Sustainable Management of Radiocesium-contaminated Soil and Waste

放射性セシウムを含む土壌、廃棄物の管理



Masahiro Osako

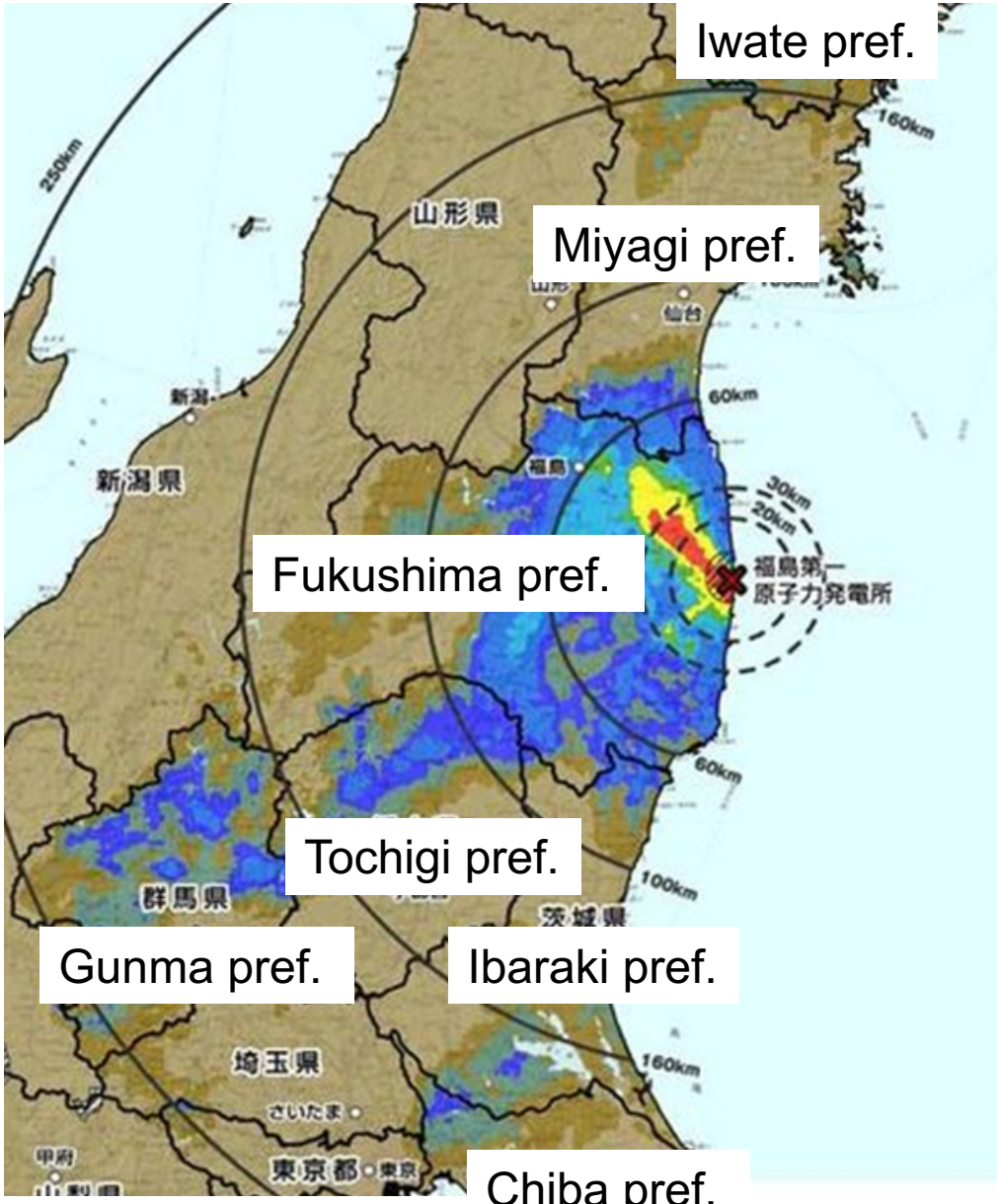
Center for Material Cycles and Waste Management Research

National Institute for Environmental Studies

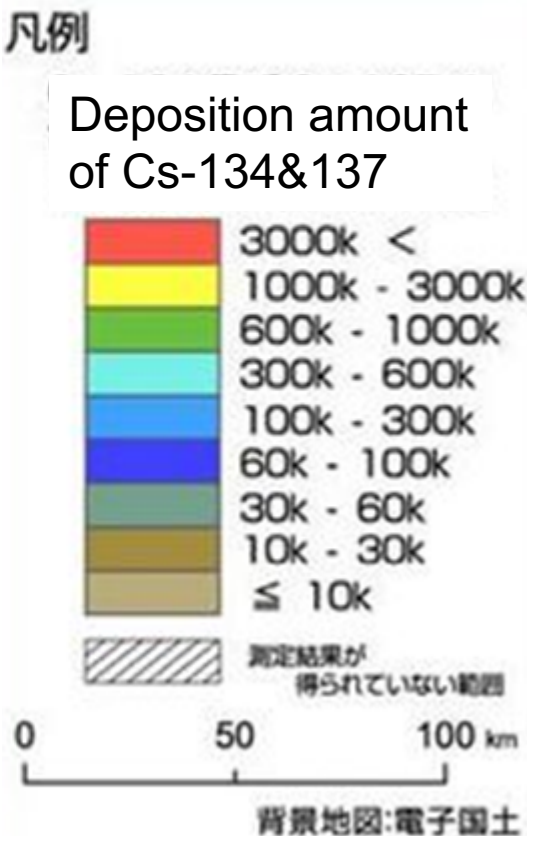
大迫政浩

国立環境研究所/資源循環・廃棄物研究センター

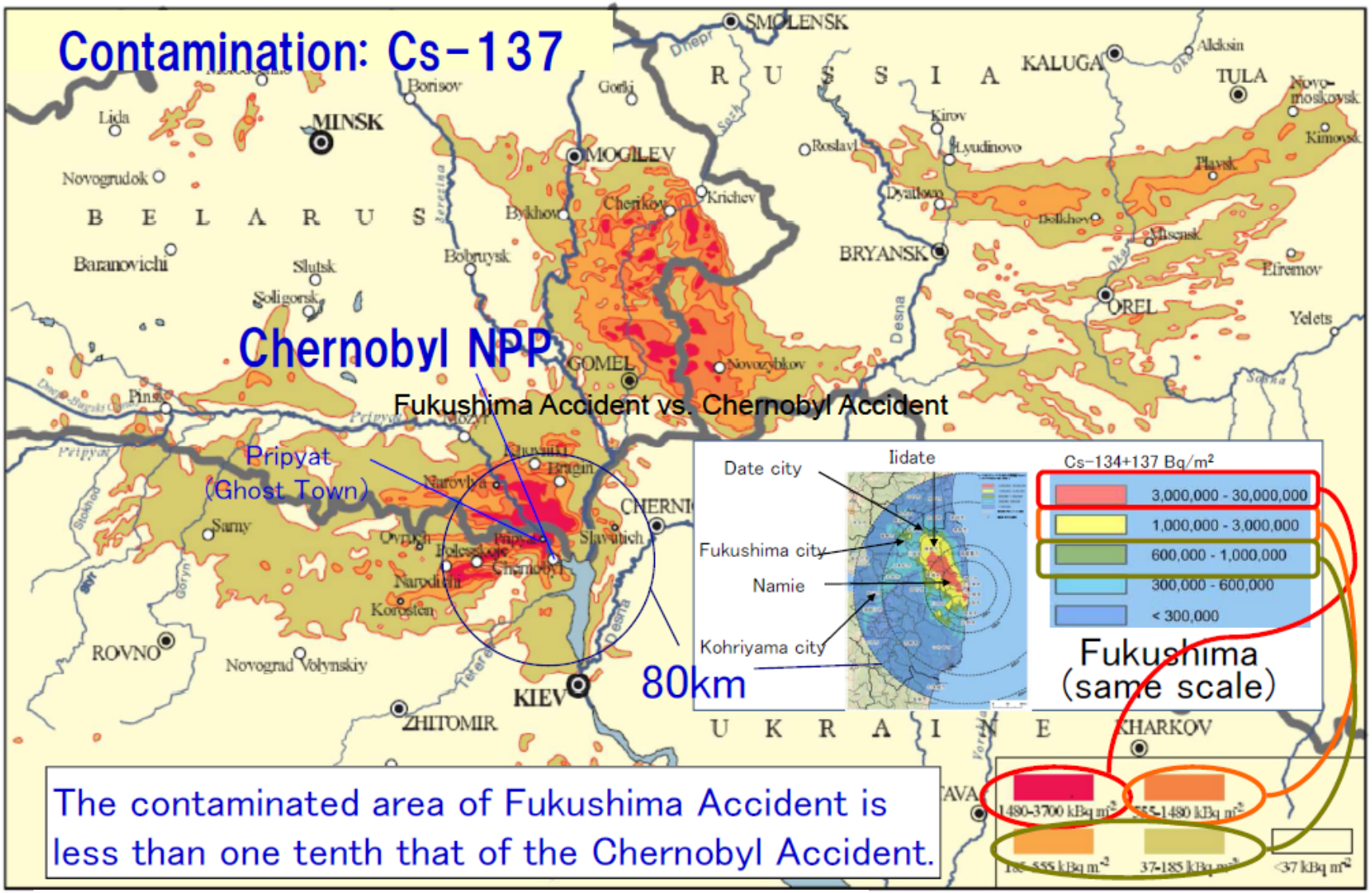
Spread of radioactive materials by the accident of Fukushima nuclear power plant



