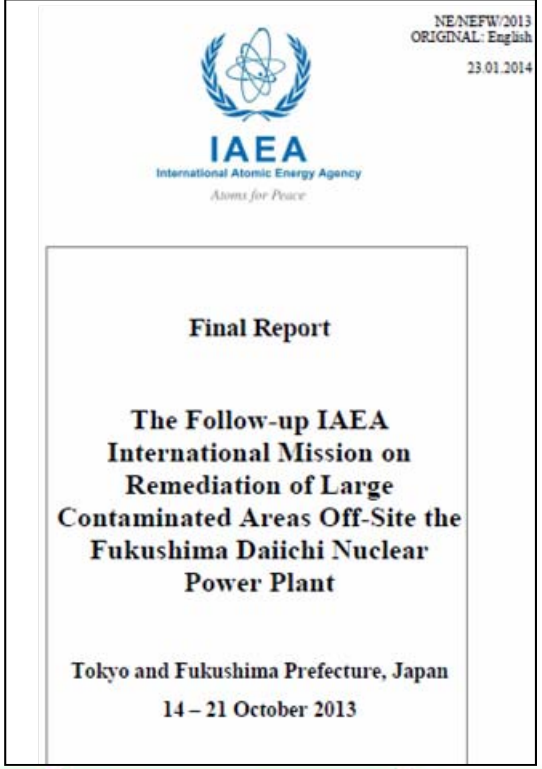
日本政府因應福島事故之

復原作業規劃

2014年4月

Outline

- INSTITUTIONAL ARRANGEMENTS AND GENERAL CONCEPTS
- RADIATION PROTECTION
- REMEDIATION STRATEGY IMPLEMENTATION
- WASTE MANAGEMENT
- STAKEHOLDER INVOLVEMENT
- CHALLENGES
- CONCLUSION



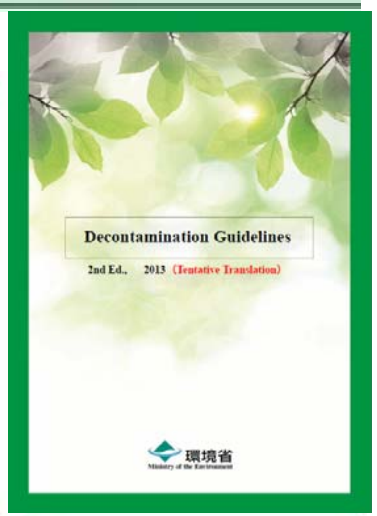
環境省
Ministry of the Environment

Guideline for measurement of radio activities in contaminated area

Guideline for decontamination techniques

Guideline for collection and transportations of recovered soil

Guideline for storage of recovered soil



Guideline for decontamination

Outlines of the Act on Special Measures*

*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 March 11,2011

Purpose

To promptly reduce the impacts of environmental pollution by instituting measures taken by interested parties, especially ,the national and local governments and the relevant licensee of NPP (i.e. Tokyo Electric Power Company)

Roles of Interested parties

(1) **The national government:**
To implement any necessary measures in consideration of its social responsibilities associated with the promotional efforts thus far channeled into its nuclear energy policy.

(2) **Local governments:**
To carry out their proper role through cooperation with the measures by the national government.

(3) **The relevant licensee of NPP:**
To implement any necessary measures in confidence, while assisting the national and local governments.

Basic principles formulation and others

- The Minister of the Environment develop a draft of the basic principles and seek a Cabinet decision.
- The Minister of the Environment set standards for the processing of contaminated waste and soil
- The national government establish a system of unified monitoring and measurement

Promulgated: at the end of August 2011, Fully came into force: January 1, 2012

合作小組

復興庁
Reconstruction Agency

Established in February 2012.
To facilitate the reconstruction process.

内閣府
Cabinet Office, Government of Japan

原子力規制委員会
Nuclear Regulation Authority

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水産省

環境省
Ministry of the Environment

厚生労働省
Ministry of Health, Labour and Welfare

厚生労働省
Ministry of Health, Labour and Welfare

食品中放射性物質的基準值
食品中放射性物質的檢驗
復原作業工作人員輻射防護

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水産省

森林、農地的除汙作業

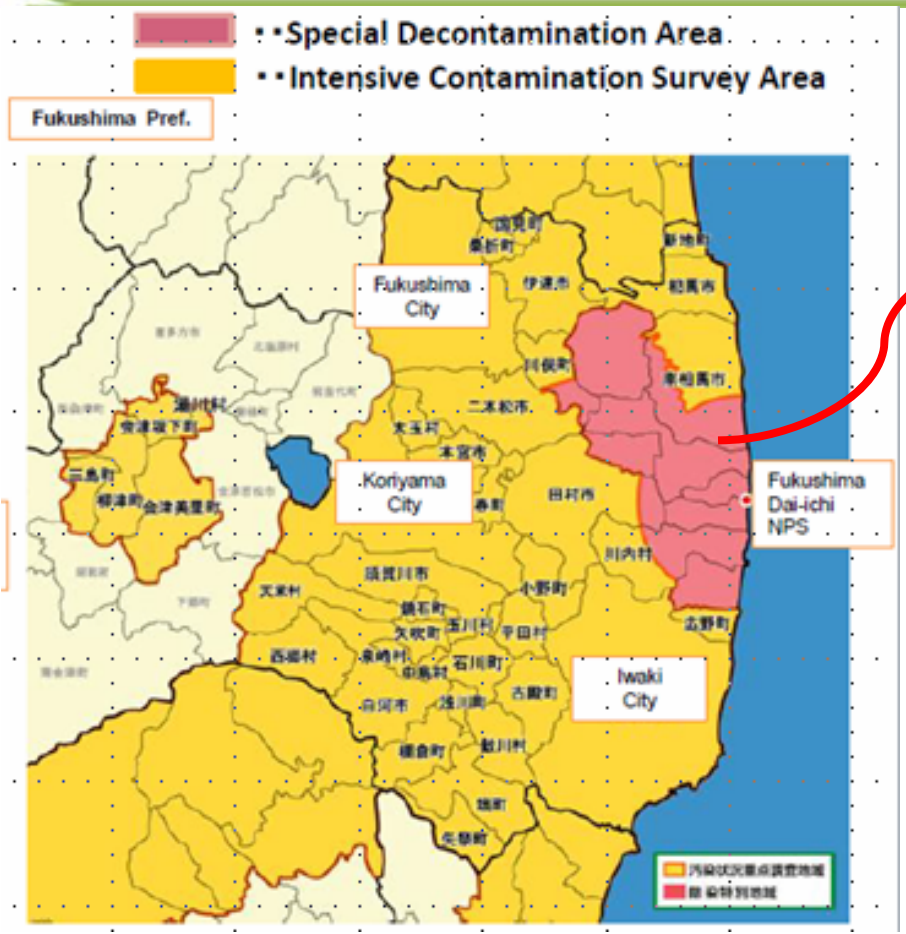
環境省
Ministry of the Environment

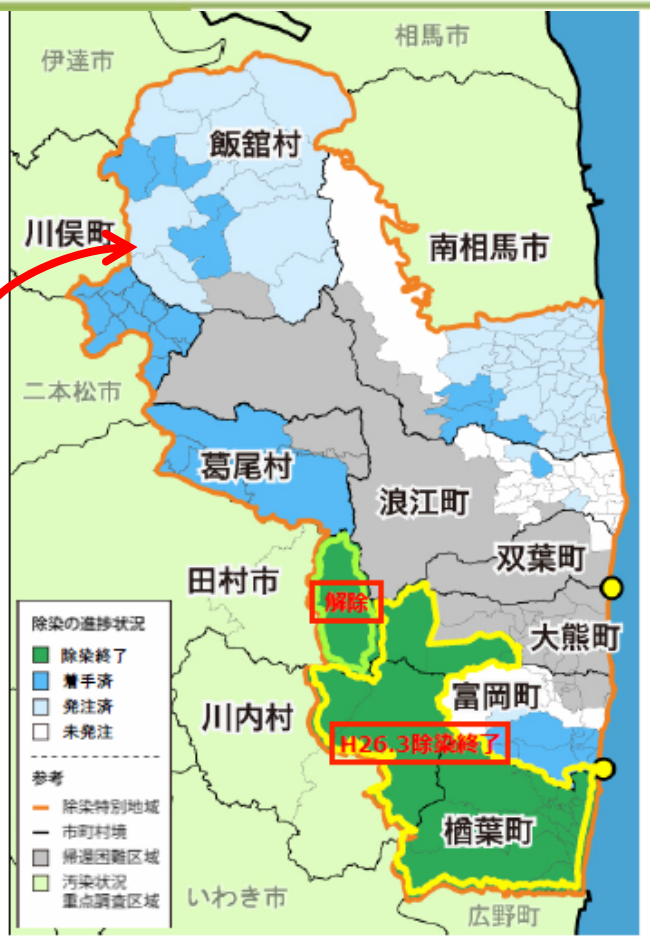
廠外復原作業的執行
放射性廢棄物的處置

Special Decontamination Area

- 11 municipalities in (former) restricted zone or planned evacuation zone (<20km from the NPS, or annual cumulative dose is >20mSv)
- Decontamination is being implemented by the national government
  National government selects contractors to perform remediation work.

(*) Entire area of Naraha, Tomioka, Okuma, Futaba, Namie, Katsurao, and Iitate.
Some area of Tamura, Minami Soma, Kawamata, and Kawauchi.



