

Management of off-site Waste Contaminated with Radioactive Materials due to the Accident at Fukushima Nuclear Power Stations

Nov. 28, 2012

Ministry of the Environment, Japan

Contents

1. Current Situations

2. Countermeasures

- 1) *Act on Special Measures concerning the Handling of Radioactive Pollution*
- 2) *Designated waste*
- 3) *Waste in the Countermeasure Area*
- 4) *Recycle of waste*
- 5) *Interim Storage Facility*

3. Conclusions and Challenges

Radiation level map in Eastern Japan and the disposal of disaster waste

(Oct. 31, 2012)

* Based on airborne monitoring survey by MEXT

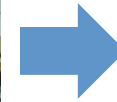
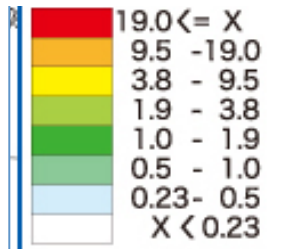
Total Amount: 3.95 million ton
 Disposed Amount: 1.03 million ton (26%)

Total Amount: 12.00 million ton
 Disposed Amount: 3.97 million ton (33%)

Total Amount: 2.07 million ton
 Disposed Amount: 0.37 million ton (18%)

Fukushima Daiichi Nuclear Power Station

Air dose rate on the points of 1 m high from surface ground [$\mu\text{Sv/h}$]
 (Oct. 13, 2011)



Progress in removing disaster waste in Soma City

Major detected radioactive materials: Cs 134, Cs137

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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

Outlines of the Act on Special Measures concerning the Handling of Radioactive Pollution

~Management of Contaminated Waste~

Specified waste

(1) Waste within the countermeasure area

Contaminated waste in the countermeasure area designated by the Minister of the Environment



A management plan for waste within the countermeasure area is formulated by the Minister of the Environment



Implementation by the national government pursuant to the treatment plan for waste

(2) Designated waste

Survey on sewerage sludge, incinerated ash, etc (obligatory)

Survey on waste other than that specified in the left box (voluntary basis)

Report to the Minister of the Environment



Application



Designation as “designated waste” by the Minister of the Environment
* Contaminated Waste above certain level



Implementation by the national government


Prohibition on unauthorized actions (ex. Unauthorized dumping)

Low-level contaminated waste other than specified waste

Measures to be taken in accordance with the Waste Management Act

Basic Approach of Waste Disposal Contaminated by Radioactive Materials

“Near –term policy to ensure the safety for treating and disposing contaminated waste around the site of Fukushima Dai-ichi Nuclear Power Station of Tokyo Electric Power Company” by Nuclear Safety Commission (June 3, 2011)

- Radiation expose of the residents living in the vicinity of the facilities during the treatment of contaminated materials : under 1mSv/y
 - Radiation expose of the residents living in the vicinity of the facilities after termination of institutional control: under 10 μ Sv/y
- 
- Management of disaster waste contaminated by radioactive materials was designed to correspond with this near-term policy.

Outline of exposure scenario considered waste management

Disaster Waste

災害廃棄物の発生



解体・撤去・分別の作業

Transfer scenario

directly

disposal

incineration, melting

Shredding and Separating scenario

金属・コンクリートの再利用

Storage scenario

再利用処理

処理業者

スクラップや一次加工品

再使用

再生利用

Recycle scenario

- Resident nearby facilities
- Workers on landfill

跡地利用

Landfill scenario

Park's visitor

Groundwater pathway

Resident using water from well

incineration ash, melted slag

処理業者

Incineration facility

処理施設の周辺居住者

Incineration scenario

溶融固化物の再利用

日常生活品 作業用品

日常生活者

Result of safety evaluation derived from Scenario

Scenario		Target for Evaluation	Radioactivity concentration resulting in an exposure dose of 1mSv/y
Storage	Waste loading and unloading work	Workers (1000h/y)	12,000 Bq/kg
	Those living around storage sites	Public (Outside in 20% resident time)	100,000 Bq/kg *A certain distance from a storage
Transfer	Waste transfer work	Workers (1000h/y)	10,000 Bq/kg
	Those living around transfer routes	Public (450 h/y)	160,000 Bq/kg
Incineration	Incinerator repair work	Workers (900h/y)	30,000 Bq/kg
	Those living around incineration facilities	Public (Outside in 205 resident time)	5,500,000 Bq/kg
Landfill	Incineration ash landfill operations	Workers (1000h/y)	10,000 Bq/kg
	Dewatered sludge, etc. landfill operations	Workers (1000h/y)	8,000 Bq/kg
	Those living nearby the final disposal site	Public (Outside in 20% resident time)	100,000 Bq/kg *A certain distance from a landfill
	Use of the landfill site as a park	Public (200h/y)	170,000 Bq/kg *exposure dose of 10 μSv/y
	Ingestion of crops grown with underground water	Public	46,000 Bq/kg *exposure dose of 10 μSv/y

Operational period

Post-closure period

Landfill Disposal of Incinerated Ash According to the Act on Special Measures Concerning Management of Radioactive Contamination

	8,000 Bq/kg or under		8,000 ~ 100,000 Bq/kg	Exceeding 100,000 Bq/kg
	Other (Criteria of Waste Management Act)	Specified Domestic Waste & Specified Industrial Waste ^{※2}		
Structure of landfill site	Controlled type landfill site ^{※1} (Landfill site equipped seepage control work and drainage treatment)			Isolated type landfill site (Landfill site equipped outer intercept)
Preventive measures against leaching of radioactive material	None	<ul style="list-style-type: none"> -*Installing the soil layer *-Prevention of rainwater penetration into fly ash 	<ul style="list-style-type: none"> *-Cement solidification -*Installing the soil layer *-Establishing the impermeable soil layer 	None (No Leaching of Radioactive Material due to Water Blocking)
Monitoring of radioactive material	None	<ul style="list-style-type: none"> *Discharged water *Groundwater *Air dose rate in the vicinity 	<ul style="list-style-type: none"> *(Non-existence of discharged water) *Groundwater *Air dose rate in the vicinity 	

*1 Isolated type of landfill site is possible to be used.

*2 Incinerated ash, sewerage sludge, etc, generated from areas with possible contamination with accident-origin radioactive materials near 8,000 Bq/kg .

