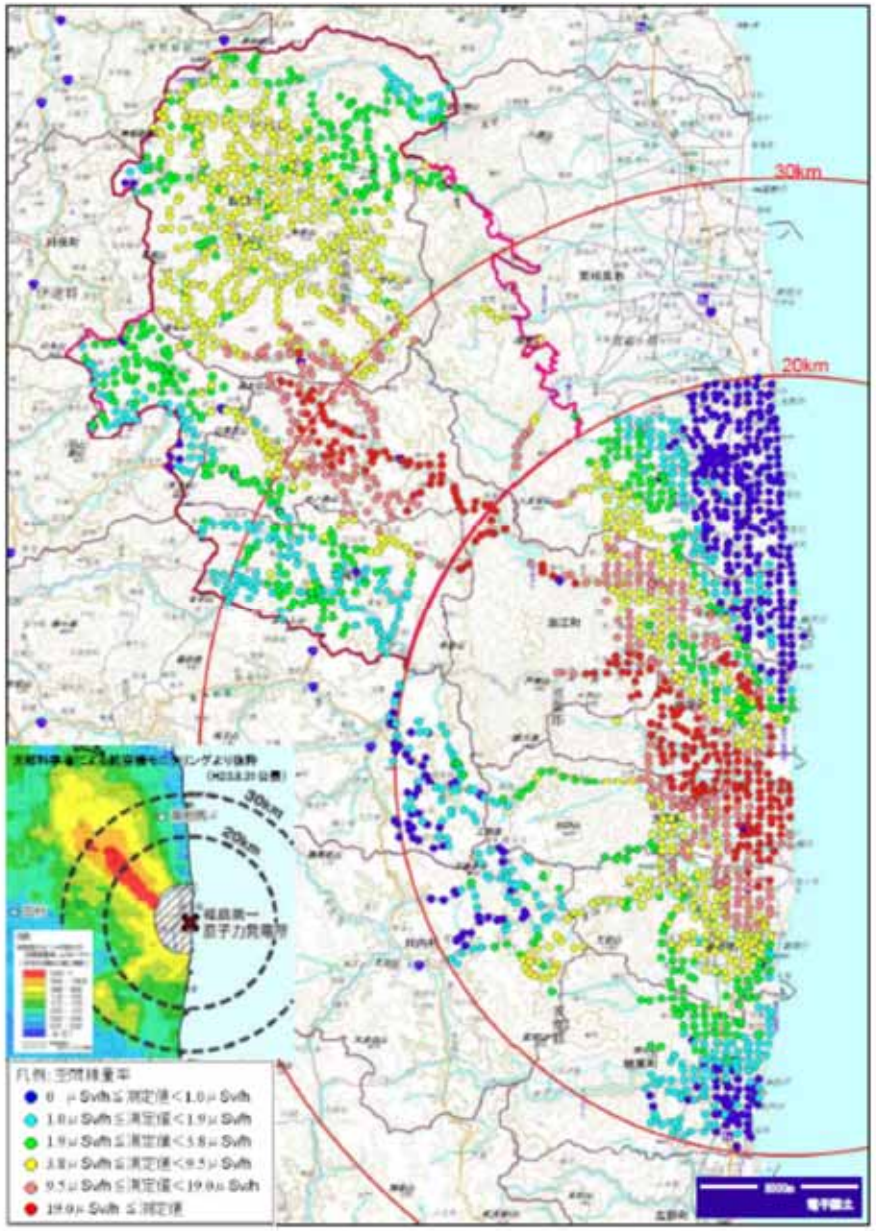
**Jul. 19** TEPCO completed Step 1 (achieved the circulation and cooling of contaminated water) ⇒ Started Step 2.

**Set. 30** The Government lifted the designation for the emergency evacuation preparation zones.

**Dec. 16** TEPCO declared completion of Step 2 (achievement of cold shutdown).

**Dec. 21** The Government announced a mid-and-long-term roadmap toward decommissioning of Units 1 to 4.

Wide-area monitoring results map (at 1 m above ground)