福島第一原発事故による
放射性物質の広がり



Chernobyl accident vs. Fukushima accident



汚染範囲はチェルノブイリの1/10に過ぎないが！

提供：三菱総研　鈴木

Environmental pollution caused by the accident of the nuclear power plant

事故による環境汚染

- ✓ Some areas of Eastern Japan were polluted with radioactive materials released by the nuclear power plant accident.

東日本における広域汚染

- ✓ The environmental contamination occurred in a populated, crowded area of Japan.

人口密集地域に及んだ環境汚染

- ✓ Generation of a wide variety of waste in large quantities that is contaminated with radiocesium.

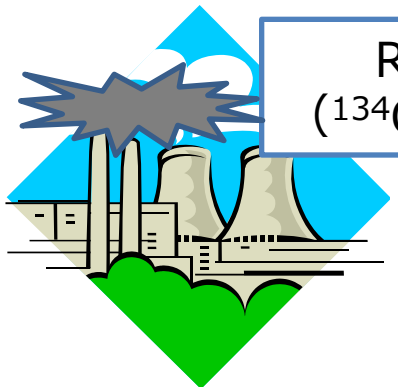
放射性セシウムに汚染された大量かつ多様な廃棄物の発生

- ✓ A large quantity of the removed contaminated soil still remain after the decontamination activities.

除染に伴う大量の除去土壌の発生

Waste management problem
汚染廃棄物問題

Flow of radiocesium in the artificial area including waste management system　人口圏における放射性Csのフロー



Release
(^{134}Cs・^{137}Cs)

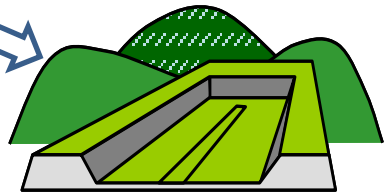
Moving, Spread

Rainfall

Concentration
Volume reduction
(bottom ash, insoluble)
Evaporation-deposition
(fly ash, water soluble)

焼却施設

Incineration



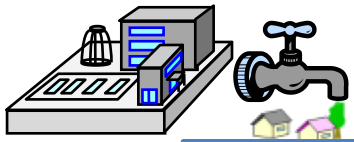
Final disposal site
最終処分場

浄水汚泥
Water sludge

Deposit to land

Soil

除染
Decontamination



General wastes　一般廃棄物
Municipal solid waste

草木類
Vegetation

Cs absorption

Cs contaminated soil wash out

下水管

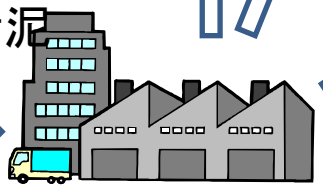
Sewage sludge

下水汚泥
Sewage plant

ポンプ場

Disaster waste

Construction waste



Crashing & segregation
破砕選別

Recycle
リサイクル

Osako（2011）

Legal aspect
法律的側面

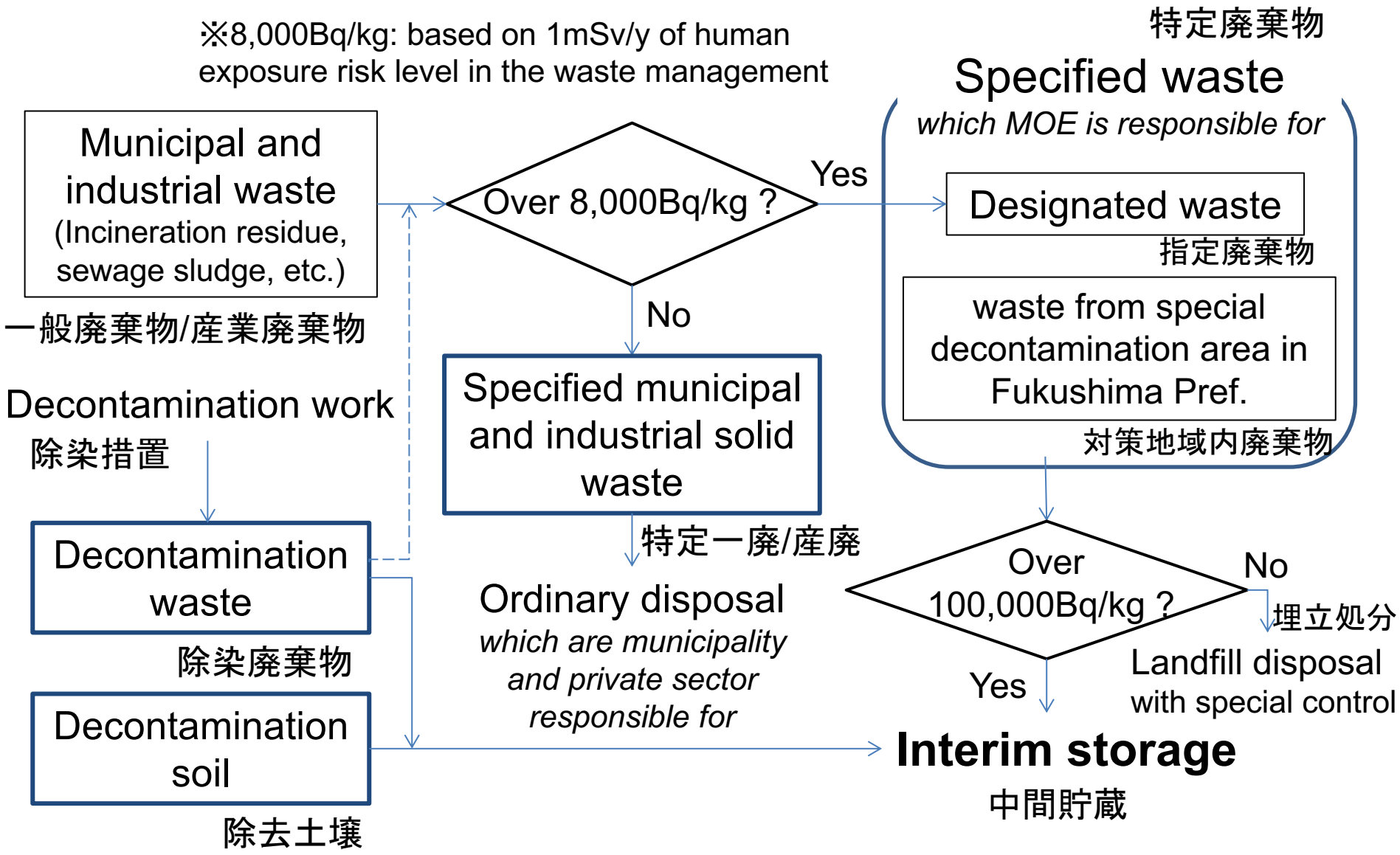
Legal Framework 法制度

Act on Special Measures concerning the Handling of Radioactive Pollution 放射性物質汚染対処特別措置法
Promulgated: at the end of August 2011, Fully came into force: January 1, 2012