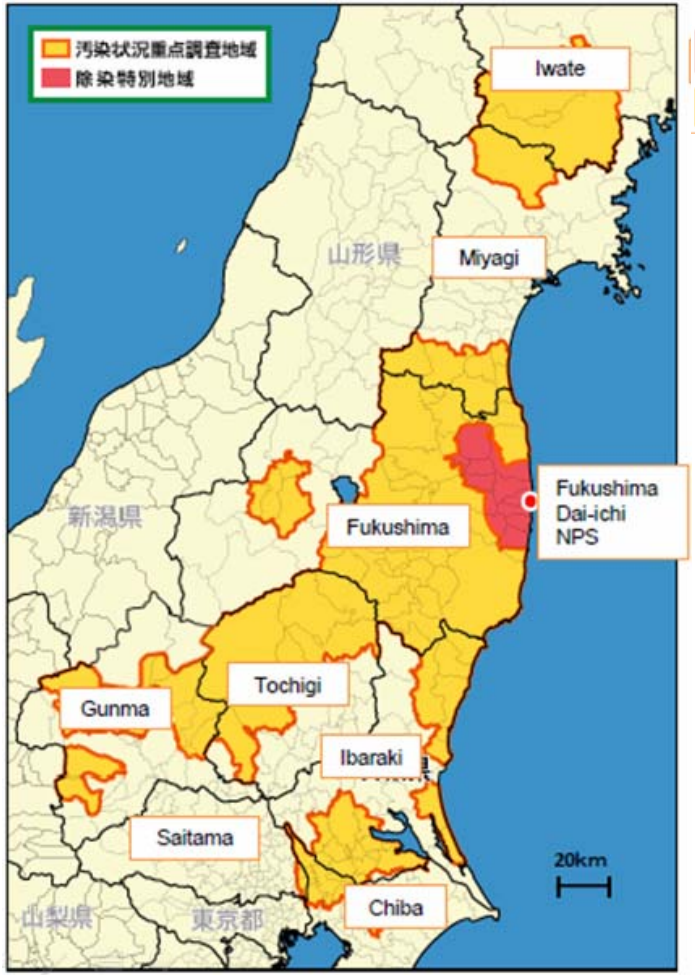


Before the work is carried out, contractors may implement pilot tests and decide upon the most effective procedures.

Intensive Contamination Survey Area

- 100 municipalities in 8 prefectures (*), in which over 0.23 μSv/hour of air dose rate (equivalent to over 1 mSv/Year) is observed, were designated.
- Decontamination is being implemented by each municipality. The national government will take financial and technical measures.

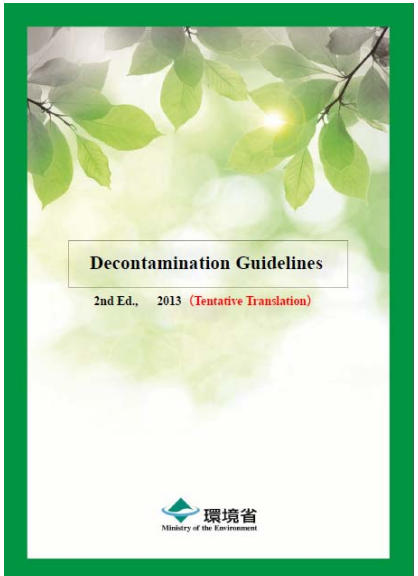
(*) Iwate, Miyagi, Fukushima, Ibaraki, Tochigi, Gunma, Saitama, and Chiba



▪▪Special Decontamination Area

▪▪Intensive Contamination Survey Area

To assist the municipalities in developing a remediation approach, the MOE developed Decontamination Guidelines



Part 1
Guidelines for Methods for Investigating and Measuring the Status of Environmental Pollution in Intensive Contamination Survey Areas

Part 2
Guidelines Pertaining to Decontamination and Other Measures

Part 3
Guidelines Pertaining to the Collection and Transfer of Removed Soil

Part 4
Guidelines Pertaining to the Storage of Removed Soil

Guideline for measurement of radio activities in contaminated area

Guideline for decontamination techniques

Guideline for collection and transportations of recovered soil

Guideline for storage of recovered soil

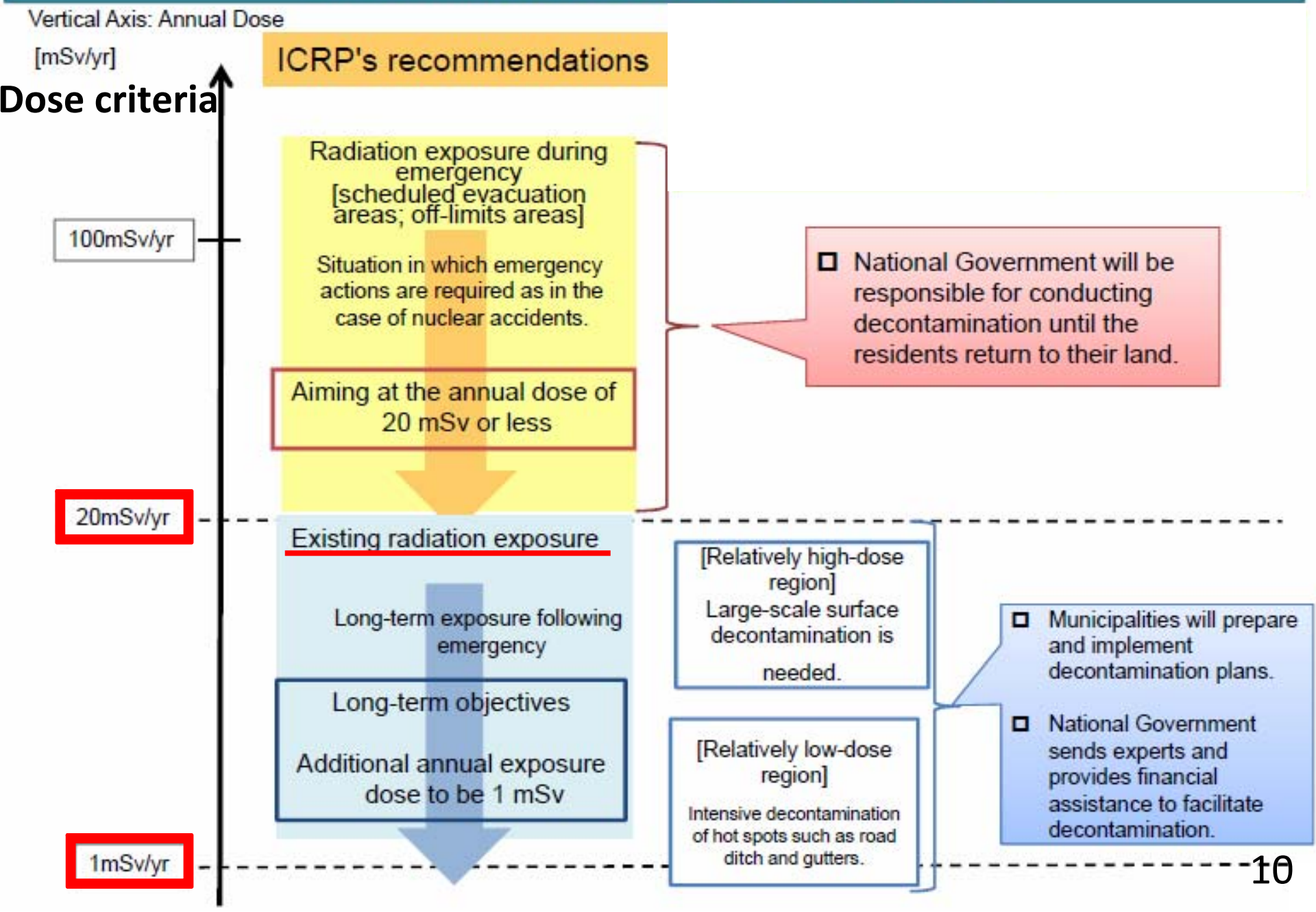
Guideline for decontamination

Provide with info
1. **Municipalities**
2. **Contractors**

Decontamination
1. **application on a large scale**
2. **reduction of external radiation dose**

Website (in Japanese) titled Decontamination Technology Options Exploitation (DETOX)

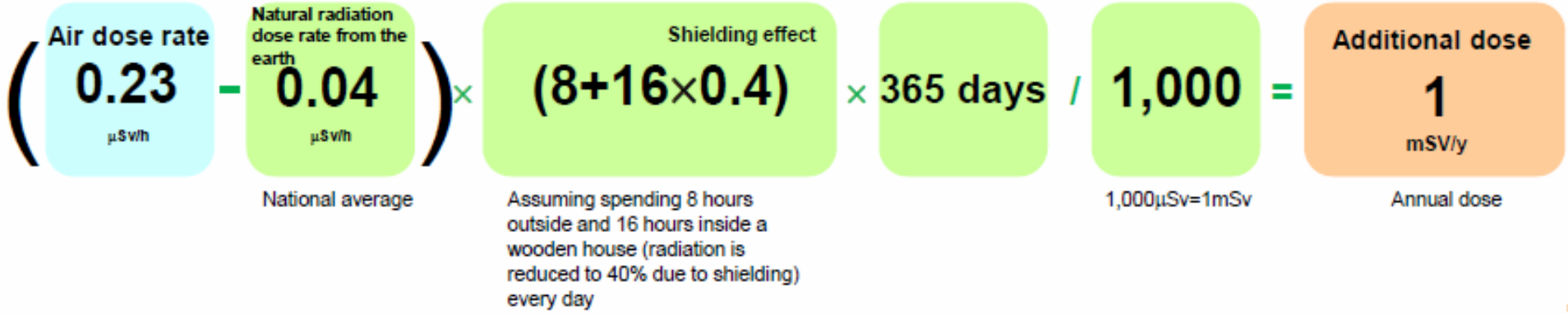
Basic Principles of Decontamination



Secondary criteria - Gamma doses in air (External exposure)

1. 空氣劑量率推估個人年輻射劑量

假設空氣劑量率0.23 μSv/hr、自然輻射劑量率0.04 μSv/hr
室外8小時、室內16小時(木製房屋屏蔽因子0.4)
→個人年輻射劑量1mSv



2. 使用個人輻射監測器

厚生労働省
Ministry of Health, Labour and Welfare

- Guidelines on Prevention of Radiation Hazards for Workers Engaged in Decontamination Works
- 復原作業工作人員輻射防護
  1. 輻射曝露限制(配戴個人劑量計)→5年內有效劑量不得超過 100mSv
     →1年內有效劑量不得超過 50mSv
  2. 防止汙染擴大→攜出物品汙染檢查
  3. 教育訓練(測定汙染程度、空氣劑量率及執行除汙)
  4. 記錄保存30年
- 焚化設施
  1. 保持焚化廠室內壓力低於室外
  2. 架設空氣劑量監測器於出入口
  3. 定期執行工作人員體內外輻射檢測

IAEA的建議：
土壤、森林除汙作業工作人員應注意傳統風險，如土地濕滑、山崖等造成的風險。

Secondary criteria - Activity levels in food (Internal exposure)

厚生労働省
Ministry of Health, Labour and Welfare

放射性銫的新標準值※2	
食品類別	標準值
飲用水	10
牛奶	50
一般食品	100
嬰幼兒食品	50

※2涵蓋放射性銫、鈰設定標準值

單位(Bq/kg)