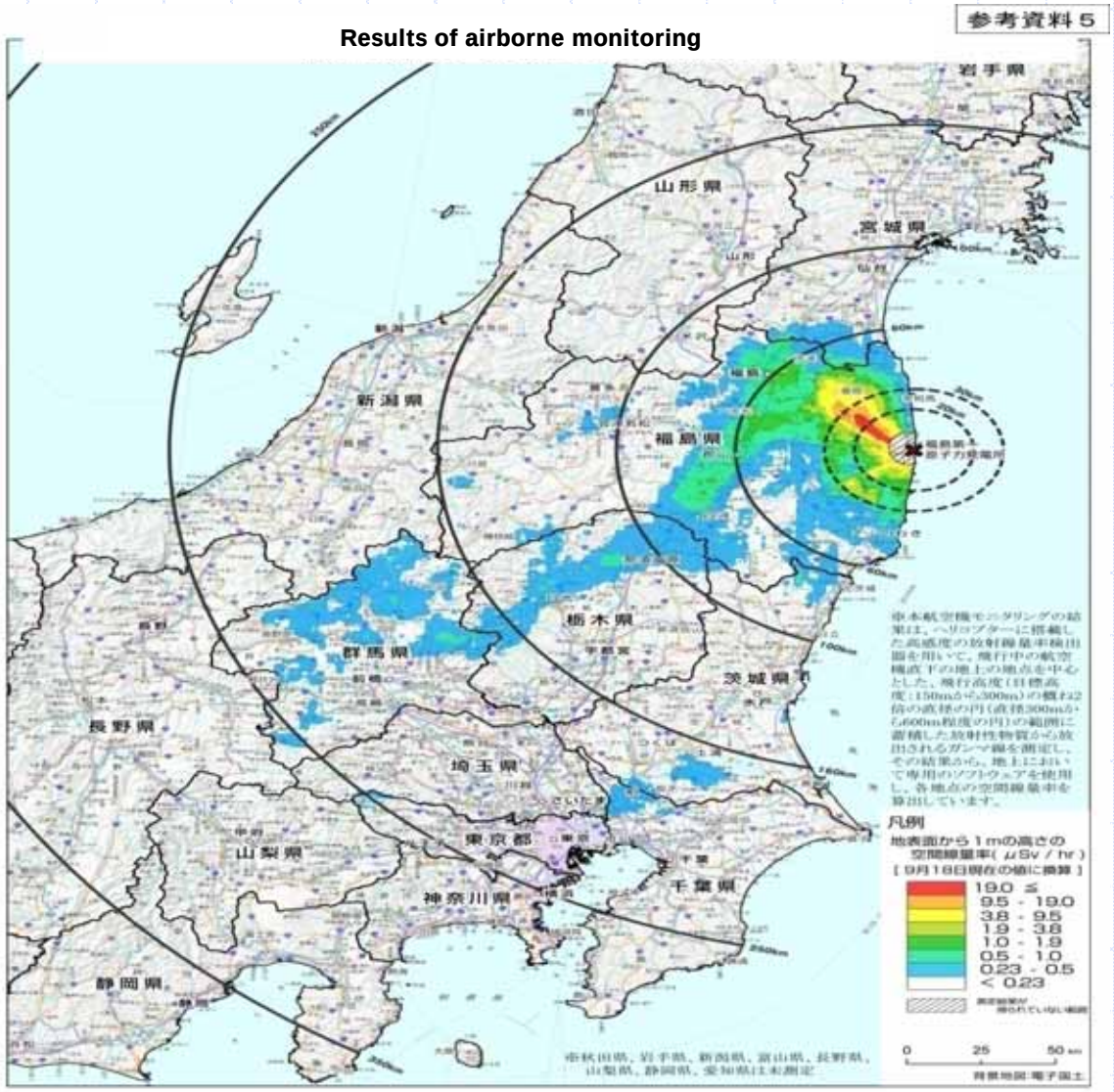

# Monitoring Results Map

**Measured at 1 m above ground at selected monitoring points**

**(7/4 to 8/20)**

**Source: Nuclear Accident Victims Support Team, Ministry of Education, Culture, Sports, Science and Technology**
**The Government released the results of wide-area monitoring in the alert and planned evacuation zones on September 1, 2011.**