The Order and Ordinance 施行令・施行規則
-Waste-related regulations: Designation standards for Designated Waste, collection and transfer standards, storage standards and final disposal standards for decontaminated waste, etc. 廃棄物関係
-Decontamination-related regulations: Standards for decontamination and other measures, collection and transfer standards and storage standards for the removed soil, etc. 除染関係

-Designation of the target areas:
Special Decontamination Areas: 11 municipalities*
(20km radius from NPP + area with 20 mSv of annual Cumulative dose) 除染特別地域
Intensive Contamination Survey Areas:102 municipalities*
(area with 1-20 mSv annual cumulative dose)汚染状況重点調査地域
* 4 municipalities have been partially designated

Classification on the contaminated waste
(in case of Fukushima pref.) 汚染廃棄物等の分類 （福島県内）



Release of Technical Guidelines　技術ガイドライン
-Helping understanding regulations under the Act

– **Waste-related guidelines:** storage, maintenance and management standards and disposal standards

– **Decontamination-related guidelines:** methods for the investigation and measurement of the status of pollution, decontamination and other measures, collection, transfer and storage of the removed soil

Characteristics of contaminated soil and waste generation

除去土壌と汚染廃棄物の発生特性

Actual wastes

Disaster waste 災害廃棄物

At temporal storage sites, combustibles are roughly separated manually and crushed in pre-treating facilities

Bulky waste 粗大ごみ

At temporal storage sites, combustibles are roughly separated manually and crushed in pre-treating facilities

Municipal waste 一般ごみ

Transport in forms of flexible containers or recollecting plastic bags, or by packer vehicles

Vegetation 草木類

①

Unwrapping wrapped roles of vegetations, then sliced or chipped.

②

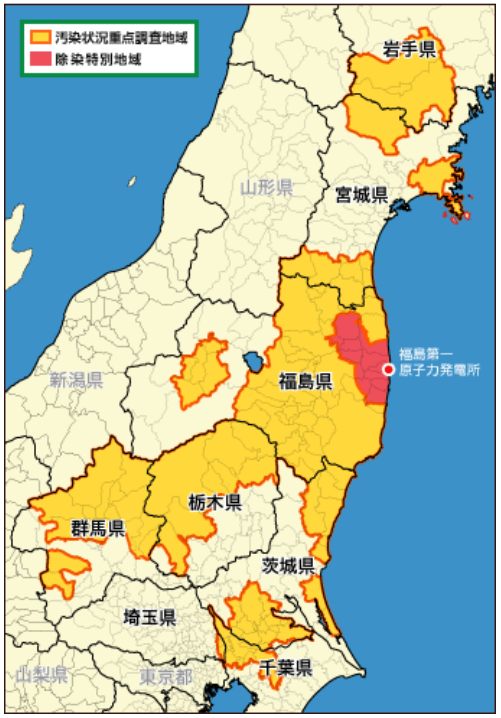
Transported in flexible containers

De-packing from flexible containers and crushing by crushing machines

Sludge 汚泥類

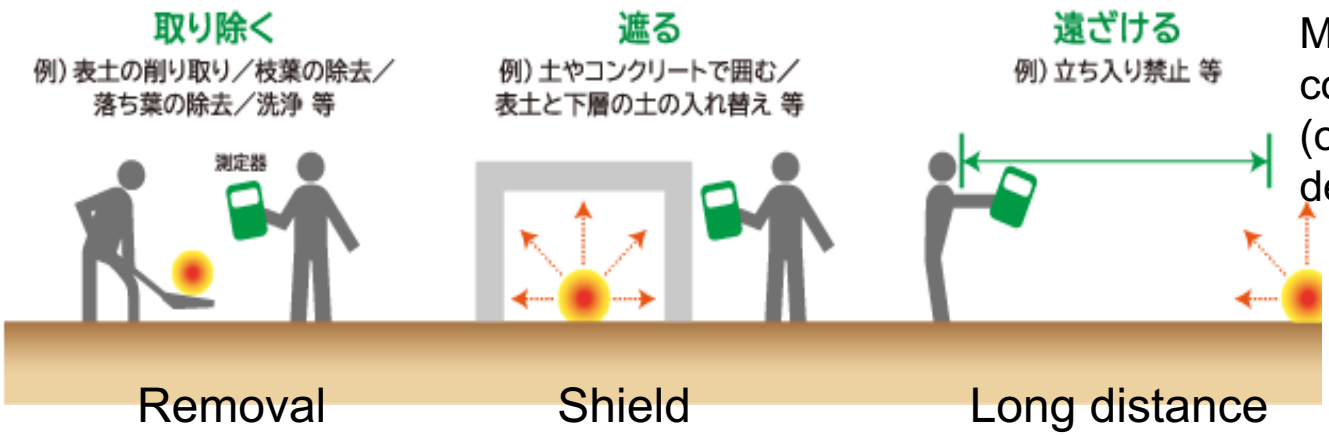
Transport in closed flexible containers and the content is threw from containers into incinerators

Decontamination works　除染措置



Map of the intensive contamination survey area (orange) and the special decontamination area (red)

除染特別地域（オレンジ）及び
汚染状況重点調査地域（赤）



Examples of wastes generated from decontamination

除染廃棄物

Plants

Woods, branches

Mud sludge (High pressure water cleaning of side girders)

Packing works In flexible containers

http://josen.env.go.jp/en/#top10

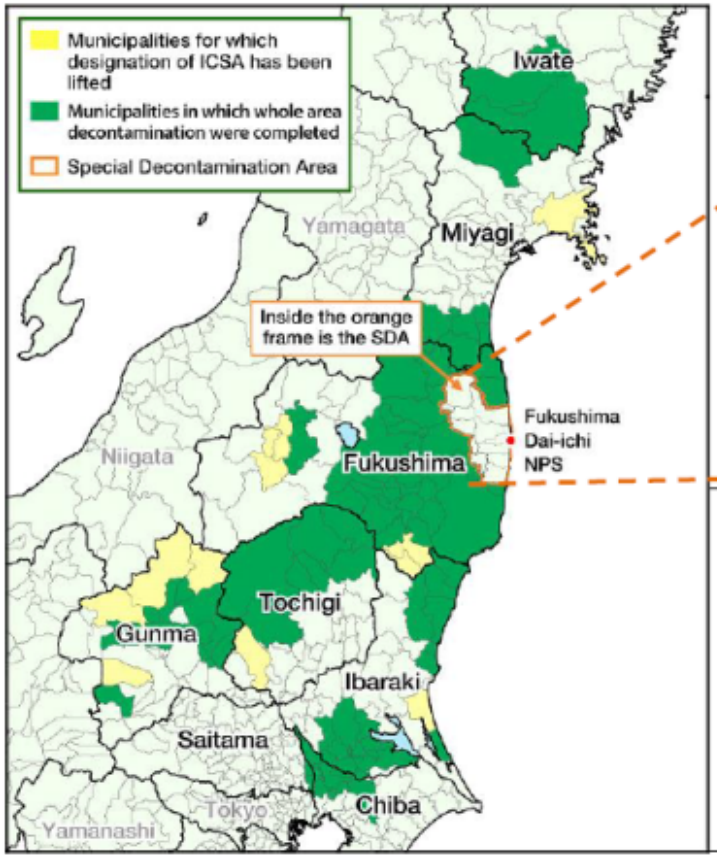
http://josen-plaza.env.go.jp/materials_links/index.html#movie131007en

Progress of decontamination

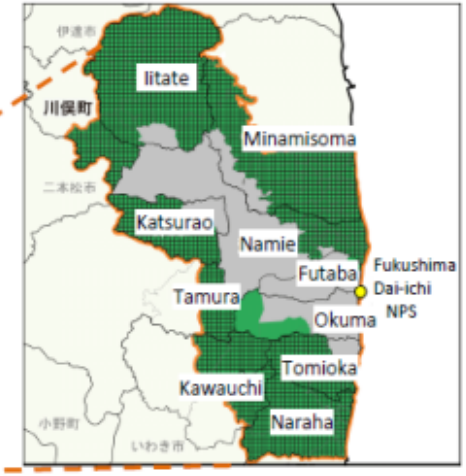
Whole area decontamination based on the Act on Special Measures was completed on March 19, 2018, excluding the Areas where Returning is Difficult (ARD)

* In ARD, "Reconstruction Hubs" will be set in each municipality, where decontamination and infrastructure construction will be implemented in an integrated way.