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Current status of Designated waste

[as of November 2nd, 2012]

	Incineration ash (t)		Wasted sludge (t) (Domestic water)	Wasted sludge (t) (Industrial water)	Sewage sludge (t)	Agriculture and forestry Waste (t)	Other (t)	Total (t)
	Municipality solid waste	Industrial waste						
Iwate	181	0	0	0	0	0	176	358
Miyagi	0	0.2	1011	0	0	2238	0	3250
Yamagata	0	0	0	0	0	0	2.7	2.7
Fukushima	57,676	1,474	1,639	168	8,589	30	307	69,883
Gunma	0	0	451	127	171	0	0	749
Tochigi	1,034	0	585	0	2,200	3,535	0	7,354
Ibaraki	1,763	0	0	0	926	0	0	2,689
Chiba	1,592	0.6	0	0	0	0	0	1,592
Tokyo	981	1	0	0	0	0	0	982
Niigata	0	0	1,018	0	0	0	0	1,018
Shizuoka	0	0	0	0	0	0	8.6	8.6
Total	63,227	1,476	4,704	295	11,886	5,803	328	87,884

Policy of disposal of designated waste (March 30, 2012), and Image of Landfill Disposal of Designated Waste

- National Government keeps effort to manage designated waste, which should be disposed of in each prefecture. If possible, the existing landfill site would be utilized for those waste.
- National Government determines sites from a few candidate sites when a landfill site is newly constructed.
- National Government lessens a burden of storage of agricultural by-products by intermediate treatment such as incineration, drying, and melting.

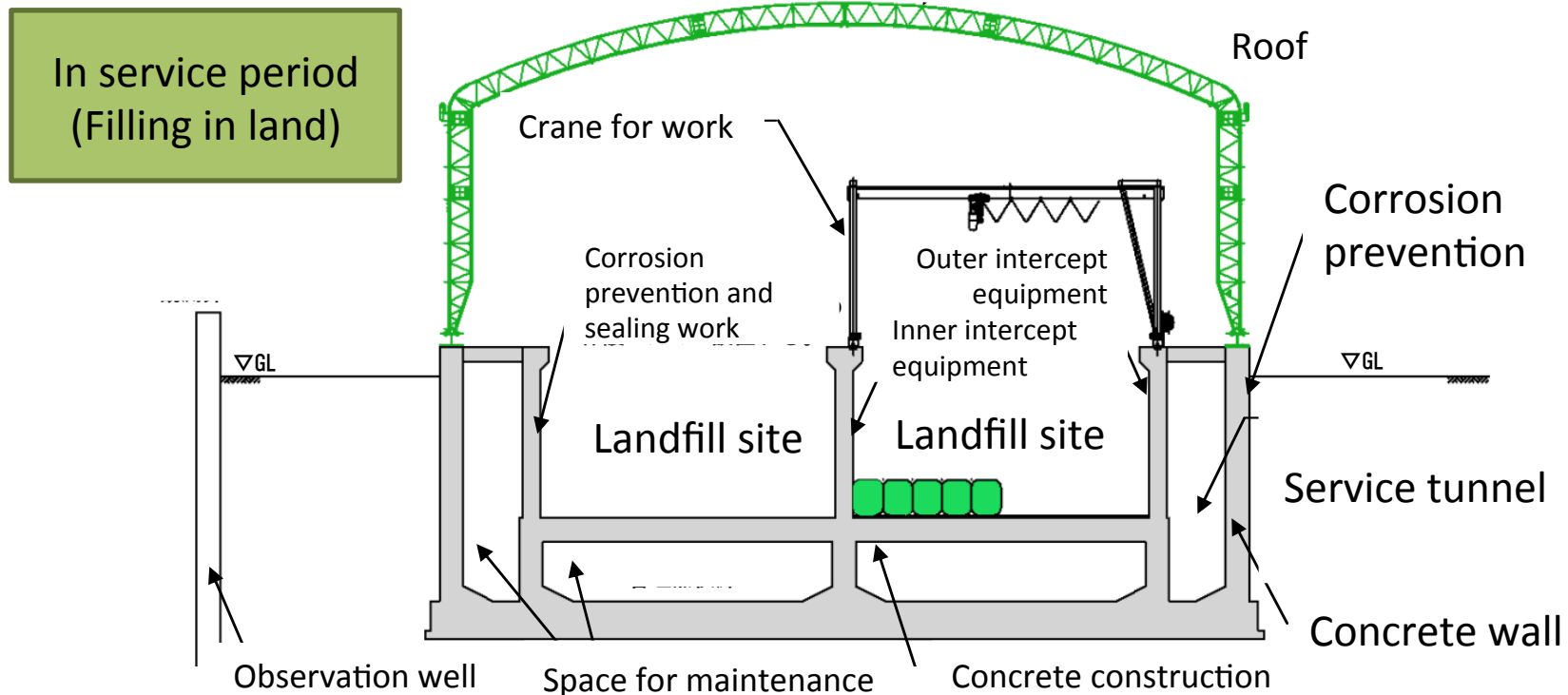
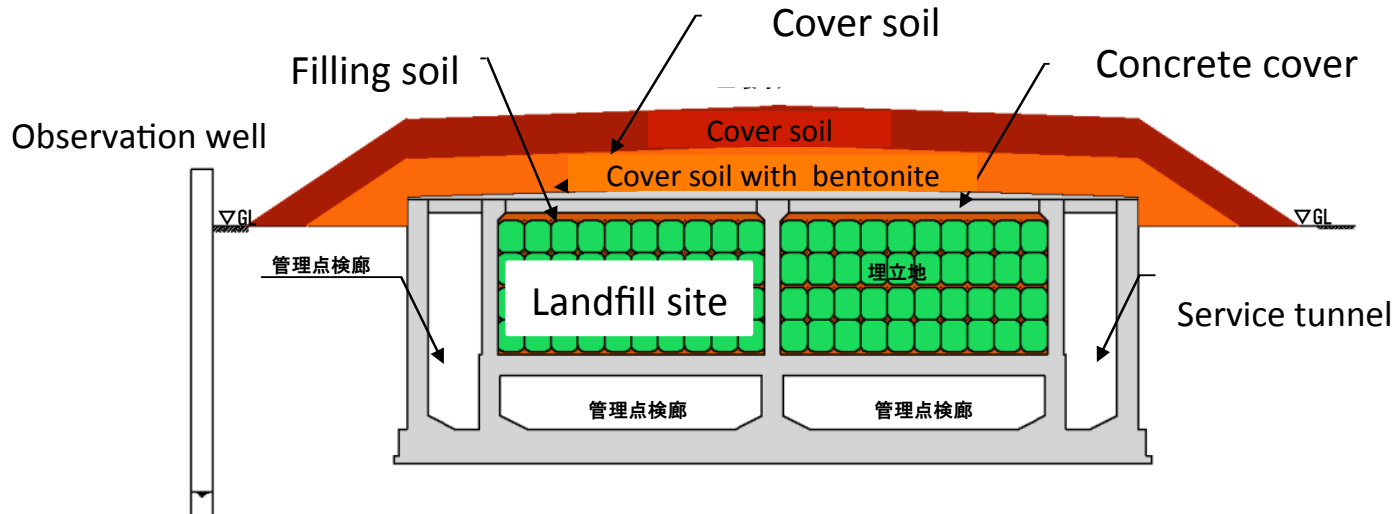
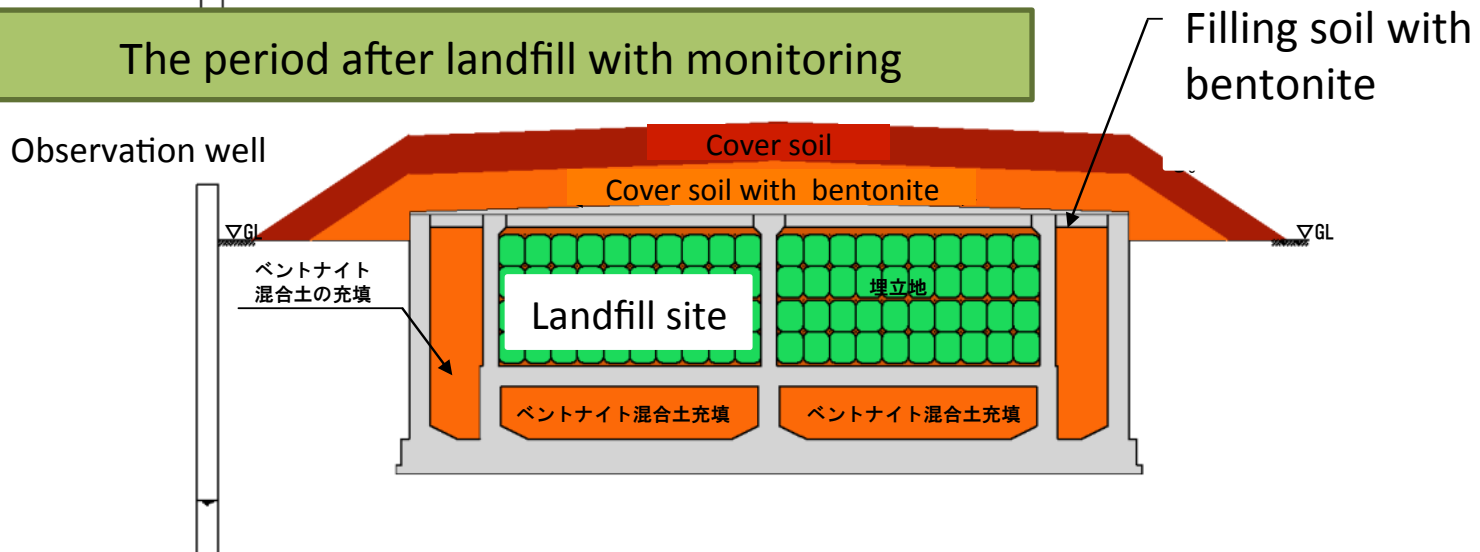