一般食品

千預劑量水準 1mSv/年

決定一般食品劑量

考量年齡別的攝取量與換算係數後計算限值

年齡別	攝取量	限值(Bq/kg)
未滿 1 歲	男女平均	460
1~6 歲	男	310
	女	320
7~12 歲	男	190
	女	210
13~18 歲	男	120
	女	150
19 歲以上	男	130
	女	160
孕婦	女	160
最小值		120

標準值 100 Bq/kg

不同時期限值中最嚴謹的數值制定為標準值

飲用水

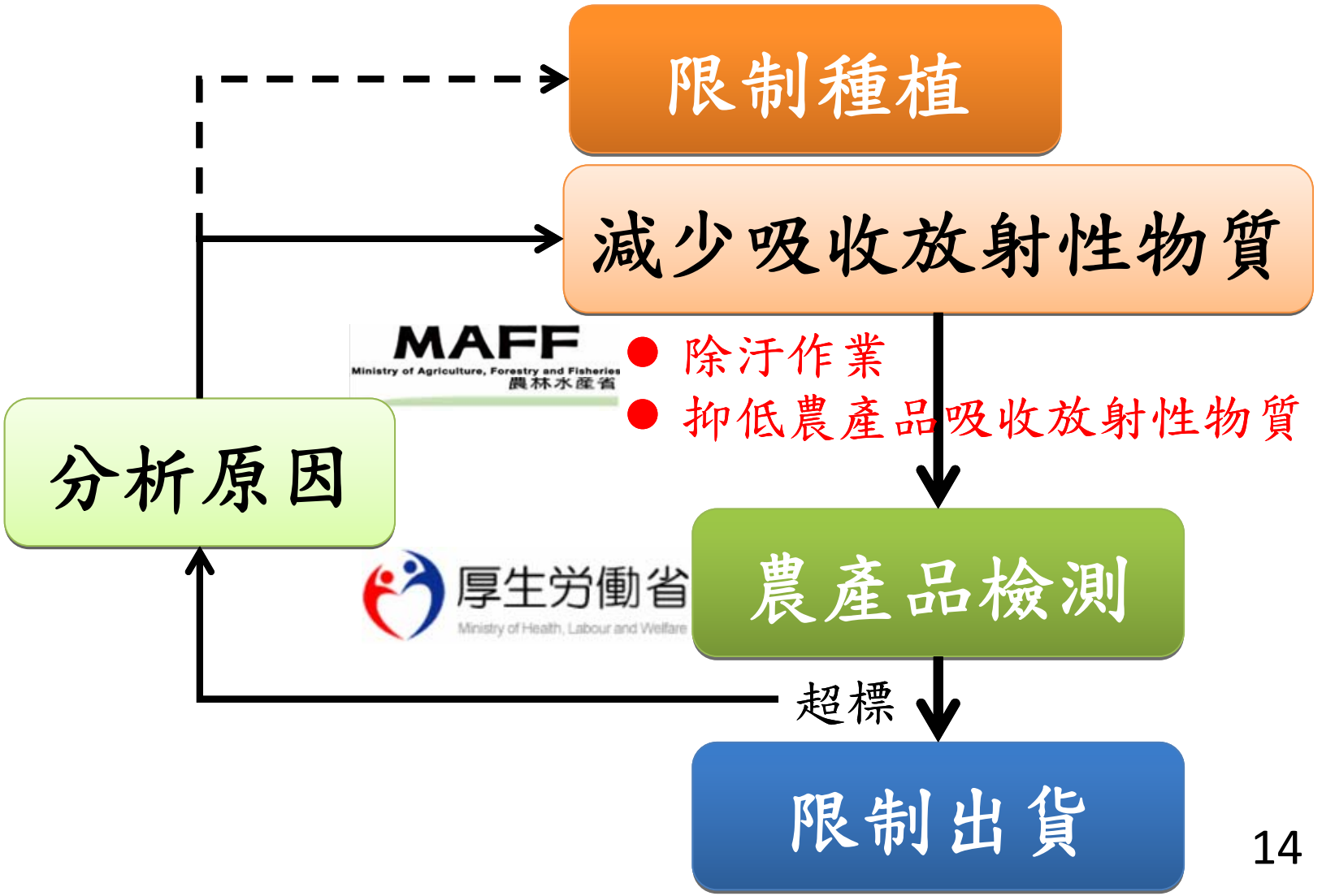
"Guideline for drinking-water quality" of the WHO

千預劑量基準0.1 mSv/年

「嬰幼兒食品」及「牛奶」是考量孩童的角度而制定的食品分類，新標準值中一般食品的一半(50Bq/kg)

厚生労働省
Ministry of Health, Labour and Welfare

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水産省



厚生労働省
Ministry of Health, Labour and Welfare

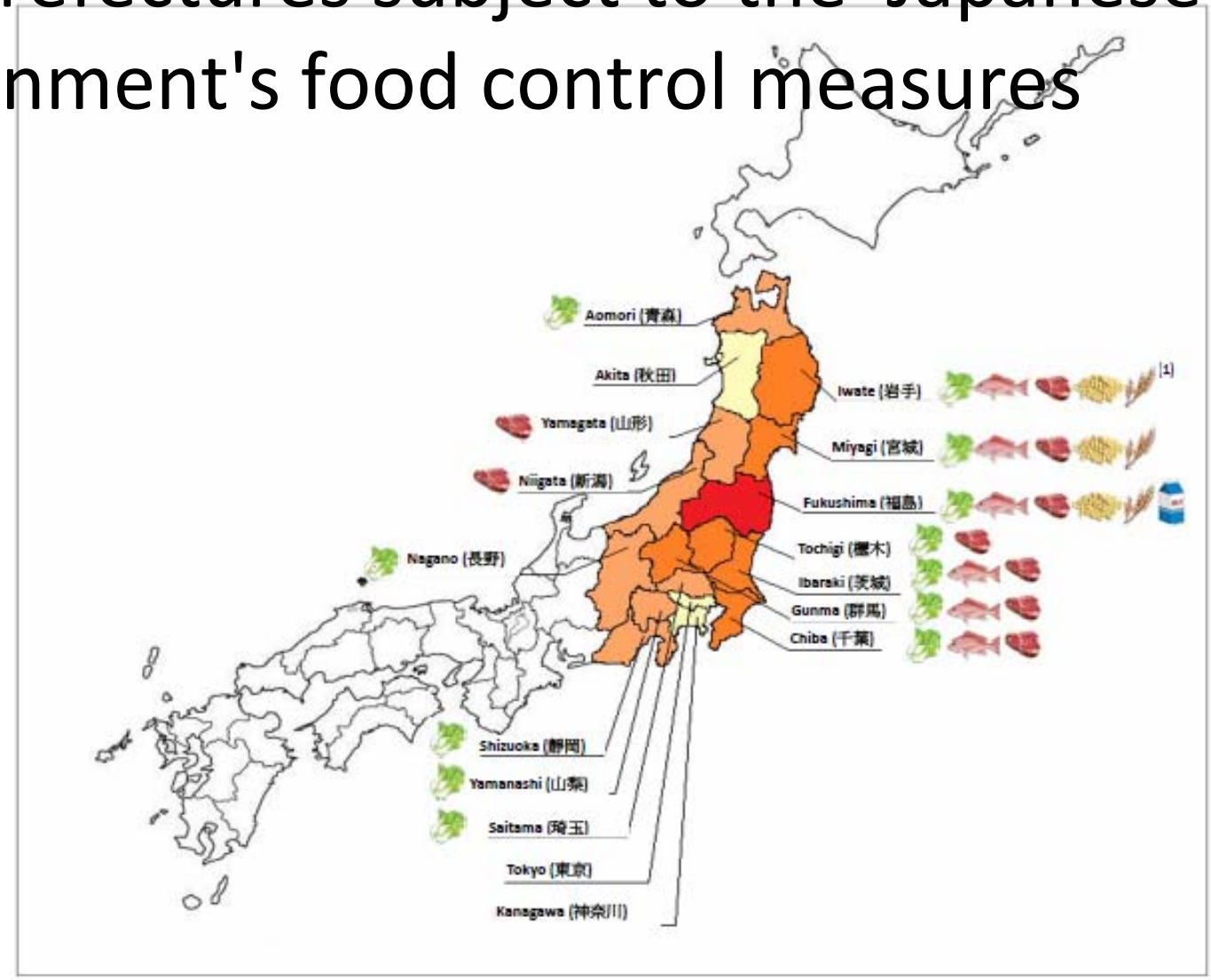
<測定の流れ>

細切 → 秤量 → 測定 → 解析

牛肉

野菜

The prefectures subject to the Japanese government's food control measures



Tier-one prefecture with six categories of food products restricted from distribution.
Tier-two prefecture with two to five categories of food products restricted from distribution.
Tier-three prefecture with only one category of food products restricted from distribution
Tier-four prefecture with selected food products tested but not restricted from distribution.

Note: (1) Food categories restricted from distribution *are*: = Fruits and vegetables; = Marine products; = Meat; = Soybean/Azuki bean; = Grain; and = Milk and milk products.

Sources: Ministry of Agriculture, Forestry and Fisheries (2013) & Ministry of Health, Labour and Welfare (2013).