Intensive Contamination Survey Areas (ICSA)



Special Decontamination Areas (SDA)



→Whole area decontamination in the SDA was completed at the end of March 2017

Evacuation order lifted
Completed
Special Decontamination Area
Areas where Returning is Difficult

	Municipalities which completed whole area decontamination		
		SDA	ICSA
Within Fukushima Pref.	43※	11	36
Outside Fukushima Pref. (7prefs)	57	-	57
Total	100	Completed in March 2017	Completed in March 2018

※There are both SDA and ICSA areas in Minamisoma, Tamura, Kawamata, and Kawauchi

Cited from MOE

Estimated amount of contaminated soil and waste carried in the interim storage site

中間貯蔵搬入推定量

Municipal and industrial waste
(Incineration residue, sewage sludge, etc.)

Over 8,000Bq/kg ?

Yes

No

Specified waste

Designated waste

waste from special decontamination area in Fukushima Pref.

Specified municipal and industrial solid waste

Ordinary disposal

Decontamination work

Over 100,000Bq/kg ?

No

Landfill disposal

Yes

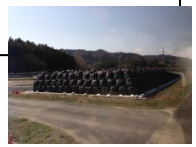
Decontamination waste

Incineration ash

1,550,000 m³

Incineration ash 20,000 m³

Decontamination soil



<8,000Bq/kg 10,060,000 m³

8,000Bq/kg< 10,360,000 m³

Interim storage

Management procedures

Temporary storage　一時保管

Incineration treatment

Landfill disposal

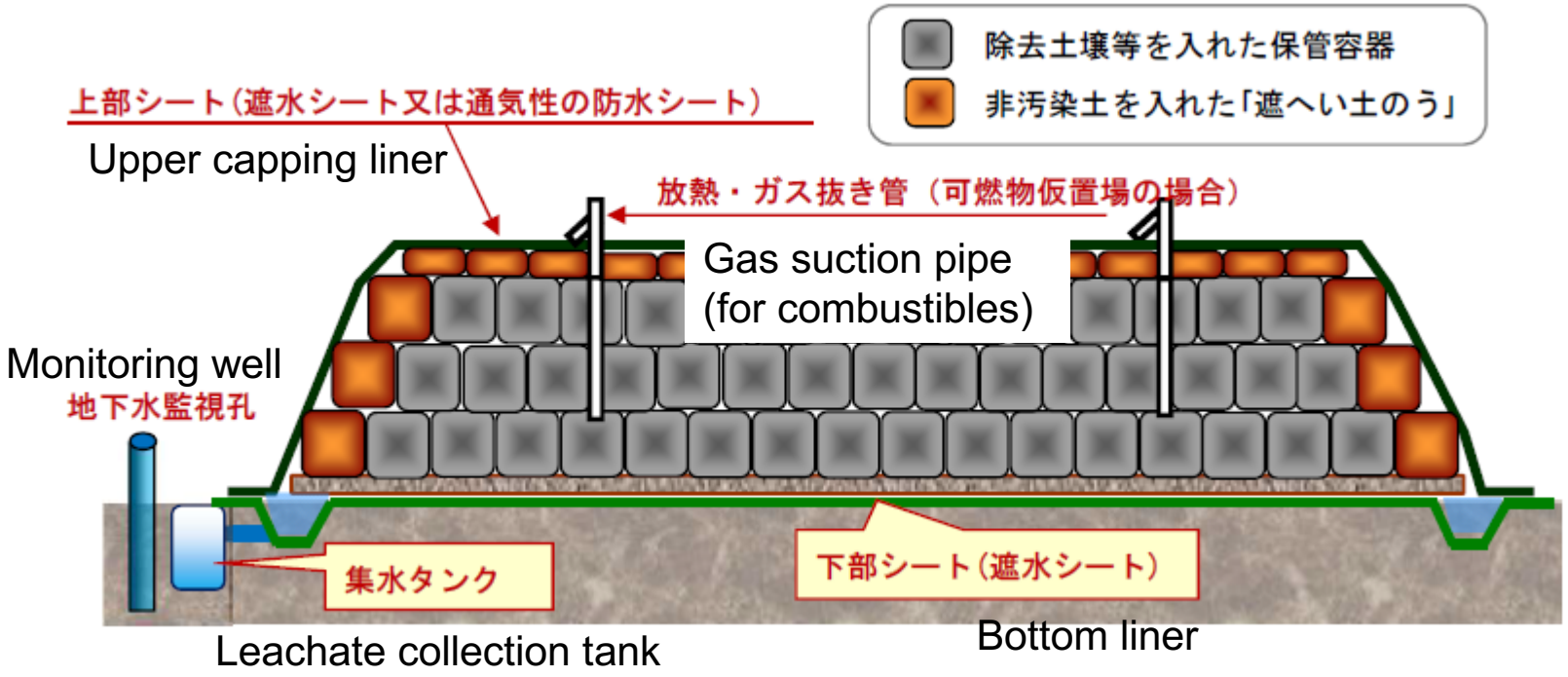
Interim storage

Contaminated soil recycling

Temporary storage site (TSS) for decontamination soil and waste
一時保管場

・内部から発生する放射線を「遮へい土のう」によって遮へい
・保管物からの浸出水の地下浸透・外部漏出を下部シートで防止
・内部への雨水の浸入を上部シートで防止

- ✓ Soil bag shielding against radiation
- ✓ Bottom liner system preventing leakage of leachate
- ✓ Upper capping liner system preventing penetrating of rainfall