Image of Landfill Disposal of Designated Waste

The period after landfill with monitoring and maintenance



The period after landfill with monitoring



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Countermeasure Area

Naraha-Town, Tomioka-Town,
Okuma-Town, Futaba-Town,
Namie-Town, Katsurao-Village,
Iidate-Village, Tamura-City,
Minamisouma-City, Kawamata-Town,
Kawauchi-Village

Area 1: <20mSv/yr

Evacuation orders are ready to be lifted

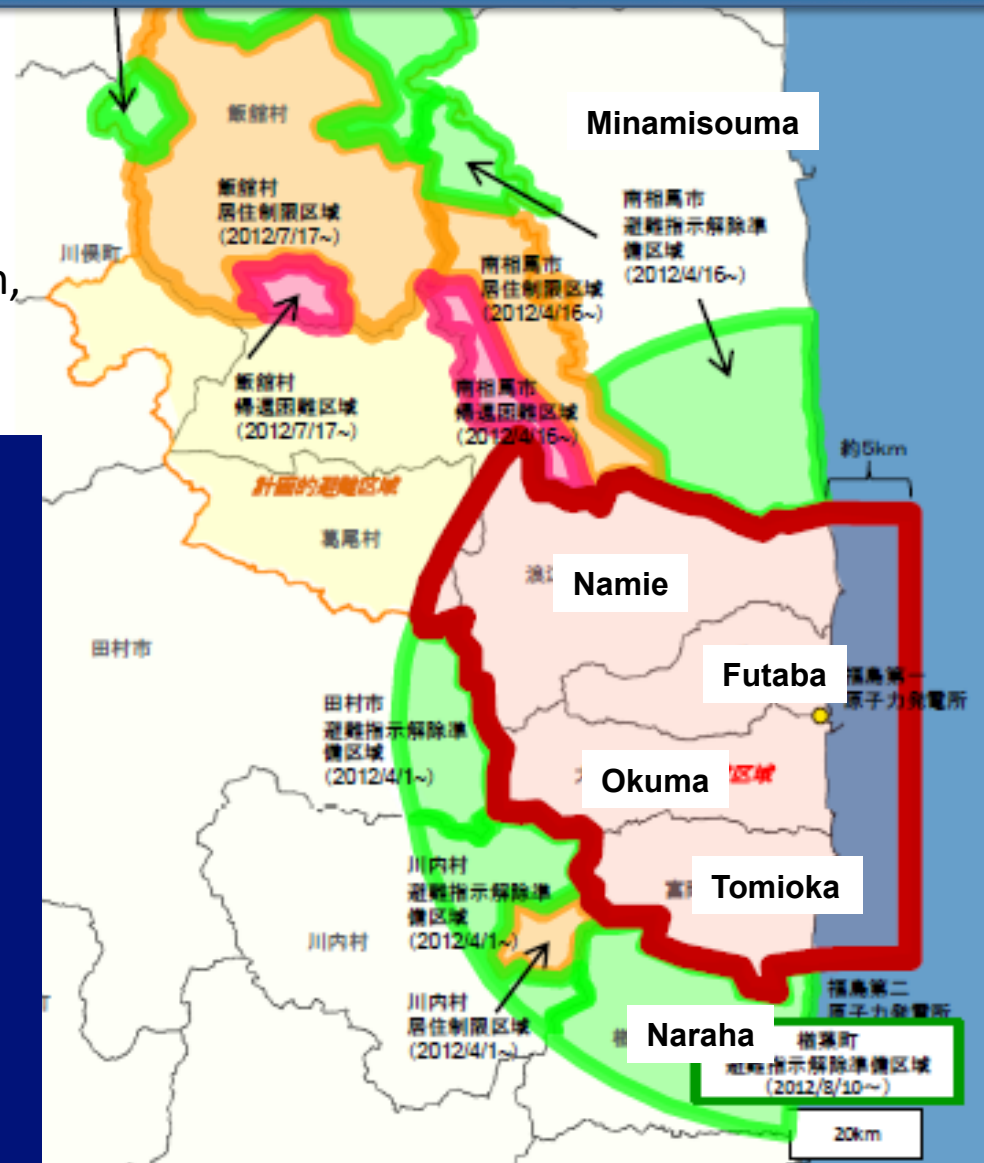
Area 2: 20 – 50 mSv/yr

Areas in which residents are not permitted to live

Area 3: >50 mSv/yr

Residents will face difficulties in returning for a long time

No-entry zone:



Amount of waste in Countermeasure Area (June, 2012)

	Estimate amount of disaster waste [t]		Activity concentration of Cs [Bq/kg]	Estimated Area of temporary storage sites [m ²]
	Sum	Upper: combustible waste Lower: Incombustible waste		
Minamisoma City	183,000	74,000 109,000	2,800 200	111,000
Namie Town	178,000	46,000 132,000	1,300 200	103,000
Futaba Town	12,000	5,000 7,000	9,700 900	11,000
Okuma Town	29,000	17,000 12,000	58,700 11,600	18,000
Tomioka Town	47,000	17,000 30,000	11,500 1,100	27,000
Naraha Town	25,000	10,000 15,000	3,500 1,000	21,000
Sum	474,000	169,000 305,000	-	291,000

Disposal of waste in the Countermeasure Area

- Waste disposal plan in the countermeasure area was released in June 11, 2012.
- Temporary storage sites are being selected now with the cooperation of municipalities.
- It is effective to set two temporary incineration plants in the area. However, if each municipality can prepare sites for temporary incineration plants and waste can be treated smoothly, National Government thinks of the setting of temporary incineration plants in each municipality.
- An existing private controlled type landfill site will be used for disposal of waste in the countermeasure area and designated waste in Fukushima, whose activity concentration is 100,000 Bq/kg or under than 100,000 Bq/kg .

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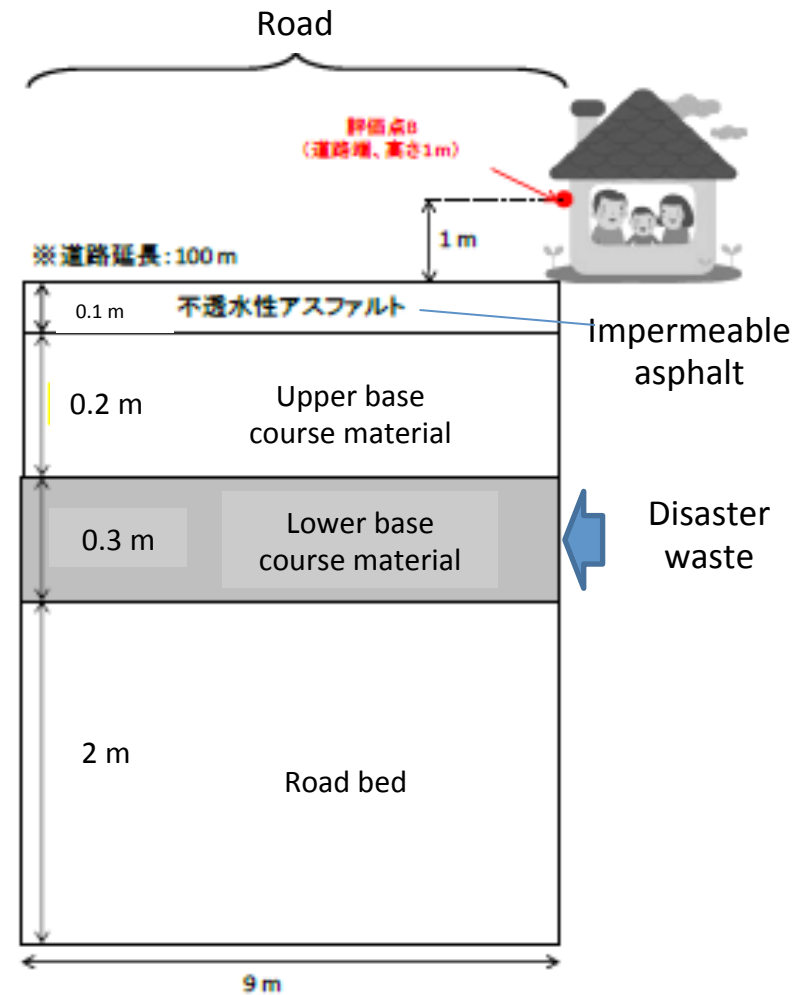
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Idea of recycle of disaster waste with control in Fukushima Prefecture (December 27, 2011)

- According to “Near –term policy to ensure the safety for treating and disposing contaminated waste around the site of Fukushima Dai-ichi Nuclear Power Station of Tokyo Electric Power Company” by Nuclear Safety Commission (June 3, 2011), it is necessary to check that the activity concentration is controlled as lower than $10 \mu\text{Sv/y}$ before the recycled materials are put on the market.
- Incombustible disaster waste such as concrete debris can be used as materials for recovery such as base course material along with the policy.
- Exposure scenarios of recycle are set.

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.