厚生労働省 Ministry of Health, Labour and Welfare

MAFF Ministry of Agriculture, Forestry and Fisheries 農林水産省

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水産省

福島事故後
尚未犁田

福島事故後
已犁田

放射性銫沉積於表土

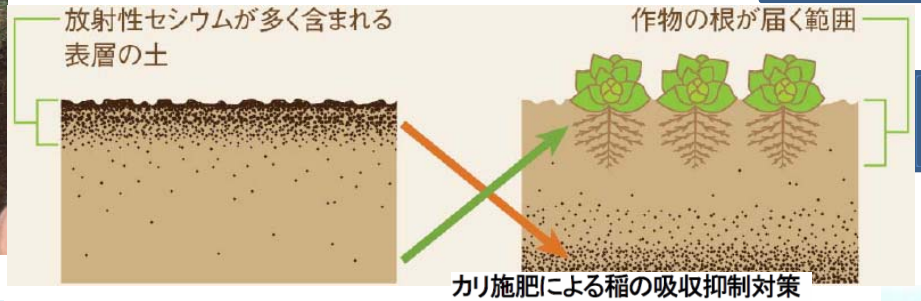
>5000Bq/kg

<5000Bq/kg

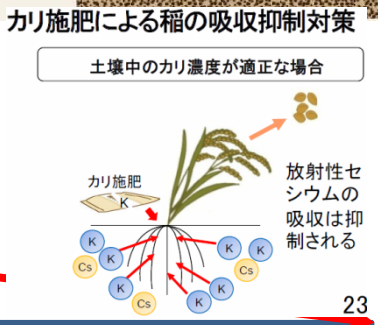
>5000Bq/kg

<5000Bq/kg

Inversion tillage(30cm)



量測地下水位



potassium fertilizer (KCl)
→減少農作物吸收^{137}Cs

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水產省

森林除汙作業

除汙作業注意事項	除汙作業效果
1. 考量森林永續發展，僅對鄰近住宅區、農地、公共場所20公尺的過度地帶執行除汙作業 2. 避免鄰近森林的道路及房屋受除汙落塵汙染 3. 森林邊緣圍沙袋，避免表土流失致汙染擴大 4. 考量除污作業人員於濕滑陡坡進行除污作業的風險	1. 減少公眾體外曝露效果差 2. 成本高(1300日幣/m^2)

落葉林 → 移除落葉、沉澱物(3cm厚)
3月福島事故，尚未發芽

常綠林 → 1. 修剪枝葉至1/2樹高(森林外圍)
放射性銫累積在枝葉 2. 移除落葉(持續3~4年)

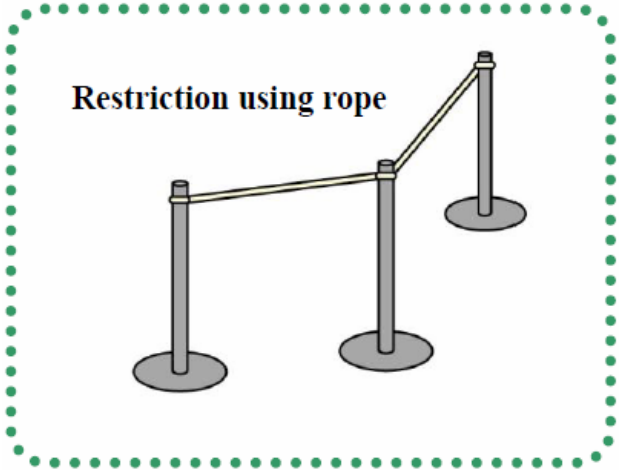
Decontamination guideline 2nd, p 166

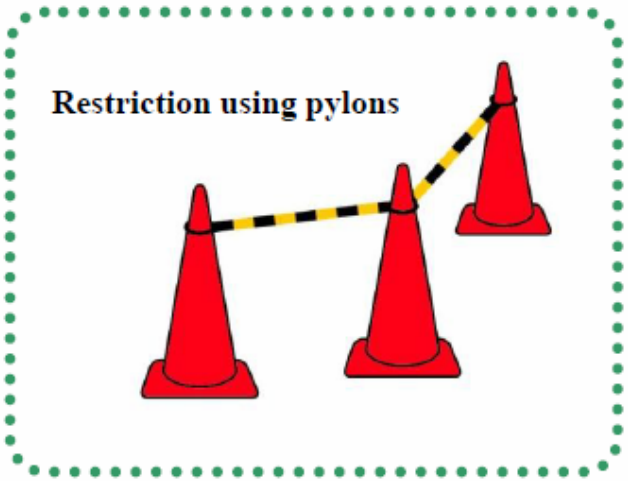
移除落葉、有機沉澱物

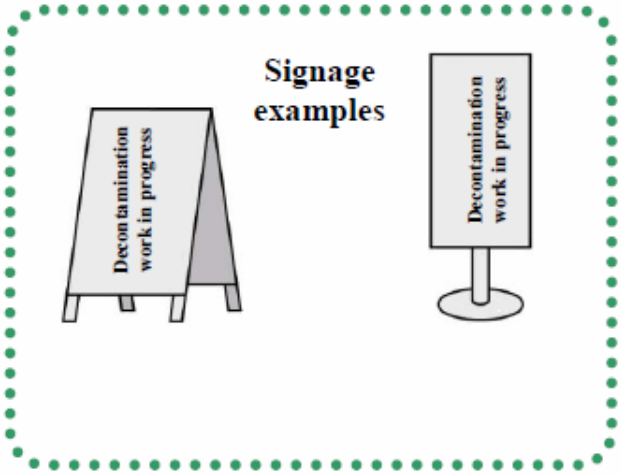
修剪枝葉(至1/2樹高)

1. Preparation	Measures to Reduce Public Exposure in Connection with Decontamination Work
環境省 Ministry of the Environment	Prevention of Radiation Hazards for Workers

公眾輻射防護



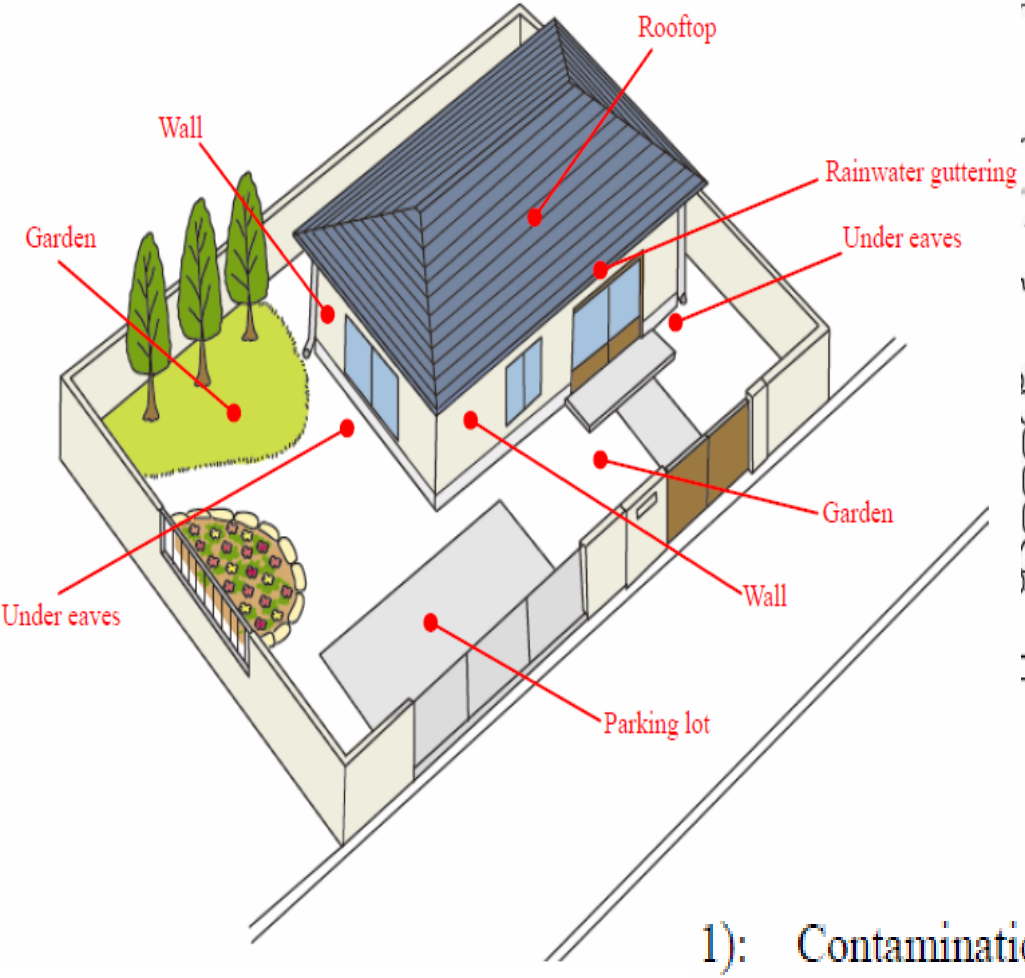


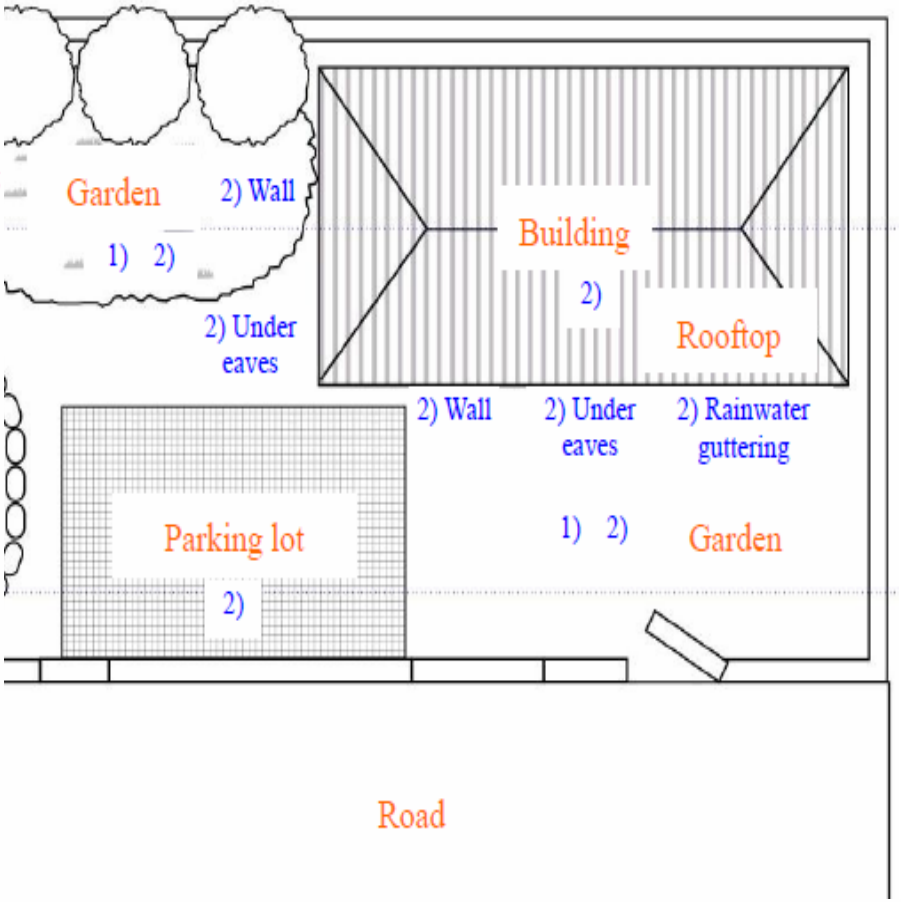


除汙工作人員輻射防護

- Guidelines on Prevention of Radiation Hazards for Workers Engaged in Decontamination Works

2. Prior Measurements	**Determination of Measurement Points**
	Measurement Methods





1): Contamination status for living spaces

μ Sv/hr (air dose rate: approximately two to five measurement points)

2): Contamination status for objects subject to decontamination

cpm (surface contamination density, surface dose rate) μ Sv/hr

2. Prior Measurements

Determination of Measurement Points

Measurement Methods

Assessment perspectives	Status of contamination in living spaces	Status of contamination of objects subject to decontamination		
Category	No. 1 measurement points	No. 2 measurements points		
Indicator (measurement position)	Air dose rate (1 m[*1])	Surface contamination density (1 cm)	Surface dose rate (1 cm) Use a collimator	Surface dose rate (1 cm) Vary the distance and measure[*2]
Examples of measuring apparatus	• NaI scintillation survey meter • CsI scintillation survey meter	- GM survey meter	• NaI scintillation survey meter • CsI scintillation survey meter	
Methods for using the measurement results	• Determine the decontamination zones • Assess the improvements in the contamination status in living spaces through the decontamination work	• Determine the decontamination methods • Assess the extent to which the radioactive materials have abated through the decontamination work		

*1: For the contamination status in living spaces, in principle, measurements should be taken at a height of 1 m from the ground (it would also be fine to measure at a height of 50 cm at elementary and lower level schools, as well as special-needs schools, with consideration for the living spaces of infants and schoolchildren in the lower grades).