Views of TSS

Management procedures

Temporary storage

Incineration treatment　焼却処理

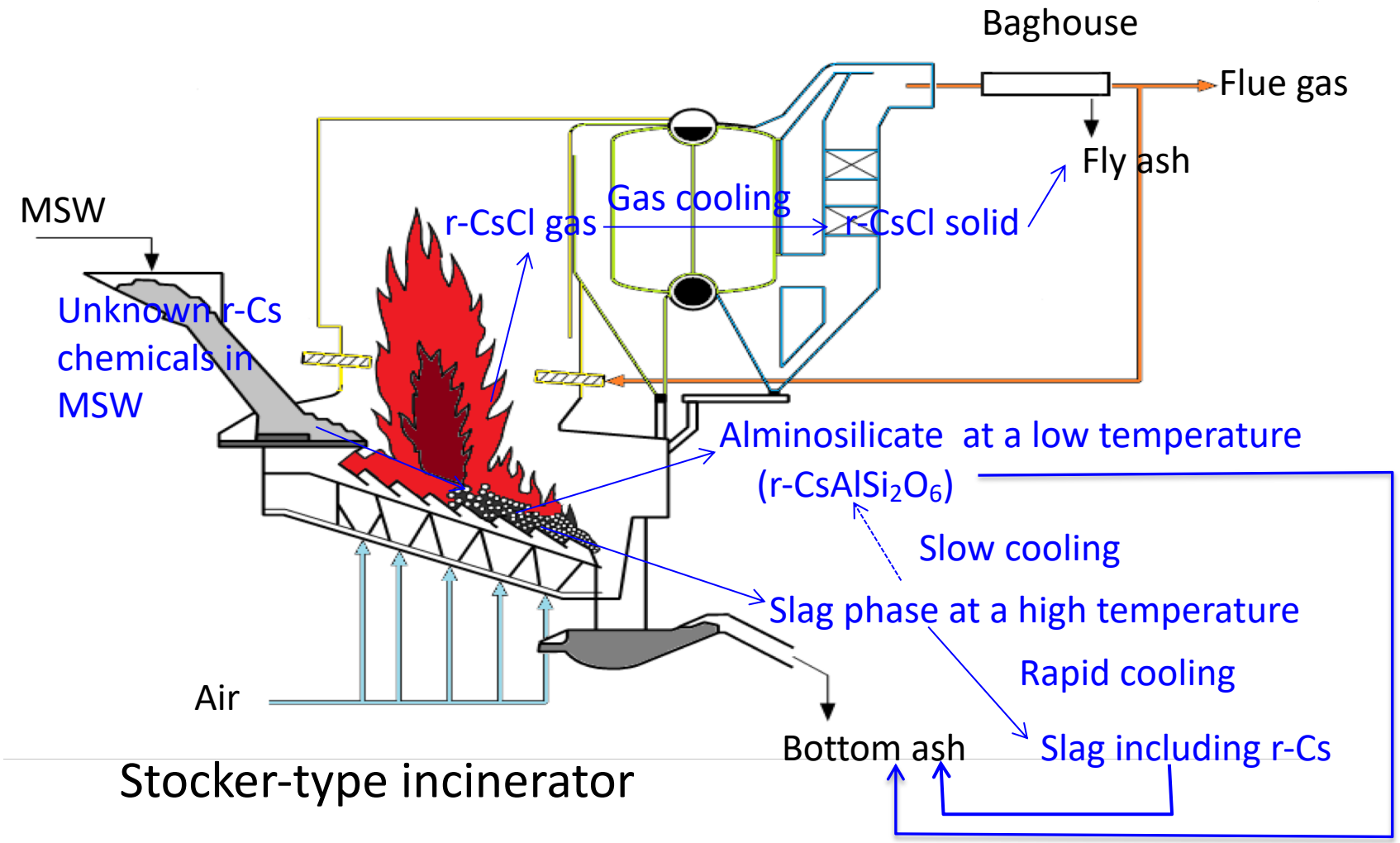
Landfill disposal

Interim storage

Contaminated soil recycling

Temporary incineration plant for the contaminated waste

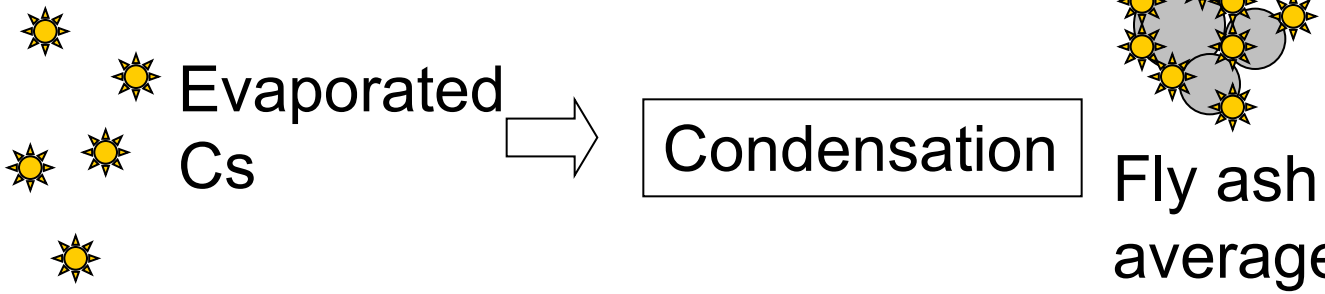
R-Cs behavior in MSW incinerator
放射性セシウムの炉内挙動



Evaporated Cs in combustion gas
放射性Csの炉内揮発

Exhaust gas is cooled and evaporated Cs condensed as a solid of CsCl and forms particles of dust.

揮発したCsはガス冷却に伴い固体化。塩化セシウムとしてばいじんに濃縮



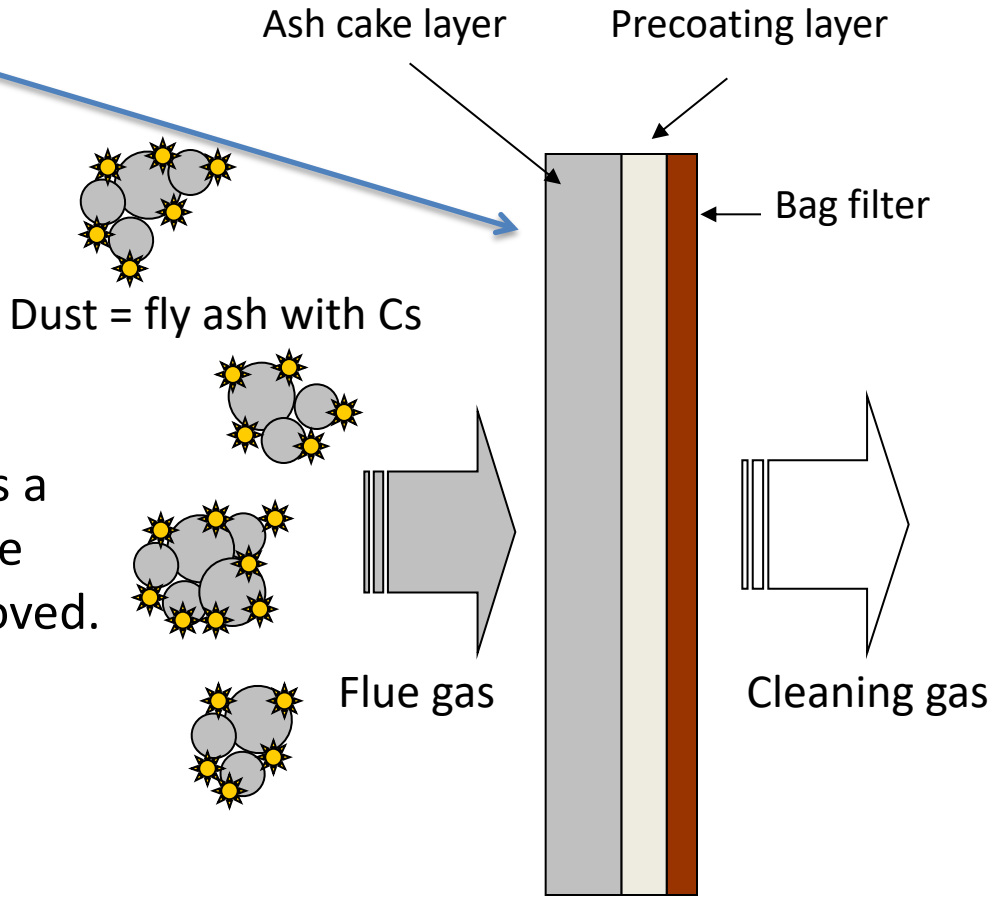
Temperature decreases less than 200 ºC at bag filter.
CsCl: bt = 1300ºC, mt = 646 ºC
Vapor pressure: 7 Pa at 600 ºC (high enough)
1 nPa at 200 ºC (low enough)

Osako, NIES, 2013

Gas cleaning for r-Cs in flue gas?

A conventional gas cleaning is valid for removal of r-Cs?

In a baghouse



- ✓ In a baghouse, dusts are removed. As a result, r-Cs chemicals solidified on the dust during gas cooling are also removed.
- ✓ The presence of ash cake layer and precoating layer enables bag filter to remove finer dusts.