# Wide-Area Monitoring

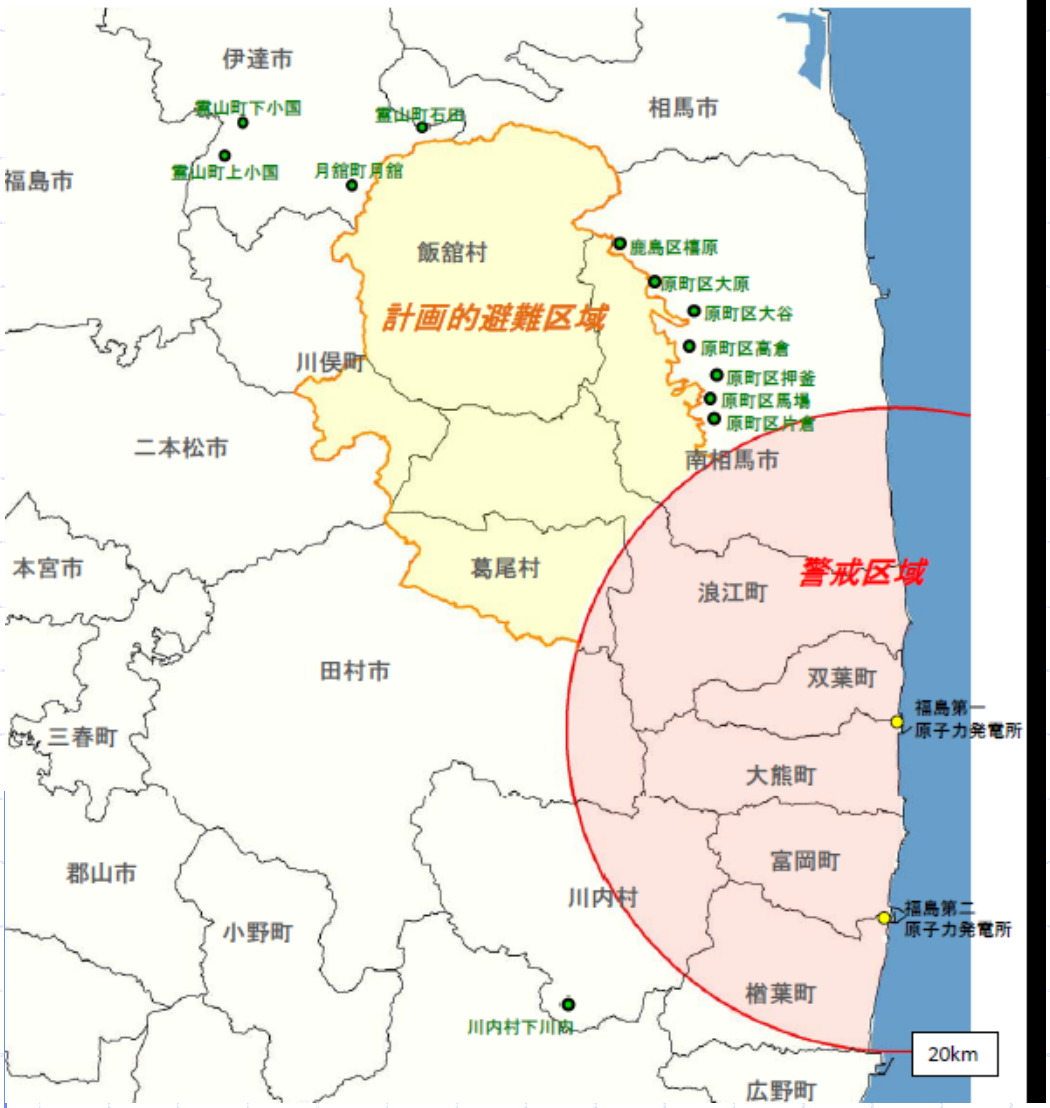



The results of airborne monitoring were converted to spatial dose rates (September 18) at 1 m above ground.

Source: A document for Waste Safety Evaluation Committee/Disaster Committee 1st Joint Study meeting (October 10, 2011), Ministry of the Environment

# Designation of Alert and Other Zones

Map of areas containing the alert, planned evacuation and special evacuation recommended spots (As of September 30, 2011)




Source: A document for Waste Safety Evaluation Committee/Disaster Committee 1st Joint Study Meeting (October 10, 2011), Ministry of the Environment

2011

Mar. 11 Evacuation zone, stay-indoor zone

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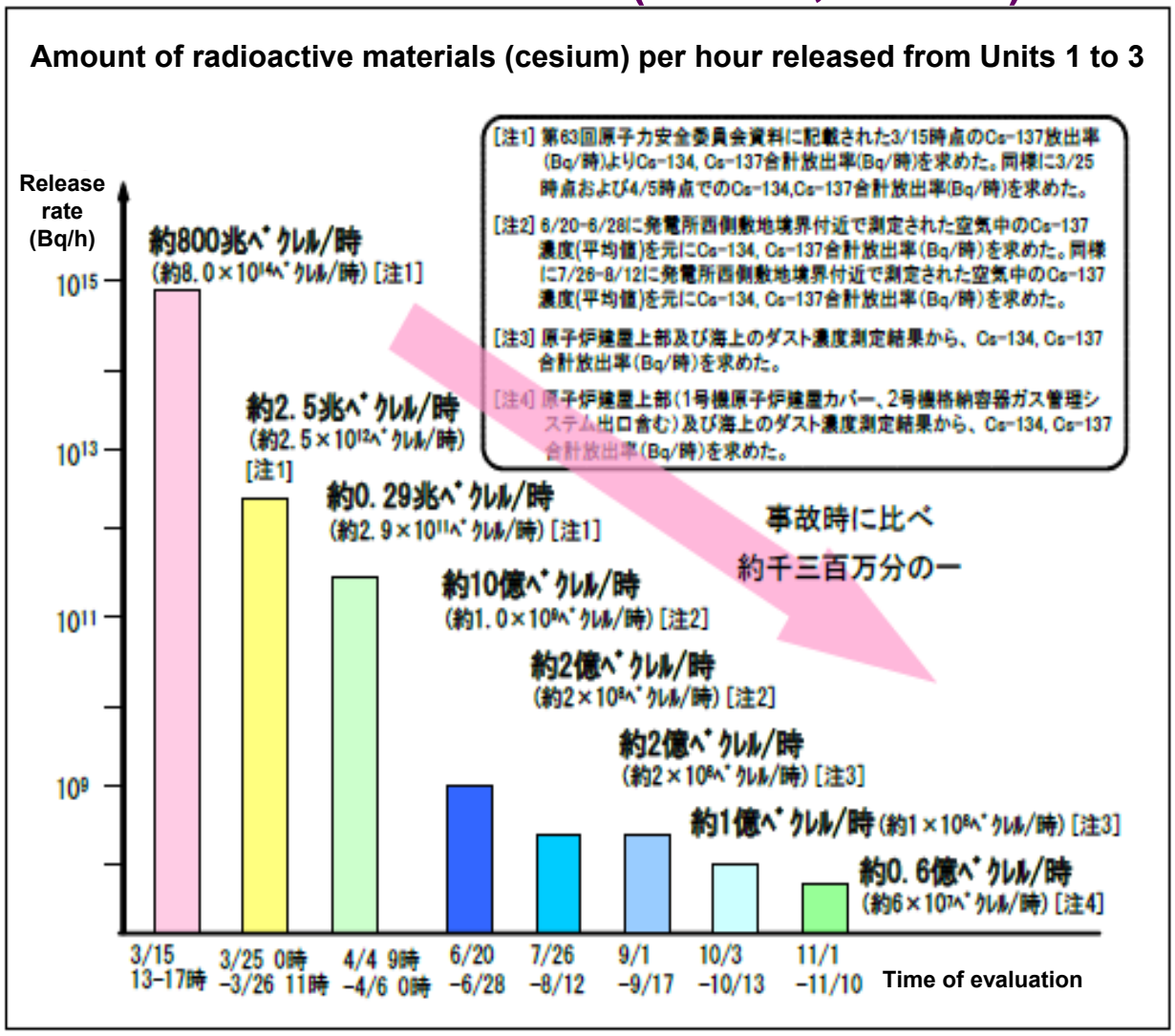
Apr. 22 Alert zone, planned evacuation zone, emergency evacuation preparation zone

Jun. 30 Special evacuation recommended spots

Sep. 30 Lifted the designation for emergency evacuation preparation zone.