Perform measurements by using a collimator to reduce the impact of the background gamma rays.

3. Decontamination Methods | High-pressure washing

Joints of metals that are difficult to clean by wiping

↓

High pressure water cleaning

↓

Wastewater treatment

Figure 2-17. Example of decontamination of playground equipment (high pressure water cleaning)

15 MPa

Photo courtesy of: JAEA

[Precautions]

- Take steps to prevent dispersal and outflows of the water and other materials
- Perform the cleaning in a partial manner and check to confirm if the decontamination has been effective before carrying out full-scale cleaning

4. Post-Work Measures	Handling the removed soil
	Wastewater treatment
	Cleaning equipment

Figure 2-30. Example of wastewater treatment (sedimentation treatment using street drains)

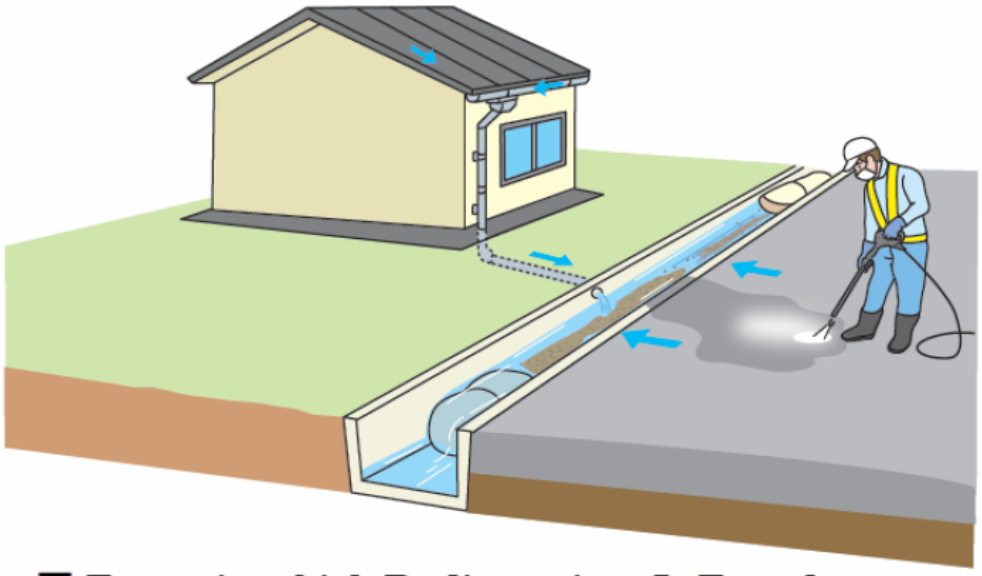


Figure 2-31. Example of wastewater treatment (sandbags installed in street drains)

Photo courtesy of: Fukushima City

■ **Forms in which Radiocaesium Is Found**

- ◆ **The radiocaesium adhering to soil hardly elutes into water at all.**
- ◆ **Radiocaesium is hardly contained at all in the water of rivers, lakes, and marshes.**
- ◆ **When sediment is removed, there is almost no radiocaesium found within the wastewater that results from cleaning.**

5. Subsequent Measurements and Records

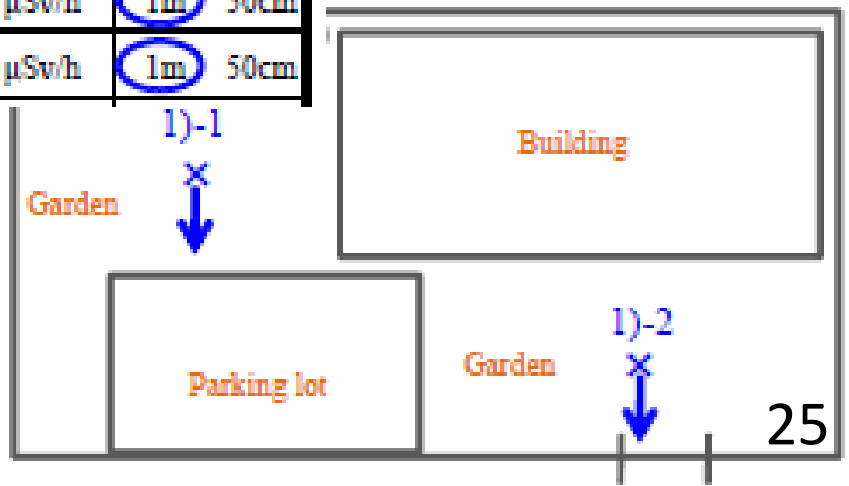
Air Dose Rate Record Sheet (Entry Sample)

Measurement location	City:	Town:	District:
Measuring apparatus	Manufacturer:	Model:	

Measurement Status Entry Column		
	Before Decontamination	After Decontamination
Date measured	Mon., April 22, 2013	Fri., April 26, 2013
Time measured	9:20 – 9:40	13:20 – 13:40
Measurer	Josen Taro	Josen Taro
Weather	Cloudy	Clear

Air Dose Rate Measurement Results Entry Section							
	Before Decontamination		Measurement height		After Decontamination		Measurement height	
No. 1)-1 measurement point	3.0	μSv/h	(1m)	50cm	0.51	μSv/h	(1m)	50cm
No. 1)-2 measurement point	0.55	μSv/h	(1m)	50cm	0.16	μSv/h	(1m)	50cm

ram of Air Dose Rate Measurement Points



收集 → 運送 → 減容 → 處置

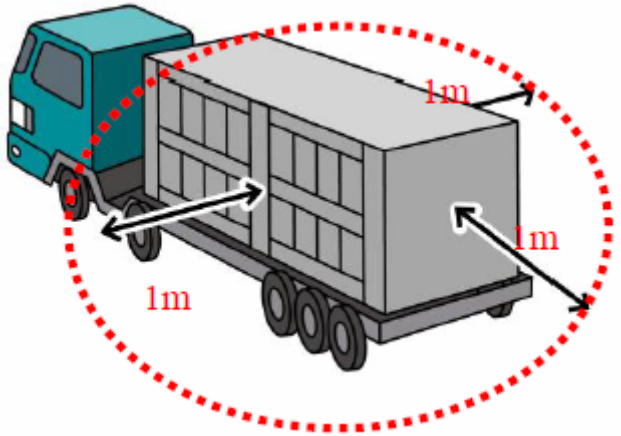
1. 使用容器：防止放射性廢棄物分散、流出、滲露
2. 放射性廢棄含水：脫水、防水容器
3. 考量暫時貯存設施及ISF得貯存時程

Table 3-1. Types of Large Sandbags and Flexible Containers

Type	Photograph	Characteristics
Flexible container (cloth-type)*1		• The assumption is that they will only be used once. • Not as good as the running-type in terms of weather resistance and waterproofness. • Some have improved weather resistance as a result of UV treatment and the like, while another type has improved waterproofness as a result of being lined with inner pouches and having an inner coating, etc.
Flexible container (running-type)*1 5年		• The assumption is that they will be used by having soil repeatedly stored in and removed from them. • Outstanding weather resistance and waterproofness
Large sandbag 2-3年	 *2	• Water permeable. • Some have improved weather resistance as a result of UV treatment and the like, while another type has improved waterproofness as a result of being lined with inner pouches, etc.

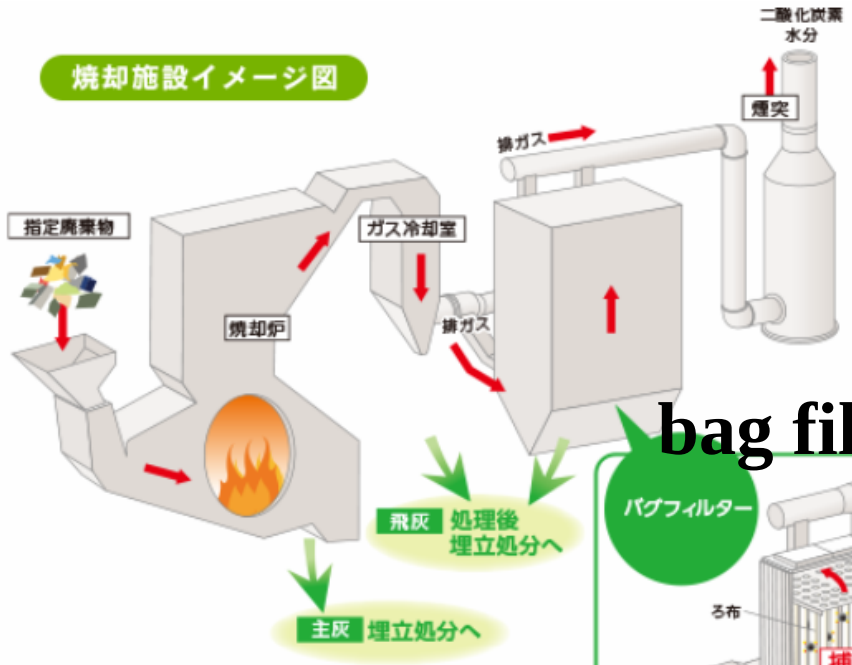
收集 → 運送 → 減容 → 處置

1. 輻射防護
2. 路徑選擇要避免
   - χ 住宅區
   - χ 商店街
   - χ 學校
   - χ 巷弄

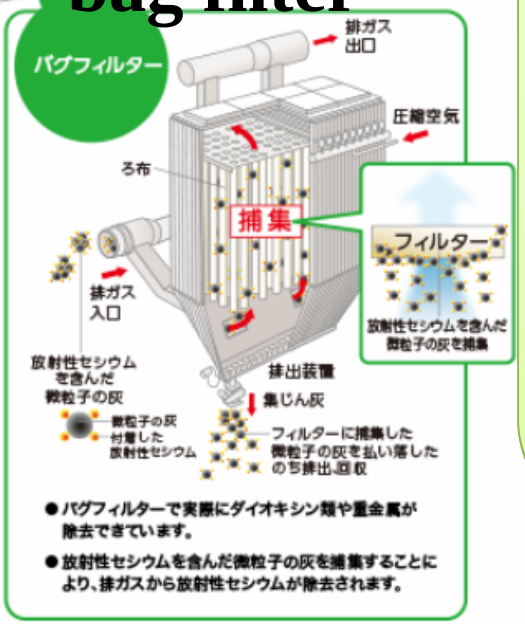


	Mean radioactivity concentration (Bq/kg)						Maximum dose equivalent rate 1 m from the truck (vehicle transfer rules)
	3,000	8,000	30,000	150,000	500,000	1,000,000	
Air dose rate (μSv/h)	0.27	0.72	2.7	13	44	89	100