バグフィルターにより微粒子まで十分に除去可能

Removal efficiency of r-Cs from flue gas using a baghouse? バグフィルターの除去率

Plant location	Thermal treatment	Concentration of Cs (Bq/m3)				Removal ratio (%)		Dust collector *	Investigative body **
		Inlet gas		Outlet gas					
		^{134}Cs	^{137}Cs	^{134}Cs	^{137}Cs	^{134}Cs	^{137}Cs		
Arakawa (Fukushima)	Incineration	78	96	<0.008	<0.006	>99.99	>99.99	BF	MOE
		98	126	0.008	<0.007	99.99	>99.99		
Sukagawa (Fukushima)	Incineration	33	42	0.2	0.2	99.39	99.52	EP	MOE
		43	57	0.2	0.2	99.53	99.65		
A-city	Incineration	58	70	<0.054	<0.053	>99.91	>99.92	BF	NIES
B-city	Incineration	58	76	<0.1	<0.1	>99.83	>99.87	BF	NIES
	Melting	677	844	<0.1	<0.1	>99.99	>99.99		
C-city	Incineration	15	20	<0.012	<0.013	>99.92	>99.94	BF	NIES
	Incineration	64	85	<0.018	<0.017	>99.97	>99.98		
	Melting	39	51	<0.01	<0.011	>99.97	>99.98		
	Melting	98	133	<0.013	<0.013	>99.99	>99.99		
D-city	Incineration	335	404	<0.4	<0.3	>99.88	>99.93	BF	A
	Melting	220	330	<0.05	<0.07	>99.98	>99.98		

*BF : Bag filter, EP : Electric precipitator

** MOE: Ministry of the Environment, NIES : National Institute for Environmental Studies, A: a private company

- ✓ Only BF is highly effective for removal of r-Cs (>99.9%).
- ✓ Outlet gas level in all the facilities was much lower than the regulation of the air environment ((^{134}Cs conc.)/20+(^{137}Cs conc.)/30 ≤ 1)

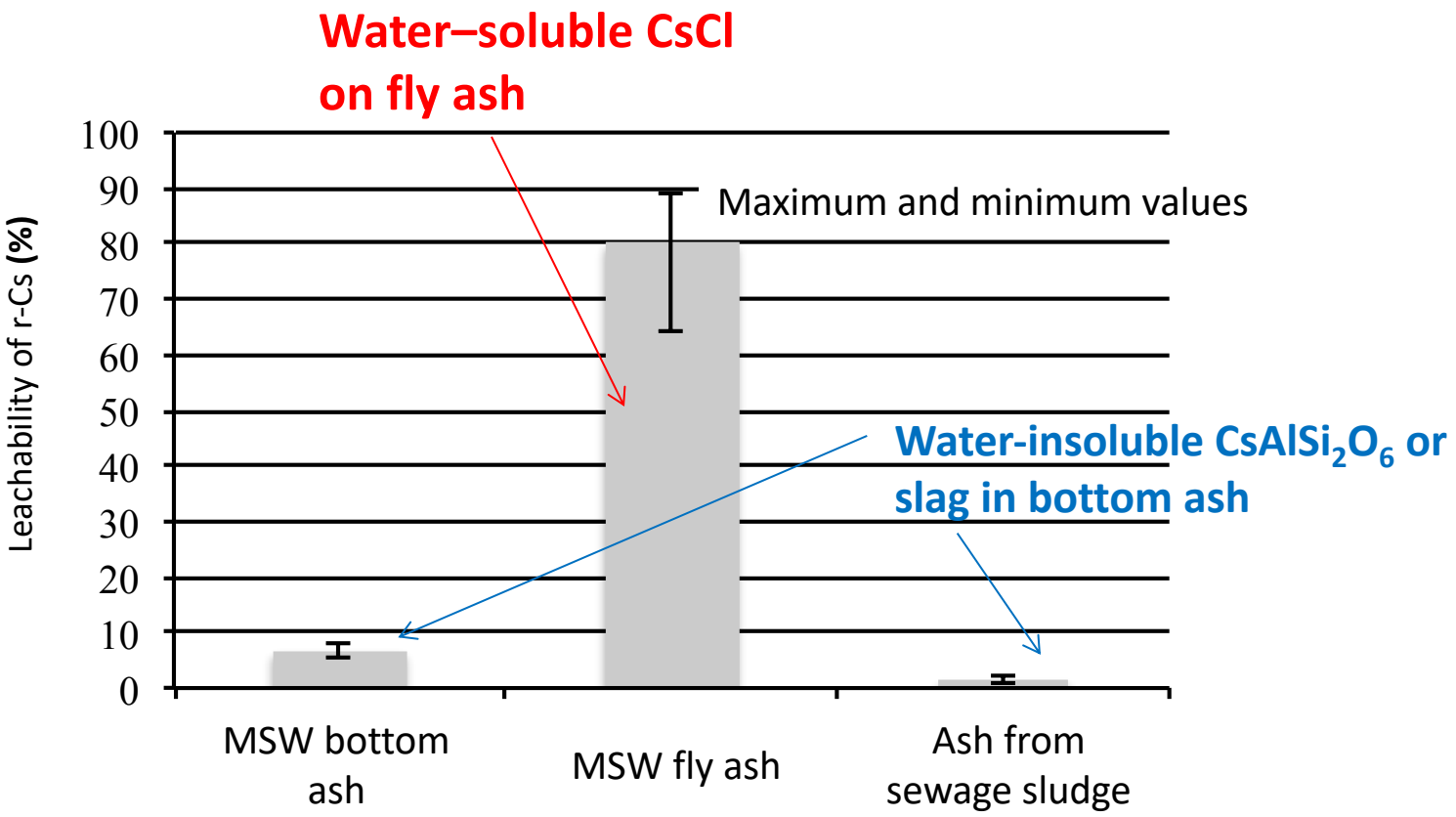
Safe!

99.9%以上の除去率、基準値を十分に下回る

Management procedures

Temporary storage
Incineration treatment
Landfill disposal　埋立処分
Interim storage
Contaminated soil recycling

High leachability in radio-Cs of the incineration fly ash　焼却飛灰の放射性Cs溶出性



Leaching test of r-Cs for various incineration ashes

Sorption test samples　吸着材試料

Silica sand CEC = 0.7 cmol/kg  Standard quartz sand Grain size = 0.4-0.6 mm	**D. granite soil** CEC = 4.1 cmol/kg  Weathering granite Fine grain (<75um) = 7%	**Powd. mordenite** CEC = 130 cmol/kg  Not artificial zeolite Grain size < 0.2 mm
Silty soil CEC = 6.3 cmol/kg  Actually used in a landfill Fine grain (<75um) = 20%	**Bentonite** CEC = 66 cmol/kg  Wyoming Na bentonite Used for hydraulic barrier	**Gran. mordenite** CEC = 140 cmol/kg  Not artificial zeolite Grain size = 1.4-4.0 mm

Results of Kd (distribution coeff.)　分配係数の結果

		Radioact. 134Cs		Radioact. 137Cs		133Cs	
	CEC	(mL/g)		(mL/g)		(mL/g)	
	(cmol/kg)	pH=7	pH=12	pH=7	pH=12	pH=7	pH=12
Silica sand	0.7	5.2	4.7	0.9	4.8	2.9	2.5
D. Granite soil	4.1	**16**	**9.7**	**16**	**13**	12	8.2
Landfill cover soil	6.3	31	36	19	35	15	25
Bentonite	66	41	51	24	63	16	38
Gran. mordenite	140	660	420	620	530	370	400
Powd. mordenite	130	840	810	840	840	450	540

Large Cs distribution coefficient of soils is well-known (e.g. bentonite = 6,200 mL/g), but such a large distribution coefficient will not exhibit in landfill environment.

The reason is probably sorption inhibition by inorganic ions, such as K, Na, and so on.

土壌は放射性Csに対して高い吸着能力を有するが、実際の埋立環境では、共存する無機イオン成分（K、Naなど）により吸着能力が阻害される

Technical issues on landfill of waste containing water soluble radio-Cs　溶出性Csの問題

- Cs leaching characteristic　放射性Cs濃度で規制、溶出性の考慮は？
  - Current regulation of landfill is prescribed by the concentration in solid, however, influence of Cs leaching amount on the landfill leachate quality is more significant.

Followings are additional measures to prevent leaching.