# Release of Radioactive Cesium

## (Cs-137, Cs-134)




**Amount Released**

**Total of ~ 6 X $10^7$ Bq/h from Units 1 to 3**

**Reduced to 1/13 millions of that at the time of the accident (November 17)**

**Source: Progress of the Roadmap toward Restoration from the Accident at the TEPCO Fukushima Daiichi NPP (November 17, 2011), Nuclear Emergency Response Headquarters**

# Post-Accident Environmental Remediation Activities - 1

## I. Government's activities

### 1) Cabinet Office

- Nuclear Emergency Response Headquarters

2011/Aug. Decontamination technology study project (commissioned to JAEA)
Demonstration of decontamination technology at model sites (2)

Aug. 26 **Announced a basic policy** on urgent work of decontamination .
Issued **guidelines for decontamination** (V1) by local governments.

Oct. Started decontamination demonstration projects in the alert, planned evacuation zones
Commissioned to JAEA: **Demonstration of a decontamination model, decontamination technology demonstration testing**

Nov. 22 Published a **decontamination technology catalog.** (Nuclear Accident Victims Support Team)

# Post-Accident Environmental Remediation Activities - 2

## 2) Ministry of the Environment

2011

Aug. 30 Promulgation and partial implementation of Act on Special Measures Concerning Radioactive Material Contamination (Special Measures Act)

Oct. 29 Announced a basic policy on interim storage facilities and other facilities required to remedy environmental contamination due to radioactive materials.

Nov. 11 Announced a basic policy for the Special Measures Act.

Dec. 14 Promulgation of the Ordinance for Enforcement of the Special Measures Act (the requirements for the area designation, etc.)

Dec. 28 Promulgation of a notice related to the Special Measures Act (designation of the contaminated waste management areas, special decontamination areas and the contamination investigation areas)

2012

Jan. 1 Full enforcement of the Special Measures Act

# Post-Accident Environmental Remediation Activities - 3

## II. Activities of local governments

### Fukushima Prefecture

- Activities to deepen the understanding of decontamination (a safety and security forum)
- Technical support for decontamination
  - Decontamination Information Plaza … Collaboration with volunteers
  - Issuance of guidance on how to reduce radiation doses
  - Wide-area decontamination projects

### Fukushima City

- Fukushima City Hometown Decontamination Project

### Date City

- Thorough decontamination in elementary schools (school yards, swimming pools)
- Home decontamination demonstration testing in special evacuation recommended spots

# Post-Accident Environmental Remediation Activities - 4

## III. Atomic Energy Society of Japan

Cleanup Subcommittee

- Translation of EURANOS decontamination datasheets
- Explanatory documents on environmental remediation technology