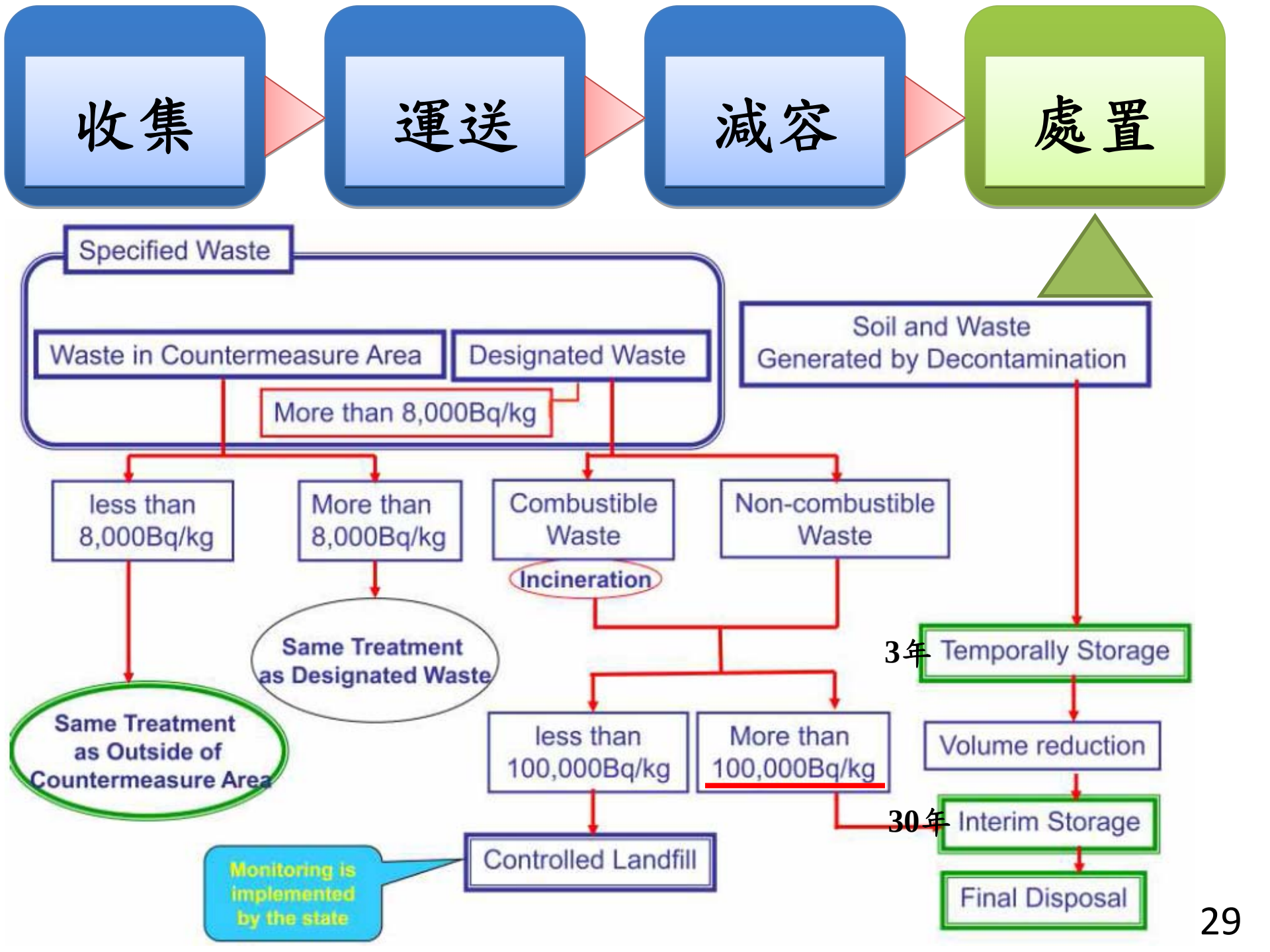
收集 → 運送 → 減容 → 處置



bag filter



1. 焚化可有效地對污染物減量。
2. 為符合放射性物質釋出標準，減少民眾的曝露，進行焚化需採取適當措施(如使用bag filter可捕捉飛塵，使放射性銫釋出符合規定限值)


収集
運送
減容
処置
Specified Waste
Waste in Countermeasure Area
Designated Waste
More than 8,000Bq/kg
Soil and Waste Generated by Decontamination
less than 8,000Bq/kg
More than 8,000Bq/kg
Combustible Waste
Non-combustible Waste
Incineration
Same Treatment as Designated Waste
Same Treatment as Outside of Countermeasure Area
3年 Temporally Storage
Volume reduction
less than 100,000Bq/kg
More than 100,000Bq/kg
30年 Interim Storage
Monitoring is implemented by the state
Controlled Landfill
Final Disposal

Idea of recycle of disaster waste with control in Fukushima Prefecture (December 27, 2011)

- The most critical scenario is living nearby road.
- When 30 cm thick shield materials exist, under than about 3,000 Bq/kg disaster waste can be used.
- When thicker shield materials exist, higher activity concentration of disaster waste can be used.
- After the construction, it is necessary to keep the thickness of shield materials.
- Projects to adapt to this idea are fundamentally limited to public projects.
- An administrator should records of sites, amount , activity concentration of disaster waste recycled.