- Sorption layer for radioactive Cs　土壌吸着層
  - Both high permeability in order to avoid over flow and high sorption ability are required simultaneously.
- Engineering barrier as an upper layer (partial capping)
  - Yearly rainfall is 1,100 – 1,600 mm.　　上部キャッピング
- Solidification of MSWIA in order to reduce leaching speed

セメント固型化

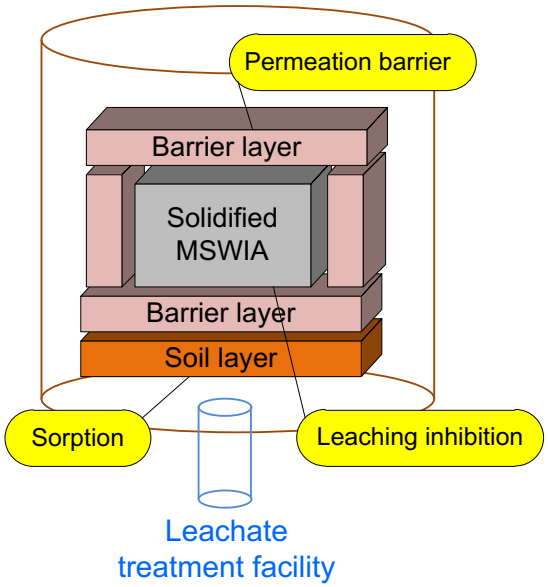
Notification from MOEJ

環境省による8,000Bq/kgを超える焼却飛灰に対する処分基準

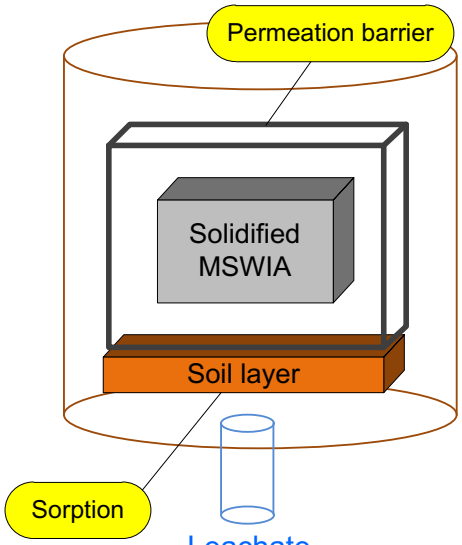
Disposing method of MSWIA with concentration of 8,000 – 100,000 Bq/kg

One method of the following (specified waste)

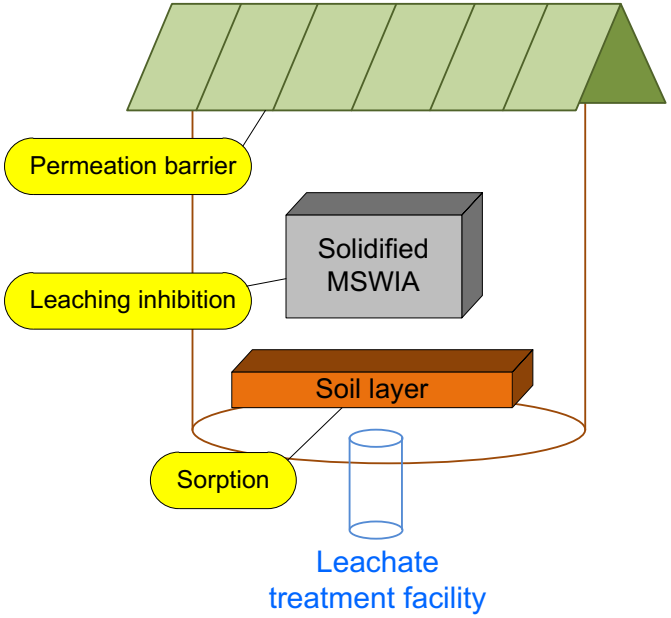
1) Installation of barrier layer



2) Long-term durability container



3) Closed-system landfill site (with a roof)



31st, Aug., 2011

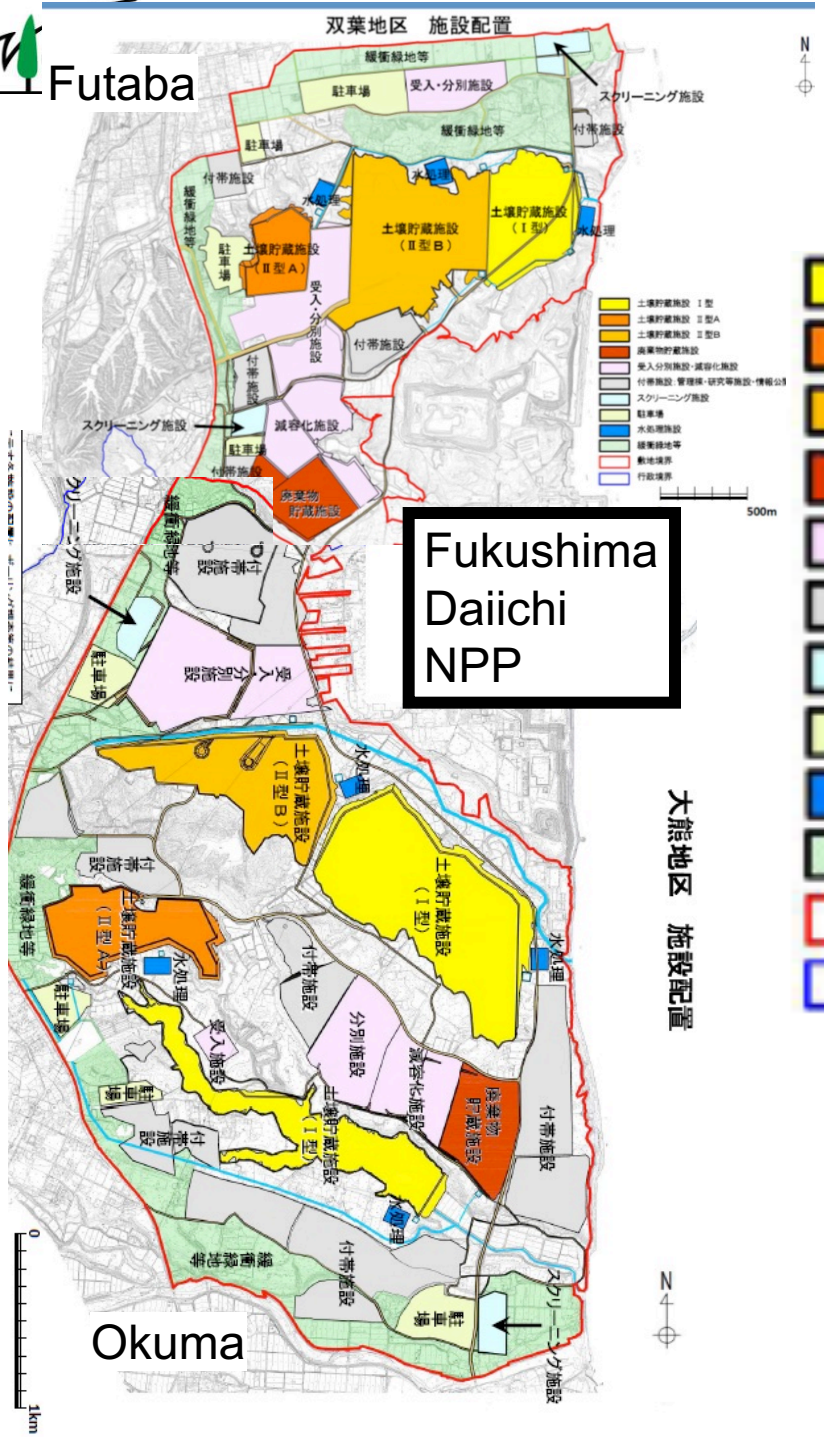
Management procedures

Temporary storage
Incineration treatment
Landfill disposal
Interim storage　中間貯蔵
Contaminated soil recycling

Location of decontamination area and interim storage site 除染エリアと中間貯蔵施設予定地

Transportation of the contaminated soilf from TSS to ISF

Facility arrangement in interim storage site



- Soil storage type I
- Soil Storage type IIA
- Soil Storage Type IIB
- Wastes storage
- Acceptation, selection, vol reduction
- Additional for administrative, research, info.
- Screening
- Parking
- Water treatment
- Buffering
- Boundary of interim site
- Administrative boundary