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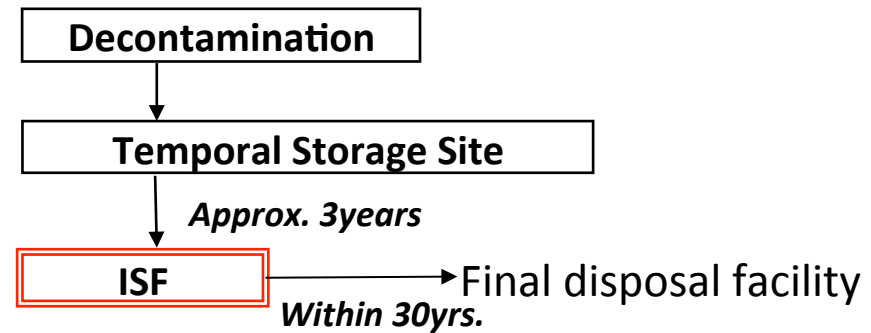
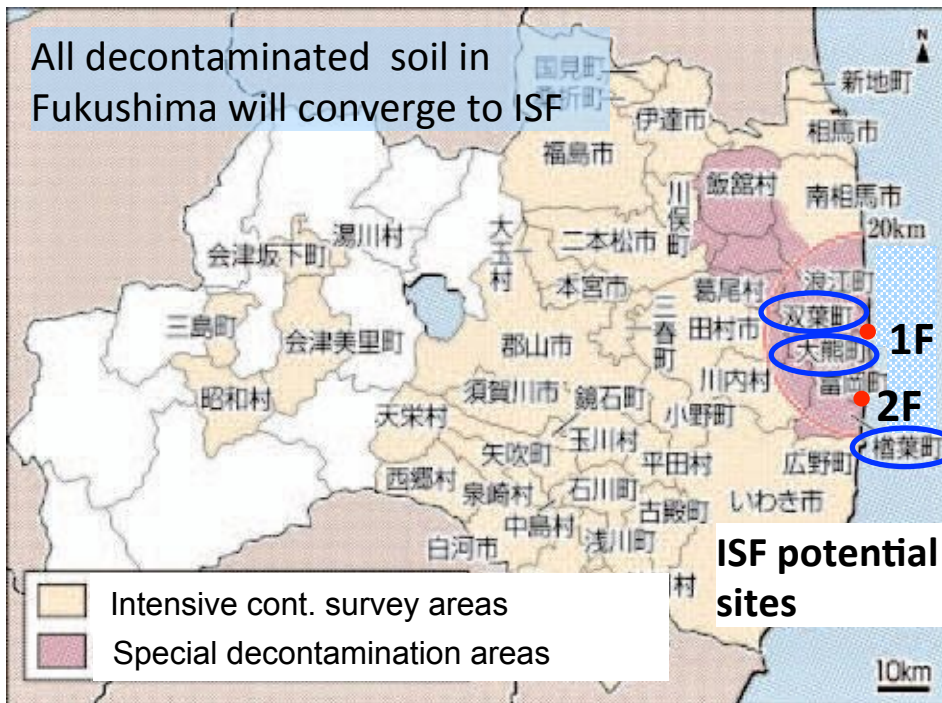
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Decontamination Plan Overview

- Decontamination of the **radiation-contaminated environment caused by the accident of Fukushima 1st Nuclear Power Station**
- Removed soil and other wastes decontaminated **are temporary stored on site, converged to Interim Storage Facility (ISF), then transferred to final disposal site** outside Fukushima.
- **Interim Storage Facility (ISF): To ensure safety and provide intensive control of the radiation materials (soil and waste) till the final disposal site is available**



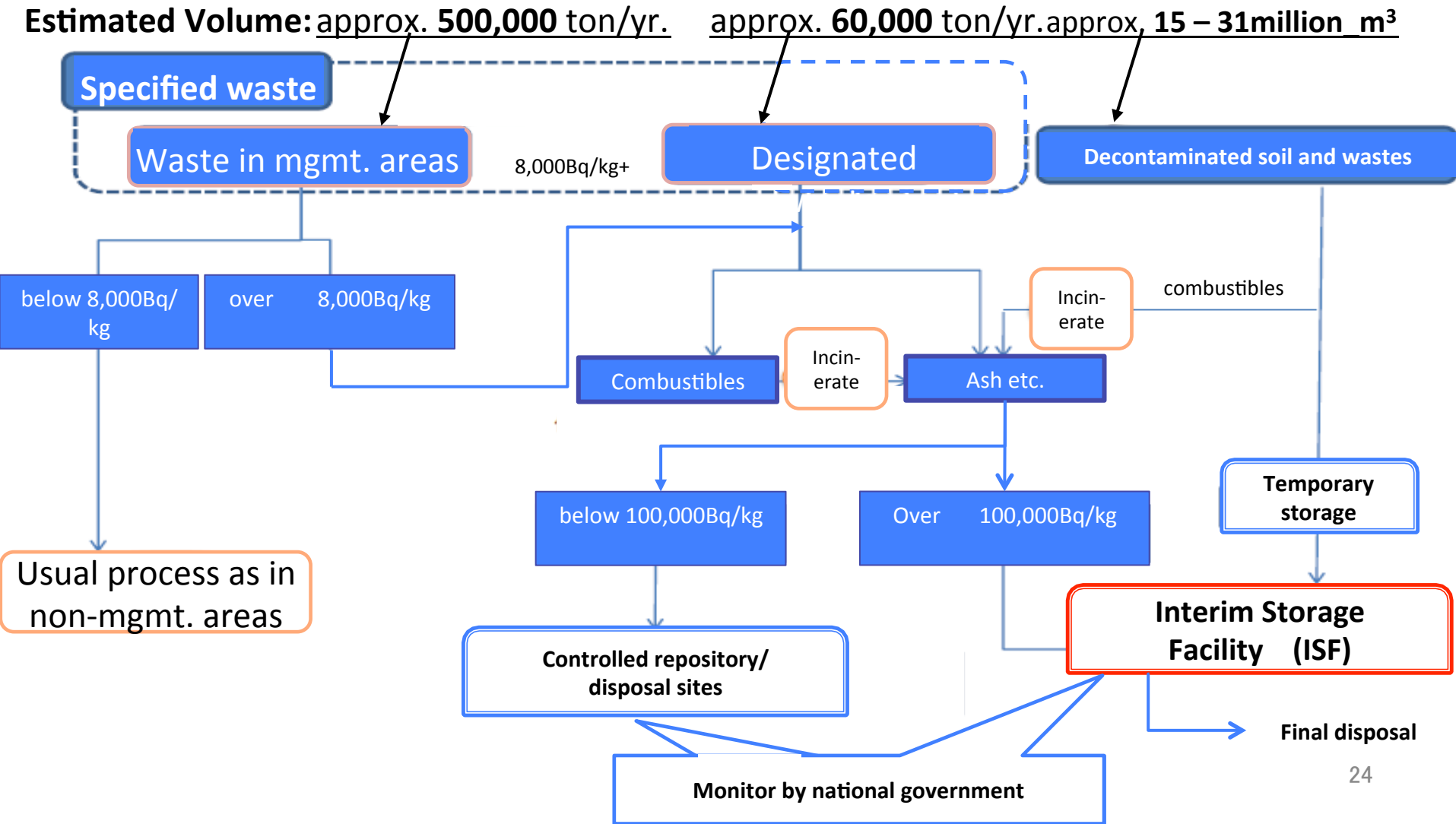
ISF

- ✓ Soil and waste generated in **Fukushima Pref. only**
- ✓ Maximum effort to start operation **within approx. 3years (=beginning of 2015)**
- ✓ Final disposal facility placed **outside Fukushima within 30years.**

* 1F=Fukushima Dai-ich (1st) Nuclear Power Station

Decontaminated Soil and waste: Flow chart

- Decontaminated soil and wastes amount to over 30million_m³ in maximum. Require ISF to be approx. 28million_m³ capacity in maximum.