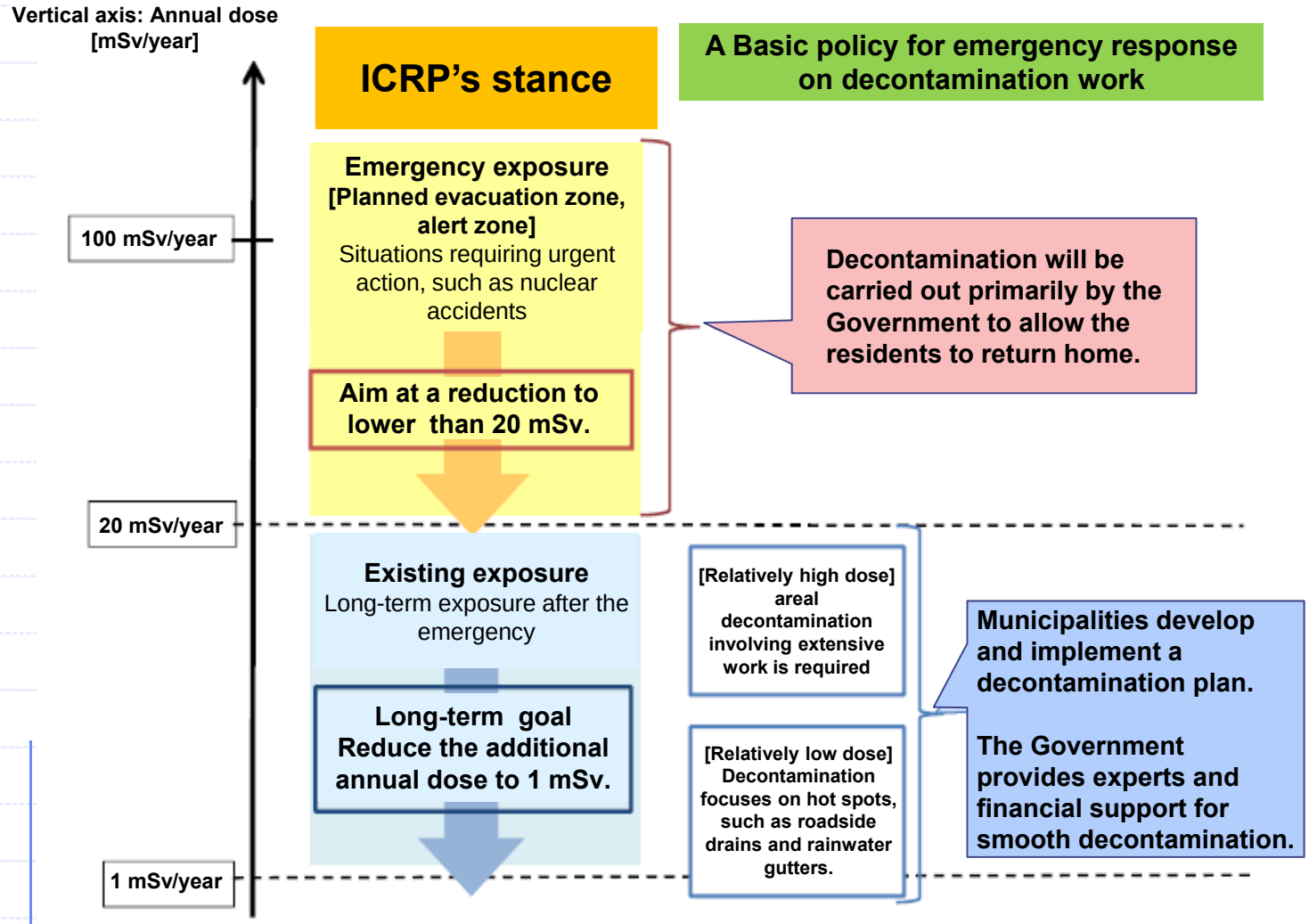
## IV. Japan Atomic Energy Agency

- Evaluation of contamination by radioactive materials
- Development of decontamination techniques for different facilities
- Model decontamination demonstration testing (2 locations), model demonstration project (12 locations), technology demonstration (commissioned by the Cabinet Office)

## V. International cooperation

- Oct. 7-15 Investigation and advice by the IAEA international mission on decontamination
- Oct. 16 International symposium on decontamination for environmental remediation (IAEA, OECD/NEA)

## A Basic Policy on Decontamination




## Specific Goals

**In 2 years**

**Reduction of additional annual dose: 50% (Decontamination 10% + natural factor 40%)**

**Reduction of doses in children's environments such as schools and parks: 60% (Decontamination 20% + natural factor 40%)**

**Source:** A Basic policy for emergency response on decontamination work , Nuclear Emergency Response Headquarters (August 26, 2011)

# Decontamination of Areas with an Additional Annual Dose of 1 to 20 mSv

- Local governments develop and implement decontamination plan.

⇓

Local governments issued guidelines for decontamination.

Contents

1. Development of a decontamination plan
2. Decontamination methods for different objects to be decontaminated
3. Points to be noted in decontamination operation
4. Provision and management of temporary storage facilities
5. Post-decontamination management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# IAEA Investigation Mission on Decontamination of Wide Contaminated Areas outside the Fukushima Daiichi NPP Site

Oct. 7-15 12-member **IAEA investigation team** headed by J.C. Lentijo interviewed the organizations involved and visited the nuclear power plant site.

**Mission's suggestions**

1. Require careful balancing of various factors that affect the benefits of decontamination and avoid extremely careful action.
2. It is necessary to strengthen communication and coordination between the central and local governments.
3. Stakeholders' participation is required.
4. Focus on dose reduction, instead of handling the decontamination issue in terms of only radioactivity concentration.
5. It is important to utilize existing infrastructure for waste management.
6. It is necessary to actively seek an appropriate site for final waste disposal.

and others

# Estimated Amount of Soil etc Generated from Decontamination

**Amount of soil:** Largely depends on the target, method and conditions of decontamination.

**Decontamination conditions:**

Surface decontamination for areas with a dose of higher than 5 mSv/y

Spot decontamination for areas with a dose of higher than 1 mSv/y

| Fukushima Prefecture (an example of estimated amount) | 1000m$^3$ |
|---|---|
| • Removal of building/housing land soil, garden soil (40%) (5 cm) | ～1000 |
| • Arterial roads: Cleaning of roadside drains | 50 |
| • Agricultural land: Removal of soil (5 cm) | 17,400 |
| • Forest: Removal of fallen leaves/removal of weeds 100%, cutting of tree branches 10% | 8,800 |
| • Other | 1,100 |
| • Spot | 400 |
| • Total | 28,750 |

# Management of Radioactive Waste from the Fukushima Daiichi Accident

## 1. Waste generated inside the plant site

⇒ **Regulated by the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors: waste is treated and disposed of by the NPP operator.**

## 2. Waste generated outside the plant site

- **Waste in contaminated waste management areas (designated by the Government)**
- **Specified waste (specified by the Government)**

⇒ **Regulated by Special Measures Act**

- **Waste other than specified waste**

⇒ **Regulated by Waste Disposal and Public Cleansing Law: treated as municipal/industrial waste**

※ **Waste not subject to the Law**

**Waste regulated by:**

- **Special Measures Act**
- **Nuclear Rector Regulation Law**
- **Radiation Hazards Prevention Law**
- **Health Care Related Laws**
- **Veterinary Practice Act**