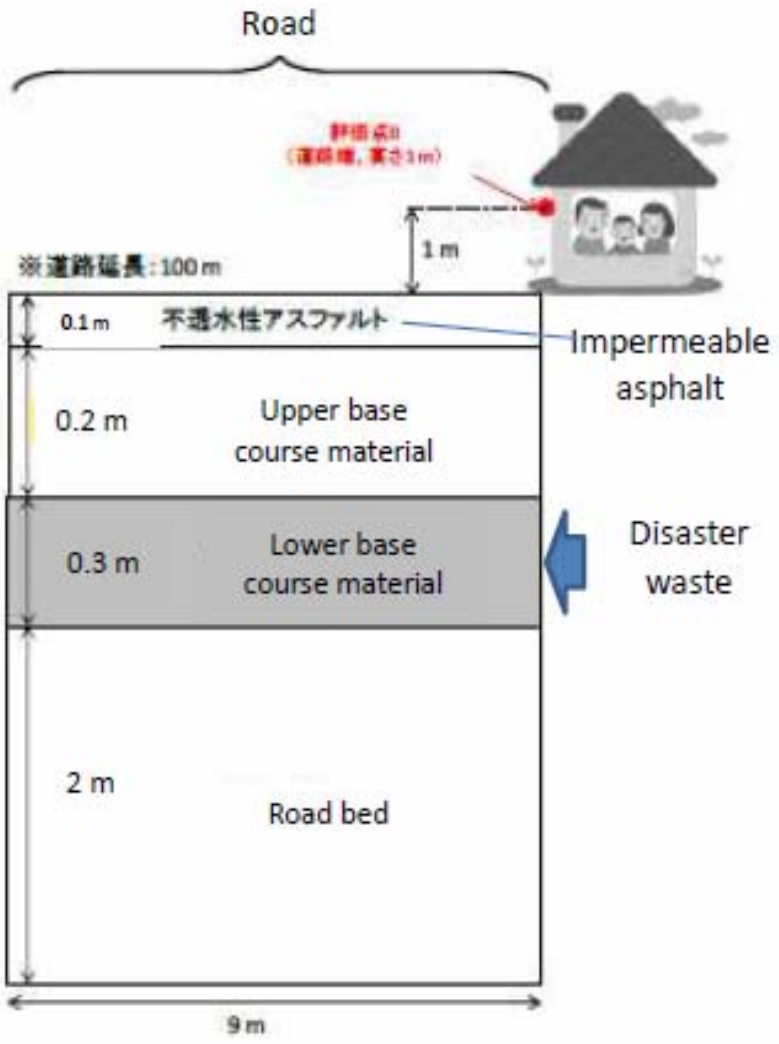
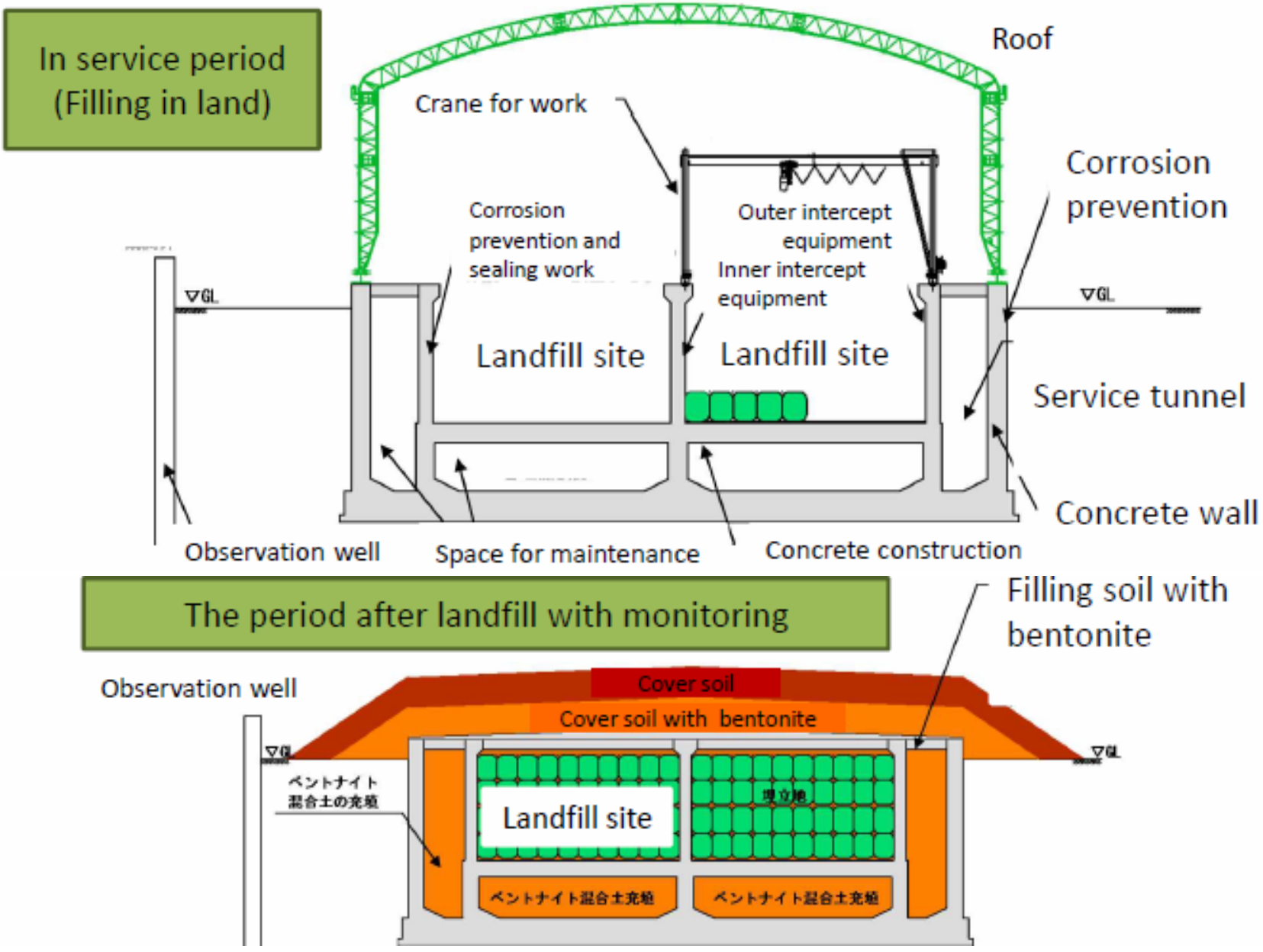
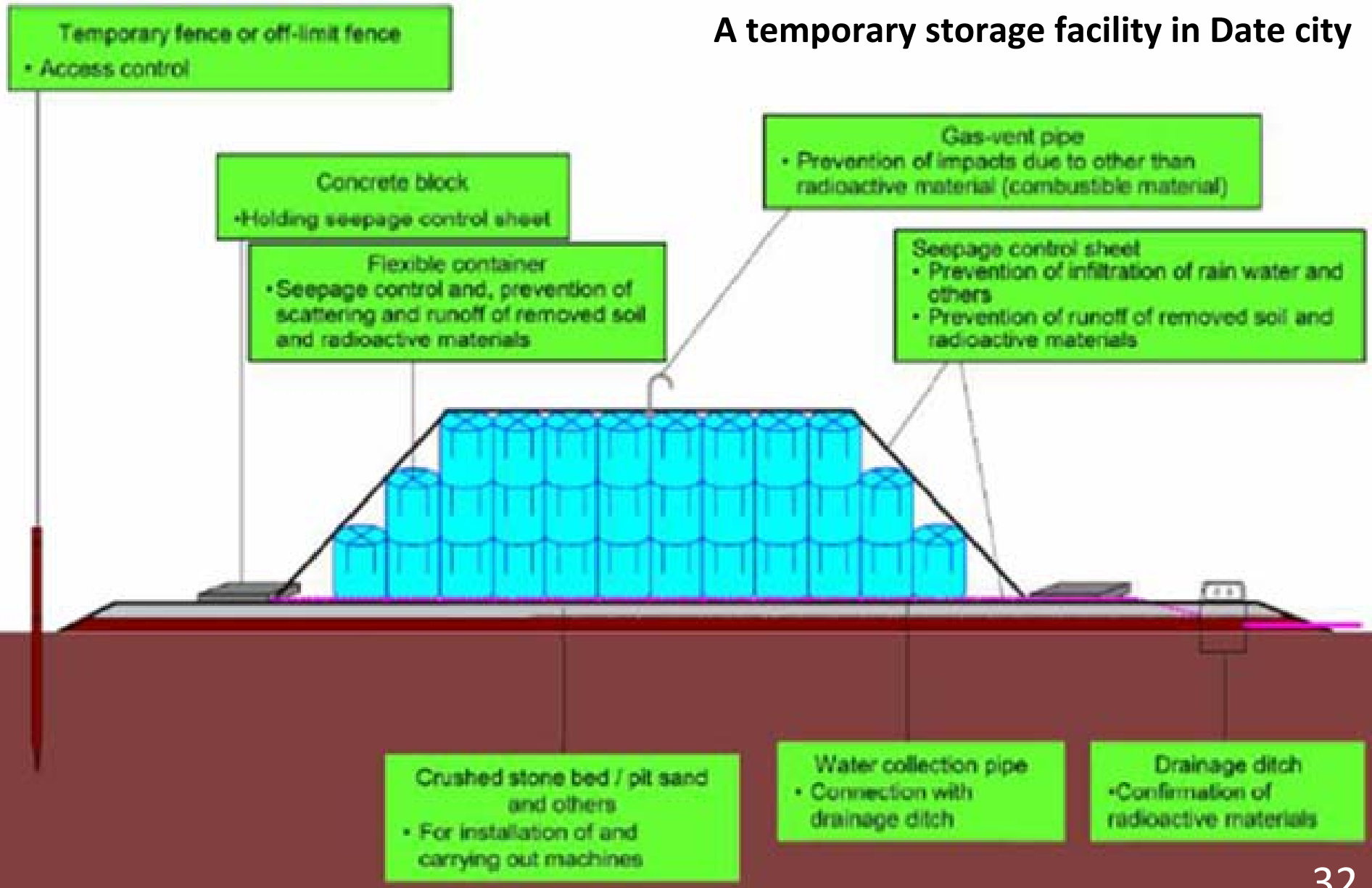


Image of Landfill Disposal of Designated Waste



Temporally Storage of Contaminated Soil

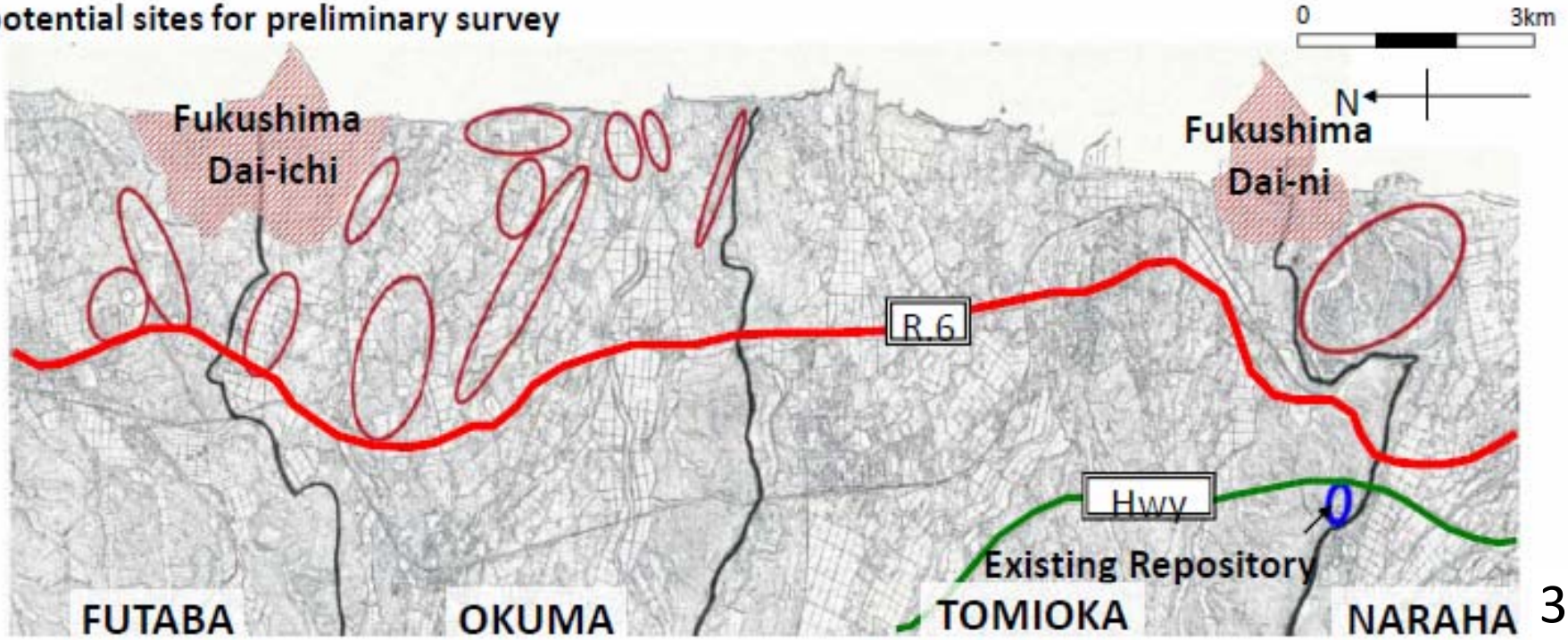
A temporary storage facility in Date city