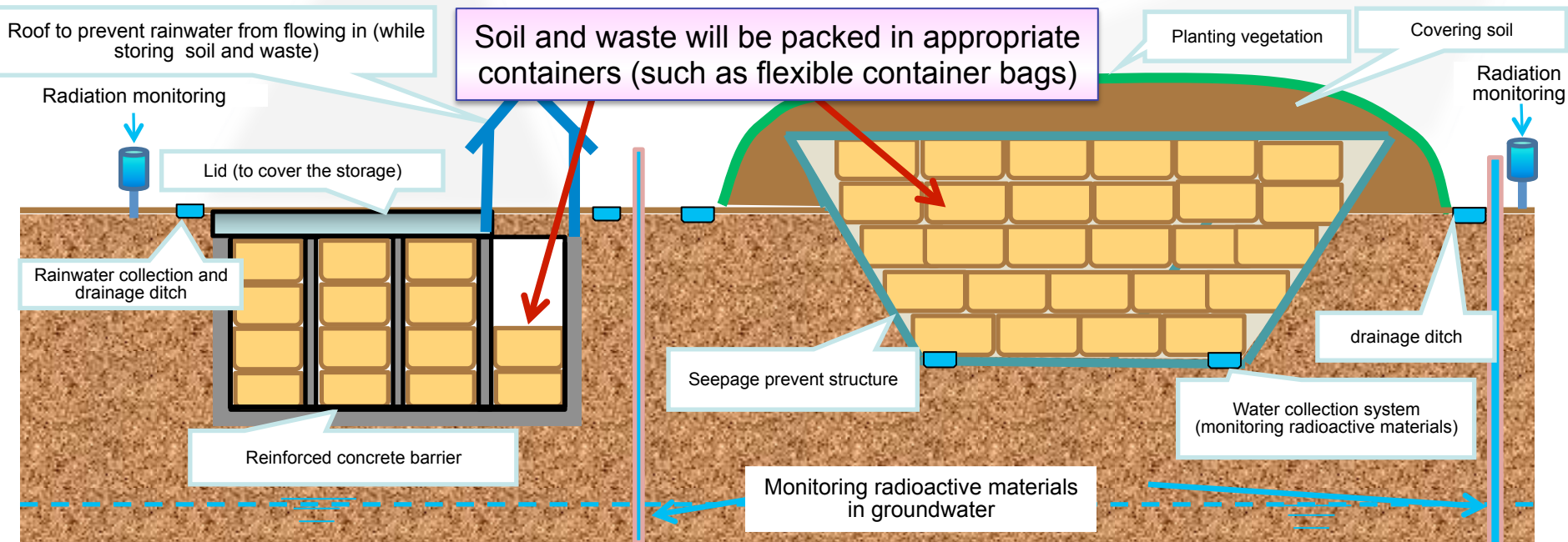


ISF: Storage Facility Image

- Several types of Storage Facilities may be installed according to the characteristics of stored soil and waste.
 - ✓ Level of contamination
 - ✓ Leachate traits under various environmental scenario.

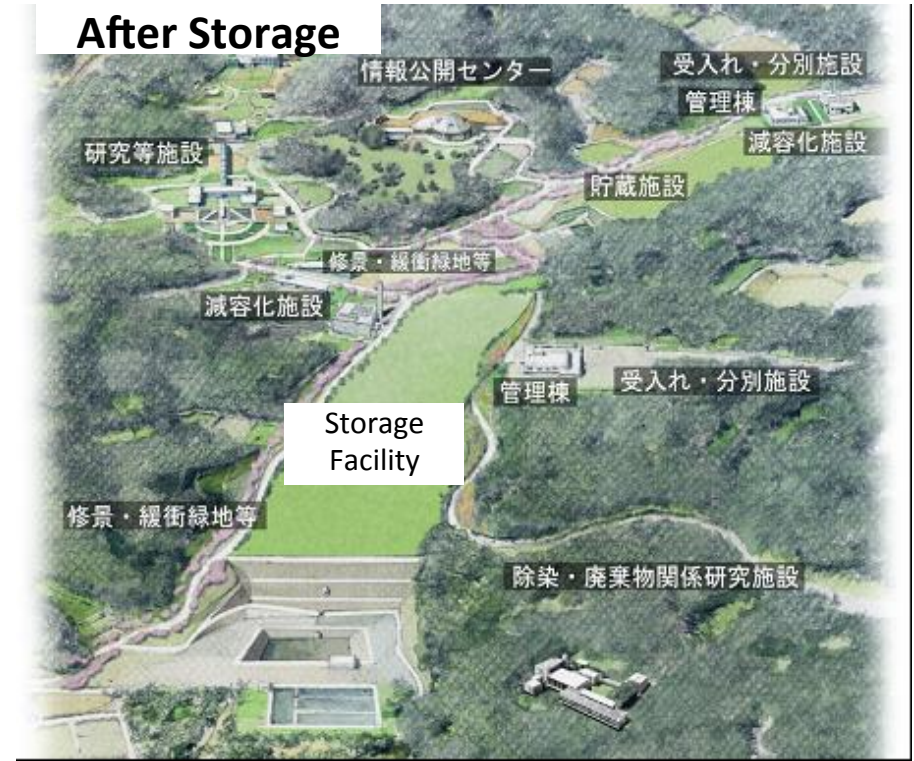
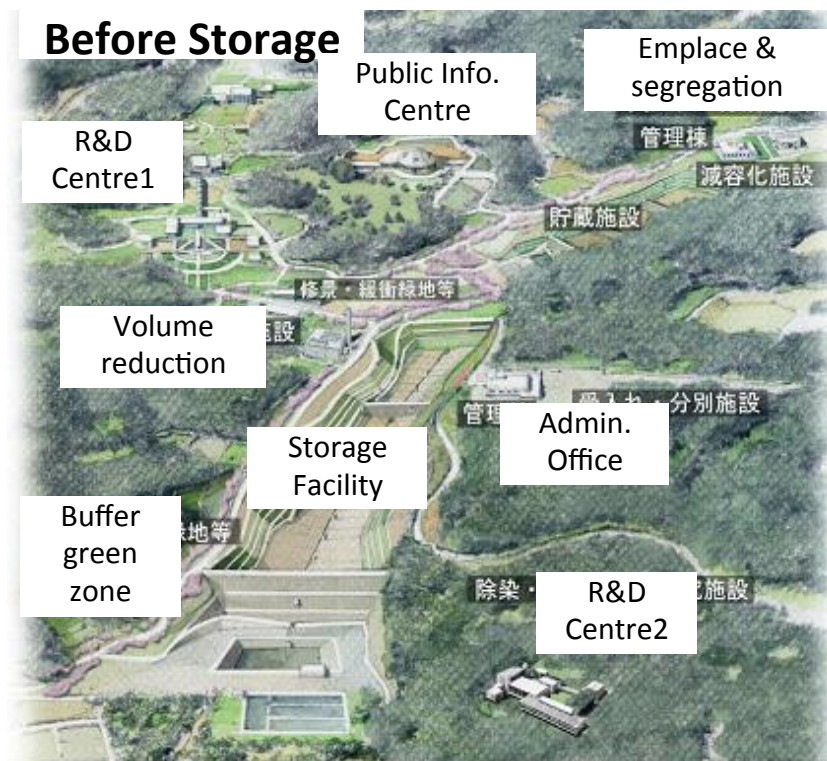
Example of facilities for radioactive waste which can generate leachate