# Act on Special Measures Concerning the Radioactive Material Contamination

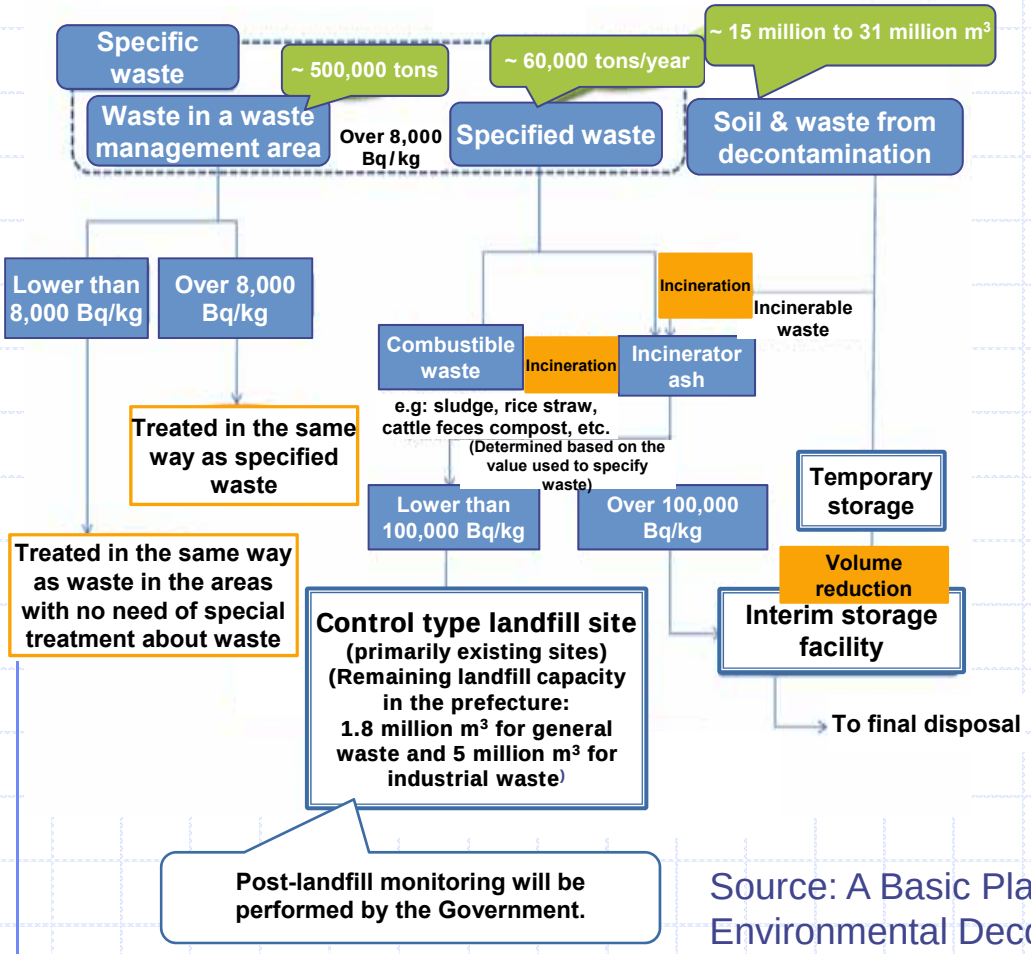
- Treatment of radioactive waste from the accident
- Decontamination and other measures

1. Designation of special decontamination areas (Minister of the Environment)
   - Scope of designation: Alert zone and planned evacuation zone (Ministerial Ordinance)
   - The Government develops a decontamination plan for special decontamination areas and carries out decontamination and other measures.
2. Designation of contamination investigation areas (Minister of the Environment)
   - Governor or mayors investigate contamination and develop a decontamination plan for areas determined to require decontamination (decontamination areas).
   - Decontamination operators designated by law (the central and local governments) carry out decontamination.

   Criterion used in designating contamination investigation areas and developing a decontamination plan: 1 mSv/y (spatial dose rate equivalent of higher than 0.23 μSv/h) (Ministerial Ordinance)

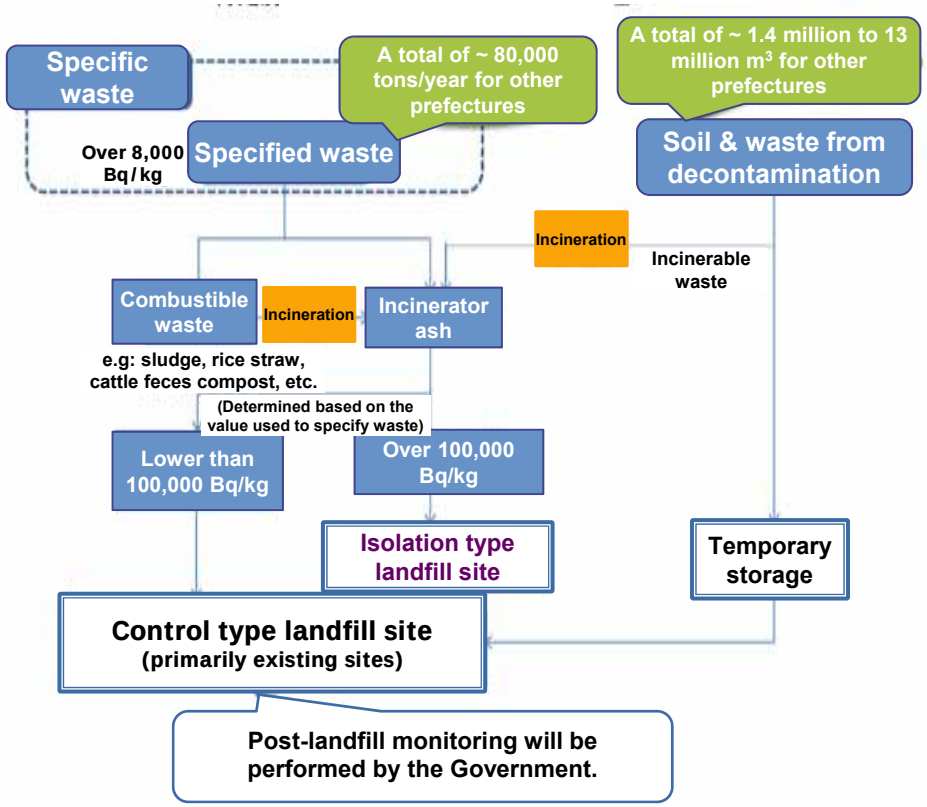
## Treatment flow of specific waste and waste from decontamination (in Fukushima Prefecture)