Potential Construction Sites

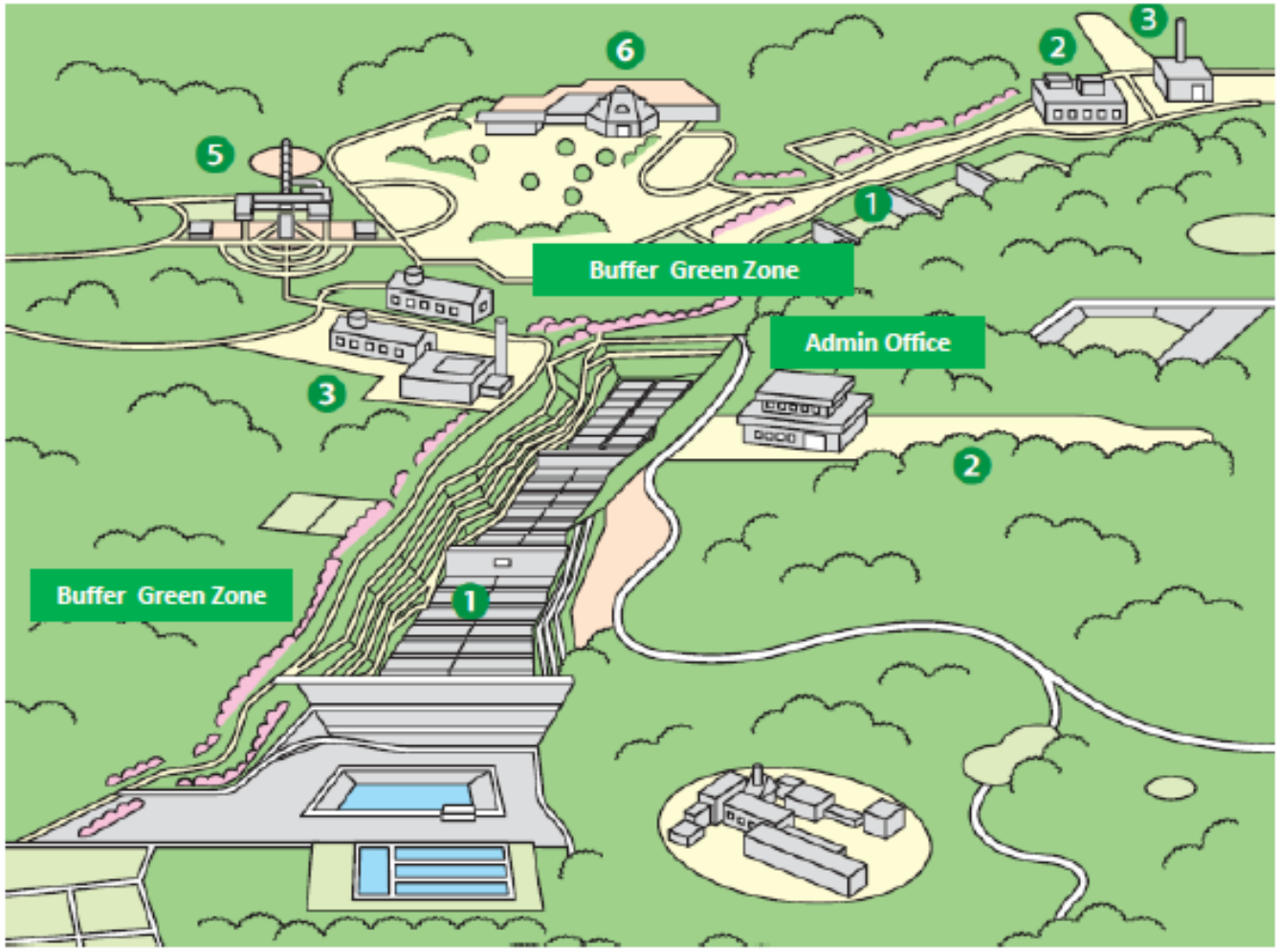
- 12 potential sites (for preliminary survey) around the Fukushima Dai-ichi and Fukushima Dai-ni nuclear power plants
  - ✓ Vicinity to the highly contaminated (=high volume) area
  - ✓ Sufficient area for storage and related facilities
  - ✓ Transportation conditions (mitigation of congestion etc.)
  - ✓ Avoid of active fault and soft ground
  - ✓ Minimization of surface water diversion

12 potential sites for preliminary survey



Interim Storage Facility: Bird's-Eye View

ISF will be consisted of facilities with various functions



①Storage Facility

②Emplacement & Segregation Facility

③Volume Reduction Facility

④24hour monitoring Equipment(placed in several points, not specifically indicated)

⑤R & D Facility

⑥Public information Center

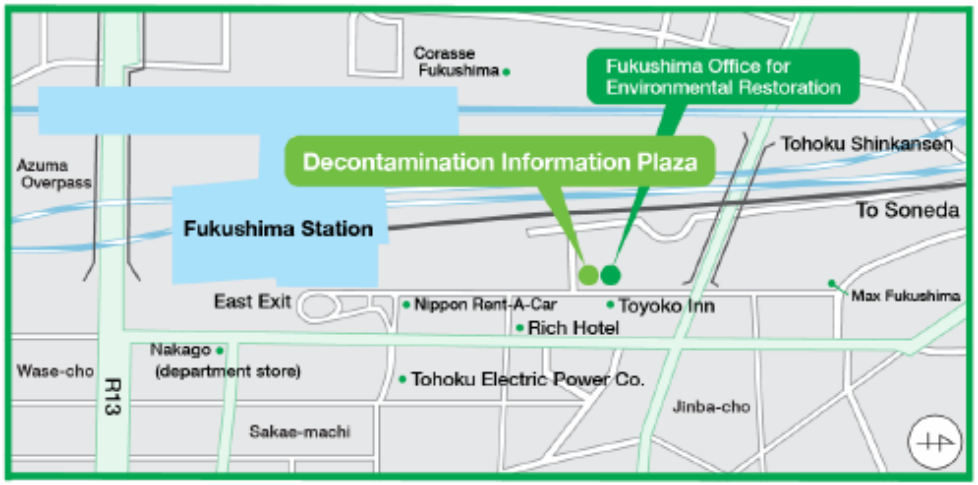
Scale of the whole facility (estimation)
Total storage volume ranges between 15-28 million m³, which is 12-23 times big as a baseball stadium(approx. 1.24million m³)

C Decontamination Corner

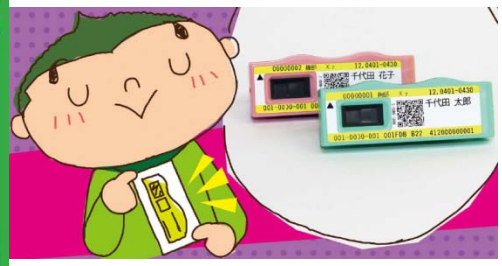
Showing Q&A's on the decontamination and its procedur
Introducing decontamination work and its effects,
and examples of already-decontaminated regions.

Outside of the Plaza

For general public



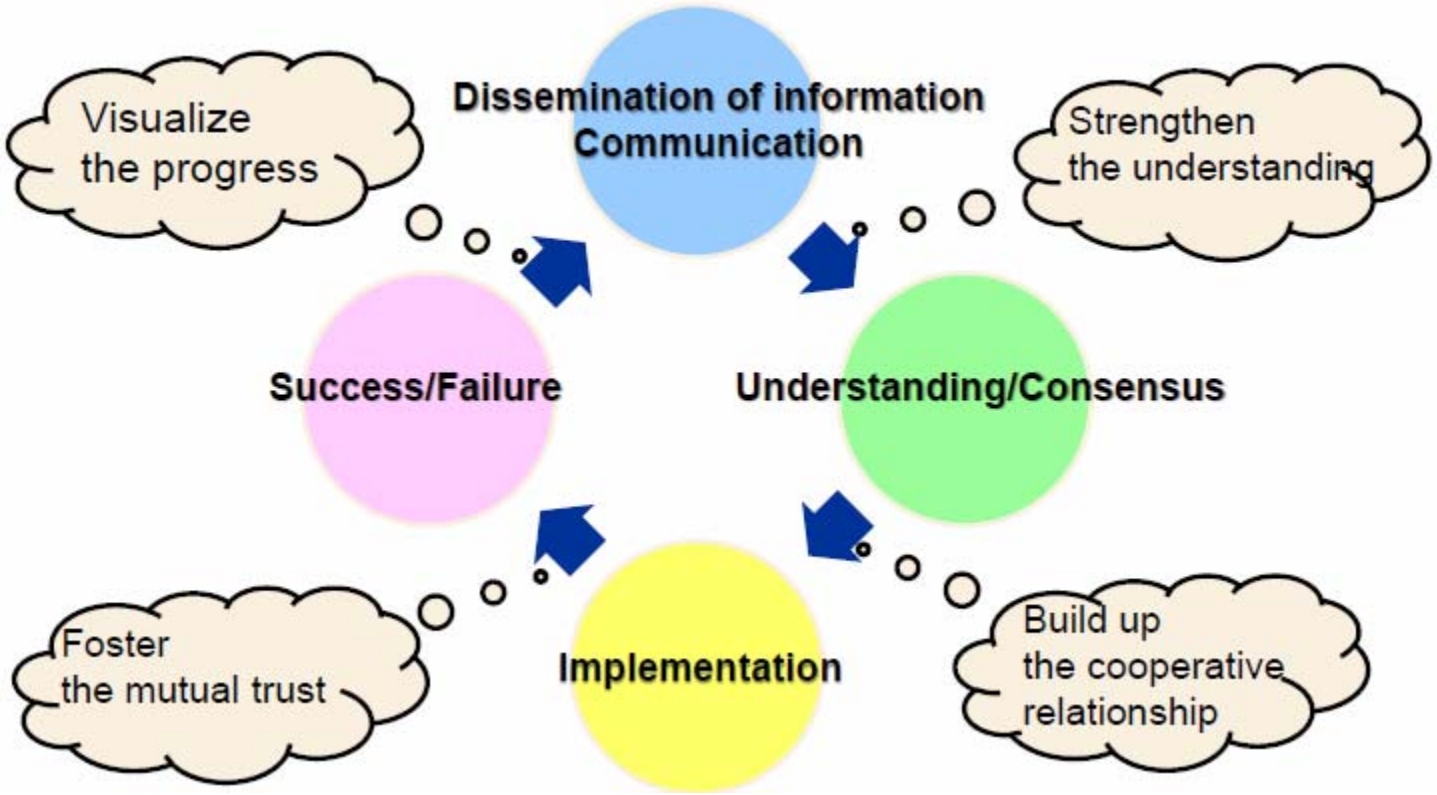
Website "Decontamination Information Site"



Challenges

- Time
- Cost
- Technology
- Communication
  - ＊misunderstanding (fear, impatience, dispute)
  - ＊distrust (the governments, TEPCO)

Conclusion


Visualize
the progress
Dissemination of information
Communication
Strengthen
the understanding
Success/Failure
Understanding/Consensus
Foster
the mutual trust
Implementation
Build up
the cooperative
relationship

参考資料

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