Example of facilities for radioactive waste which does not generate leachate



ISF: Bird-view Image

- Total storage volume ranges 15-28 million_m³ according to the decontamination scope and methods
- Should contribute to municipal economy during construction and monitoring phases.



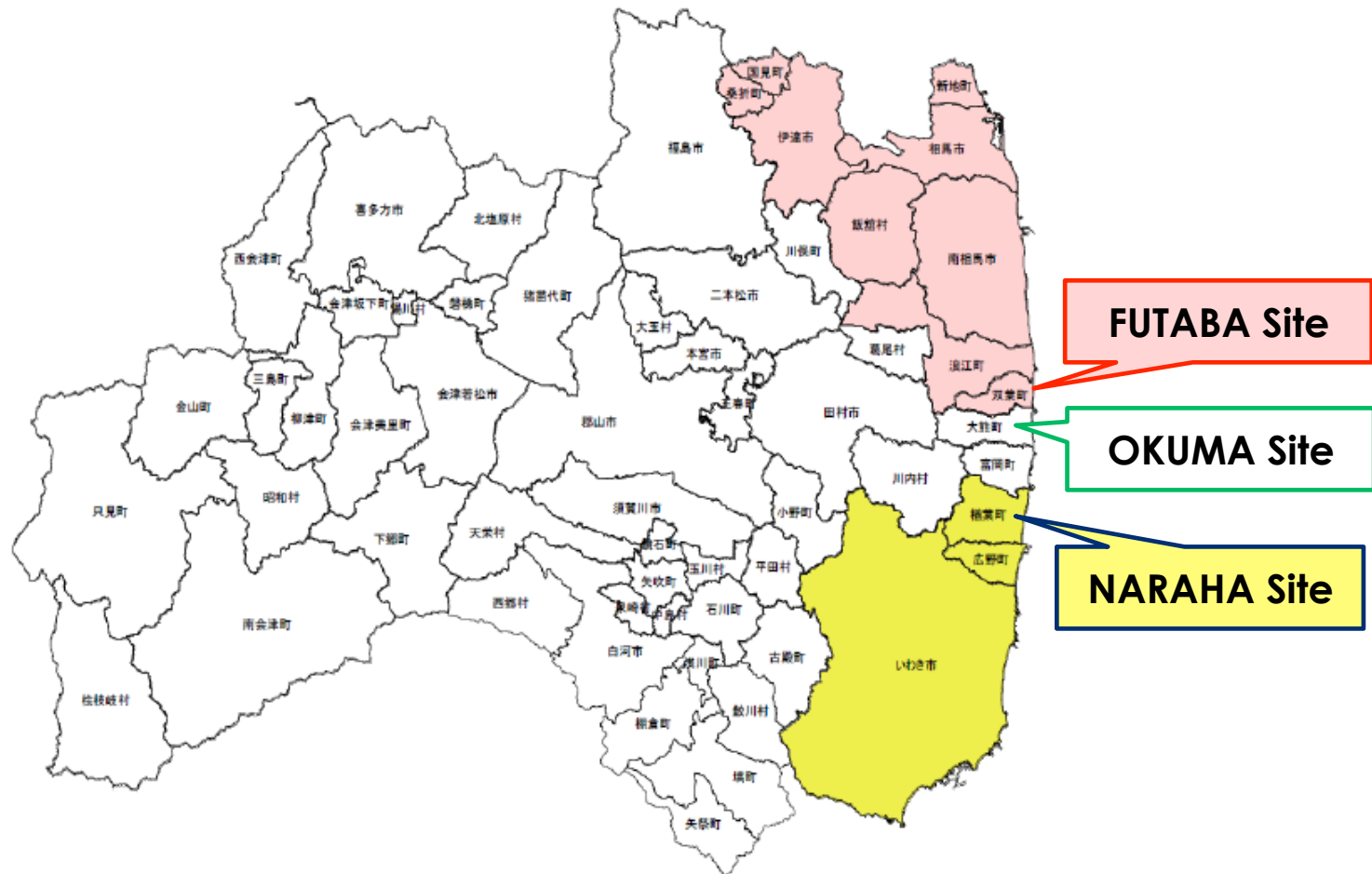
❌ The image is conceptual. Actual facilities and their layouts will be modified to the sites selected.