Figure 2




## Treatment flow of specific waste and waste from decontamination (in other prefectures)

Figure 3

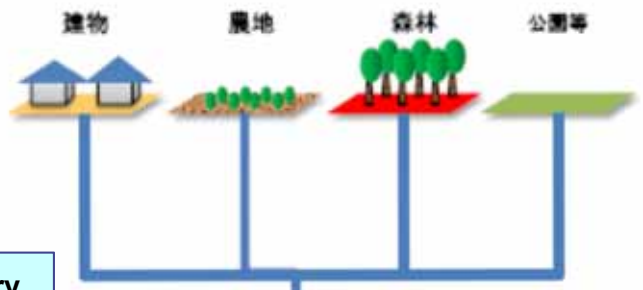



Source: A Basic Plan for the Use of Interim Storage Facilities required for Environmental Decontamination of Radioactive Materials from the TEPCO Fukushima Daiichi Nuclear Power Plant Accident (October 29, 2011), Ministry of the Environment

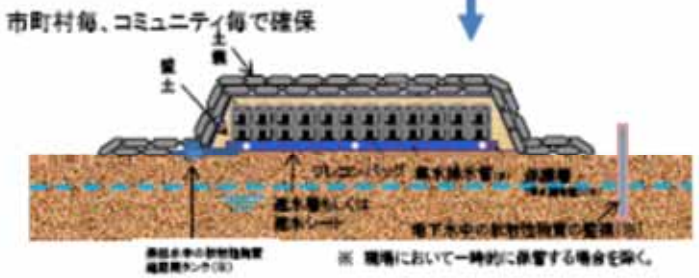
資料2

## Treatment of soil and waste from decontamination (in Fukushima Prefecture)

(1) Start of full-scale decontamination

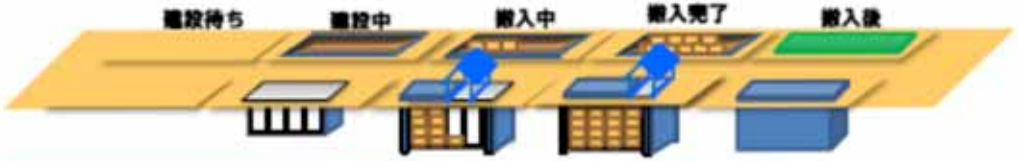



(2) Storage in a temporary storage facility (about 3 years)




(3) Storage in an interim storage facility (less than 30 years)

Waste from Fukushima Prefecture only (excluding waste from other prefectures)




(4) Final disposal: outside Fukushima Prefecture

**Image of Temporary Storage and Interim Storage Facilities (Left)**

**Importance of ensuring temporary storage facilities**

**Interim storage facility established only in Fukushima Prefecture aiming at starting operation in 2015**

**Source: Altered the Key Points in the Roadmap for Decontamination (Oct 29, 2011), Ministry of the Environment.**

# Designation of Contaminated Waste Management Areas, Special Decontamination Areas and Contamination Investigation Areas Ministry of the Environment Notice (December 28, 2011)

**1. Contaminated waste management area**

Applicable zone: Alert zone or planned evacuation zone

Designated area: Fukushima Prefecture – 7 towns and villages (the entire area), including Naraha,
(11 municipalities) and 4 cities, towns and villages, including Tamura
(areas included in the alert zone or planned evacuation zone)

**2. Special decontamination area**

Applicable zone: Alert zone or planned evacuation zone

Designated area: Same as the contaminated management area
(11 municipalities)

**3. Contamination investigation area**

Applicable zone: Areas with a dose rate of higher than 0.23 μSv/h

Designated area: Iwate Prefecture – 3 areas, including Ichinoseki
(102 municipalities) Miyagi Prefecture – 8 areas, including Ishinomaki
Fukushima Prefecture – 40 areas, including Fukushima
Ibaraki Prefecture – 20 areas, including Hitachi
Tochigi Prefecture – 8 areas, including Sano
Gunma Prefecture – 12 areas, including Kiryu
Saitama Prefecture – 2 areas, including Misato
Chiba Prefecture – 9 areas, including Matsudo

# Outline and Implementation of the Project

## Outline of the project

**The purpose of the project is to demonstrate technology required to effectively implement decontamination in 12 municipalities in the alert and planned evacuation zones.**

## Implementation of the project

**Government (Cabinet Office)**

**Commissioned to**

**Fukushima Technical Headquarters, Japan Atomic Energy Agency**

**Public solicitation of projects**

- **Municipality Group A: Taisei JV (Minamisoma, Kawamata, Namie, Iidate)**
- **Municipality Group B: Kajima JV (Tamura, Futaba, Tomioka, Katsurao)**
- **Municipality Group C: Obayashi JV (Hirono, Okuma, Naraha, Kawauchi)**

**A decontamination model for the alert and planned evacuation zones**
**Areas where the demonstration project is performed (As of December 20, 2011)**

**Each group was set up to include the following:**

- **A wide variety of decontamination objects: Forest, agricultural land, housing land, large structures, buildings, roads**
- **A wide range of dose rate: High (> 100 mSv/year,) medium (20 to 100 mSv/year). low (5 to 20 mSv/year)**

**Source: A document for the JAEA Decontamination Demonstration Project Implementation Committee (December 20, 2011)**

# Decontamination Technology Demonstration Test Project

**Demonstration testing of each technology** that can be used for decontamination in the future

Oct. 3-24 Public solicitation of technology demonstration test projects: 305 applications

Oct. 25-Nov. 9 Review: 25 projects accepted.

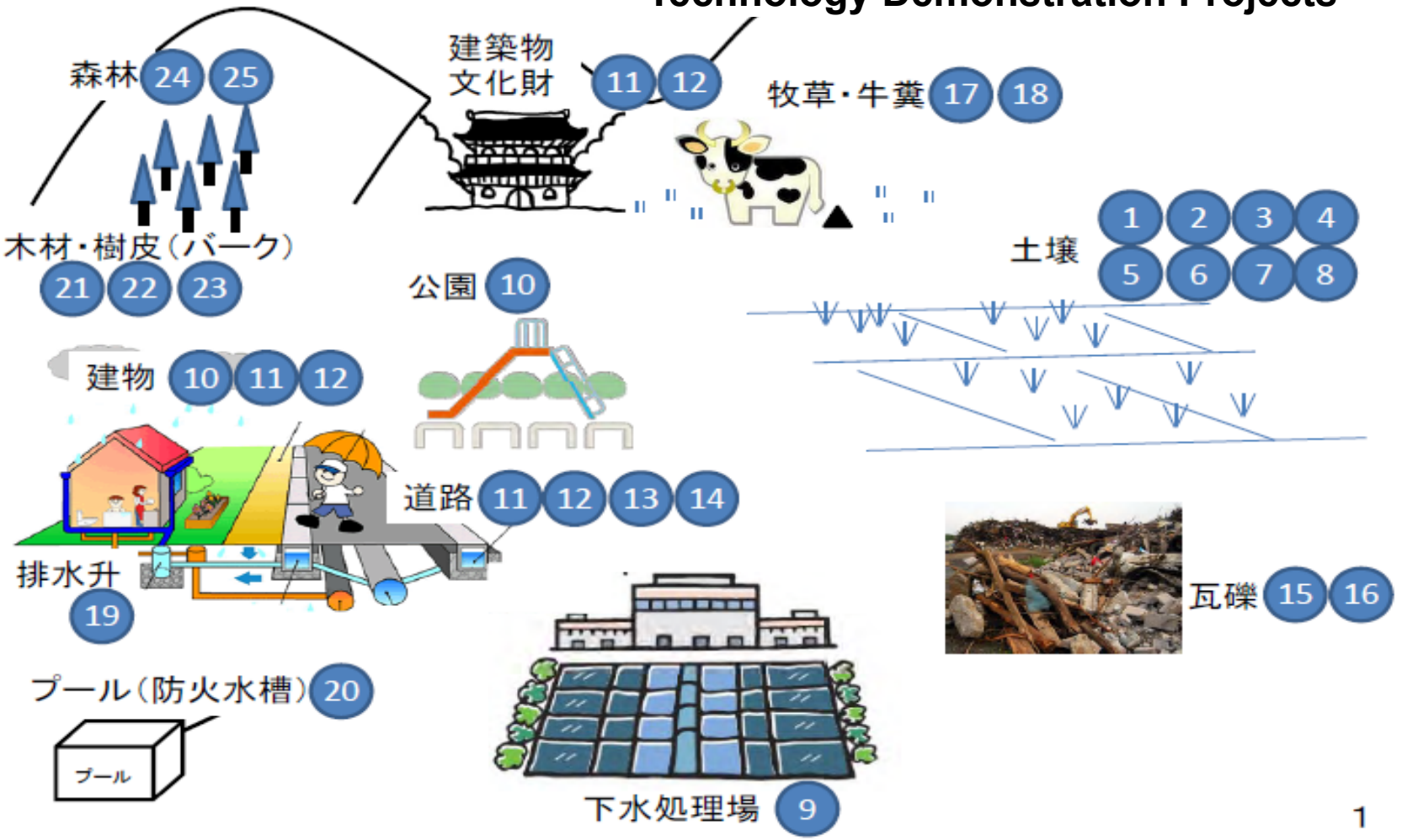
Nov. 21 and onward Successive start of the tests

Interim report in January 2012, final report in March

**Accepted Projects**

| To be decontaminated | Technique | No of Projects |
|---|---|---|
| Soil | Sorting, treatment | 8 |
| Sewage sludge | Dissolution | 1 |
| Parks, roads, buildings | Cutting, grinding, washing | 5 |
| Rubble | Washing | 2 |
| Plants, cattle feces | Microbe decomposition | 2 |
| Water | Collection, adsorption, agglomeration | 2 |
| Forest, lumber | Peeling, washing, incineration, treatment, thinning | 5 |

# Scope of Application of the Accepted Technology Demonstration Projects




**Source: A document for the JAEA Decontamination Demonstration Project Implementation Committee (December 20, 2011)**

# Key Issues Related to Decontamination

1. It is indispensable to develop "Decontamination Plan" based on dose measurements in advance.
2. A variety of techniques are now available for different objects to be contaminated. It is important to select the optimum technique best suited to the object.
3. It is necessary to accumulate both efficiencies and data evaluations from the integrated demonstration tests.
4. It is needed to maintain the functions of soils (e.g. fertility) and woods after their decontamination which occupy quite large areas in decontamination targets.
5. Realistic volume-reduction techniques are important because of large amount of waste (incl. soil) generated by decontamination.
6. It is indispensable to construct temporary storage facilities, but securing the lands for them is difficult.
7. It is important to start early construction of interim storage facility and planning of final disposal site.
8. It is of vital importance to work together in cooperation with the related local people.

# Summary

1. The **Act on Special Measures Concerning Radioactive Material Contamination** became fully effective on January 1, 2012 and full-scale decontamination starting.
2. The organizations involved published guidelines, manuals and guidance for decontamination.
3. Some organizations are carrying out preliminary decontamination and testing decontamination techniques.
4. The following issues were identified regarding decontamination
   1) A variety of techniques are available. Data need to be accumulated for choosing the best suited technique.
   2) It is necessary to develop an appropriate decontamination plan.
   3) Technology is required which can reduce the enormous volume of waste from decontamination.
   4) It is difficult to acquire temporary storage facilities.
   5) It is important to prepare for future waste disposal.