ISF: Facility Components

- Waste Emplacement and Segregation Facility
 - ✓ Confirmation of waste characteristics (weights, surface dose rate etc.)
 - ✓ Segregate waste into combustibles or non-combustibles, radioactive or not.
- Storage Facility
 - ✓ Store soil and waste, prevent radiation from leaking and water contamination
- Waste Volume Reduction Facility
 - ✓ Incineration plant with associated facilities
 - ✓ Other volume reduction facilities
- Monitoring Centre
 - ✓ Continuous monitoring of storage sites (stored soil and waste) and surrounding environment (e.g. air, ground water).
- Research and Development Centre
 - ✓ R and D for volume reduction technology for stored soil and waste, and for high concentration isolation technology, etc.
- Public Information Centre

Transportation Plan

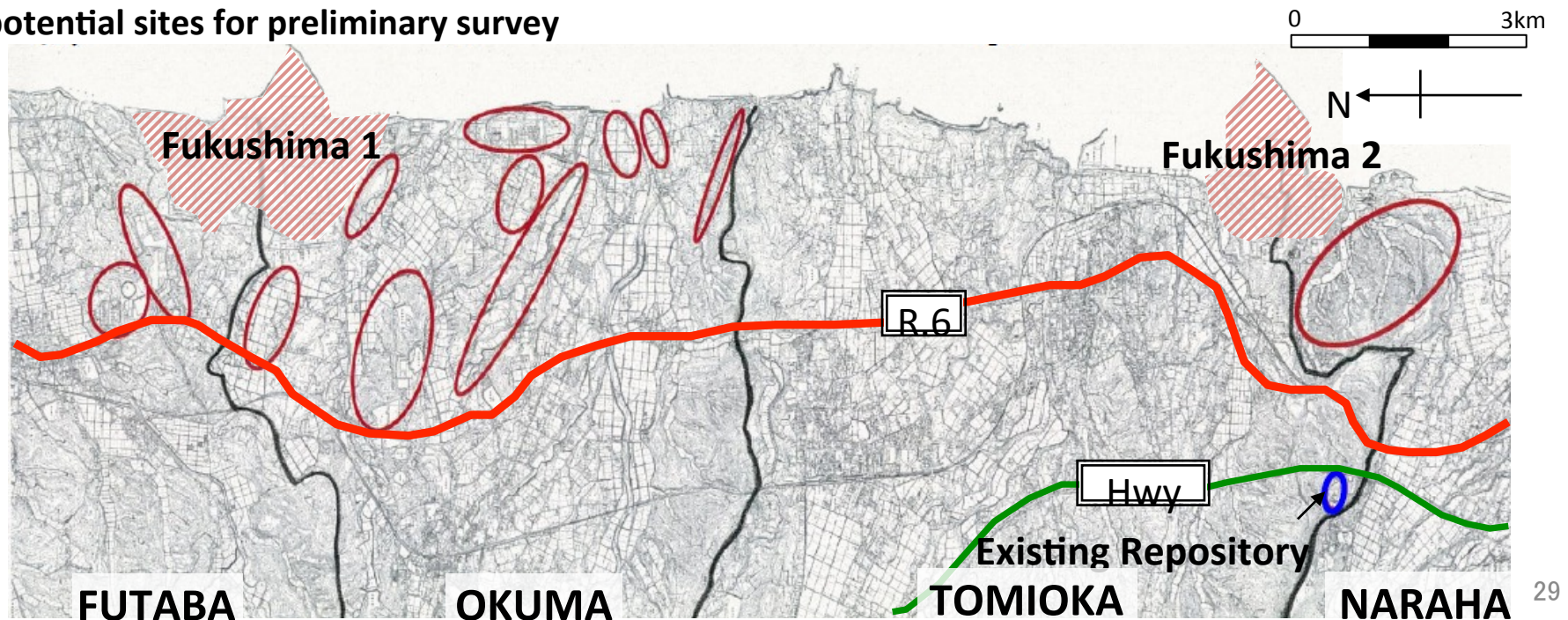
- Divide into 3 areas corresponding to ISF locations (FUTABA, OKUMA and NARAHA).
- Challenge: Mgmt. of huge volume transportation, avoiding local congestion.



Potential Construction Sites

- 12 potential sites (for preliminary survey) around the Fukushima 1st and 2nd 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



Major Events

Oct. 2011 The Ministry of the Environment announced the basic plan of ISF; explain to the heads of relevant municipalities.

Dec.2011 The Minister requested 8 towns in Futaba county and Fukushima Pref. to examine potential location in Futaba county.

Mar.2012 The Minister explained 8 towns and Fukushima Pref. that facilities be dispersed in three towns(Futaba, Okuma and Naraha)

Aug.2012 The Minister requested 8 towns and Fukushima Pref. that feasibility surveys be implemented in Futaba County

Overall Schedule

No.	Item	Details	FY2011			FY2012			FY2013			FY2014			FY2015 and beyond			Notes
			4	7	10	1	4	7	10	1	4	7	10	1	4	7	10	
1	Survey on basic concept	<ul style="list-style-type: none"> Investigate type, condition and volume of wastes and soil, as well as concentration of radioactive materials Rough estimate of cost of facility structure, scale and construction costs, investigate potential locations (several sites) 																
2	Selection of site for interim storage facility	<ul style="list-style-type: none"> Coordination with prefecture, municipality or locality of selected site for interim storage facility 																
3	Basic design, execution design	<ul style="list-style-type: none"> Rough estimate of cost of structure, scale and construction for interim storage facility *Basic design(outline for various preliminary discussions), execution design(for contracting of project and acquisition of land) 																
4	Environmental impact assessment, impact study of radioactive materials on the environment	<ul style="list-style-type: none"> Study, assessment and survey of countermeasures on environmental impact Study on environmental impact, assessment, and measures for radioactive materials 																
5	Site acquisition	<ul style="list-style-type: none"> Land survey for site acquisition Site acquisition for interim storage facility etc. 																
6	Processing of various types of permits for development	<ul style="list-style-type: none"> Consultation on development permit (agricultural land, forest, urban area, natural park, buried cultural property etc.) 																
7	Construction of roads etc. for construction site	<ul style="list-style-type: none"> Construction of roads, temporary facilities etc. 																
8	Main construction of interim storage facilities	<ul style="list-style-type: none"> Implementation of main construction of interim storage facilities 																
9	Installation of wastes etc.	<ul style="list-style-type: none"> Installation of wastes etc. 																
Survey of use of existing disposal sites																		
Decontamination																		
Disposal of wastes																		
Wastes from areas under measures																		
Designated wastes																		

*For decontamination, installation into interim storage facilities will start after 3 years from beginning of the installation into temporary facilities.

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Conclusions and Challenges

- Waste management began last year in parallel with development of framework.
- Technical challenges
relatively highly contaminated waste disposal including incineration
- Siting challenges
temporary, interim storage and landfill site etc.
- Communication challenges
trust building, knowledge base for people, especially neighborhood of facilities etc.