MOE HP

The whole of interim storage facility composed of several facilities 中間貯蔵施設の構成

Temporary storage sites

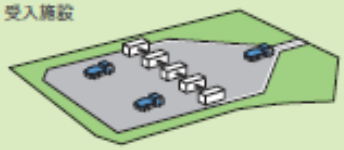
除染仮置場等

Transportation

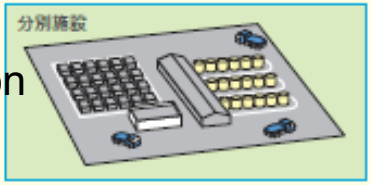
受入・分別施設

搬入される土壌や廃棄物の重量や放射線量を測定し、分別を行います。

受入施設



分別施設

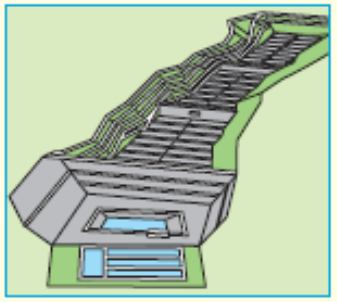


※イメージ

Receiving/segregation facility

土壌貯蔵施設

分別を踏まえて、放射性セシウム濃度や、その他の特性に応じて、土壌などを貯蔵します。

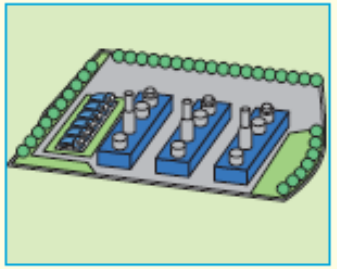


※イメージ

Soil storage facility

減容化（焼却）施設

草木などの可燃物を減容化（焼却）して、貯蔵物の容量を減らします。

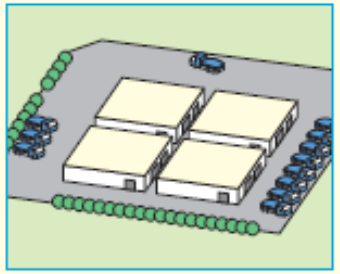


※イメージ

Volume reduction facility (incineration)

廃棄物貯蔵施設

放射性セシウム濃度が10万Bq／kgを超える焼却灰等の廃棄物を貯蔵します。



※イメージ

Waste storage facility

その他の個別施設

・スクリーニング施設　・水処理施設　・ストックヤード
・管理棟　・研究等施設　・情報公開センター　等

Other facilities (screening, wastewater treatment, stockyard, laboratory, information, etc.)

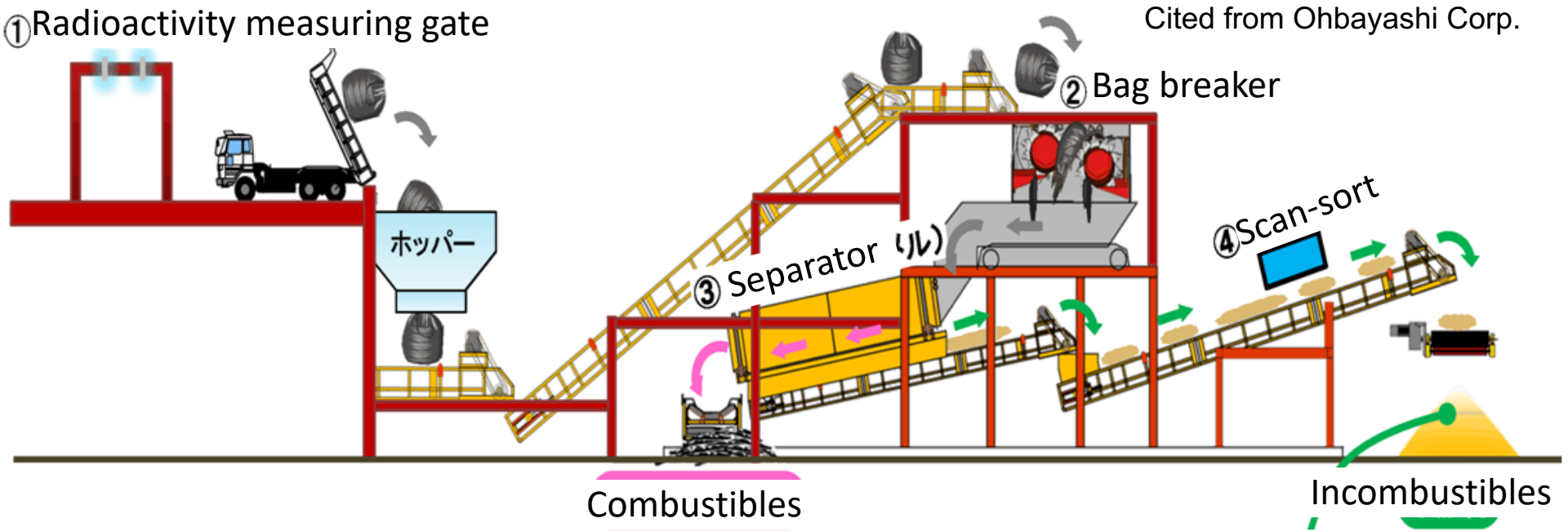
Operational status of the ISF

- Construction of the facility started in November 2016
- Trial operation of Reception/Separation Facilities started in June 2017 in Futaba, and in August 2017 in Okuma
- The storage of the removed soil started in October 2017 in Okuma and in December 2017 in Futaba after the completion of the soil storage facilities

Reception/Separation Facility
(First period in Futaba)
(Processing capacity 140t/h)

Soil Storage Facility (First period in Okuma)
(Planned storage volume approx. 210,000m³)

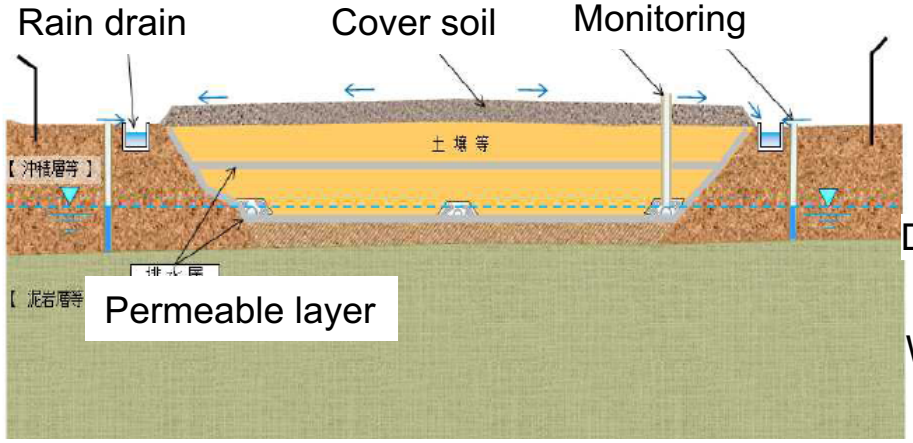
Pretreatment technology prior to the landfill storage
中間貯蔵における前処理



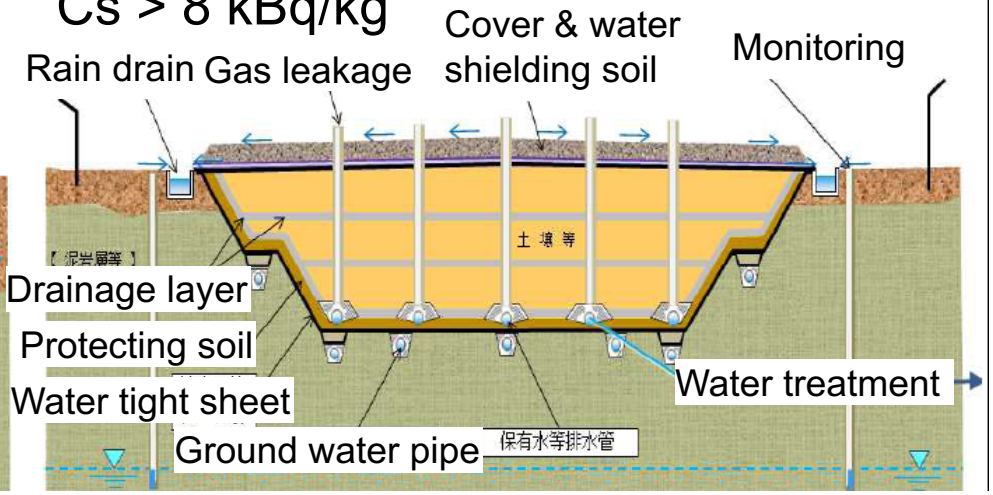
New system combining various technologies.

- Monitoring radioactivity of bags on a truck.
- Sliding down in a hopper.
- Bag breaking machine.
- Classification for combustibles and incombustibles.
- Incombustibles are classified into three categories depending on radioactivity.

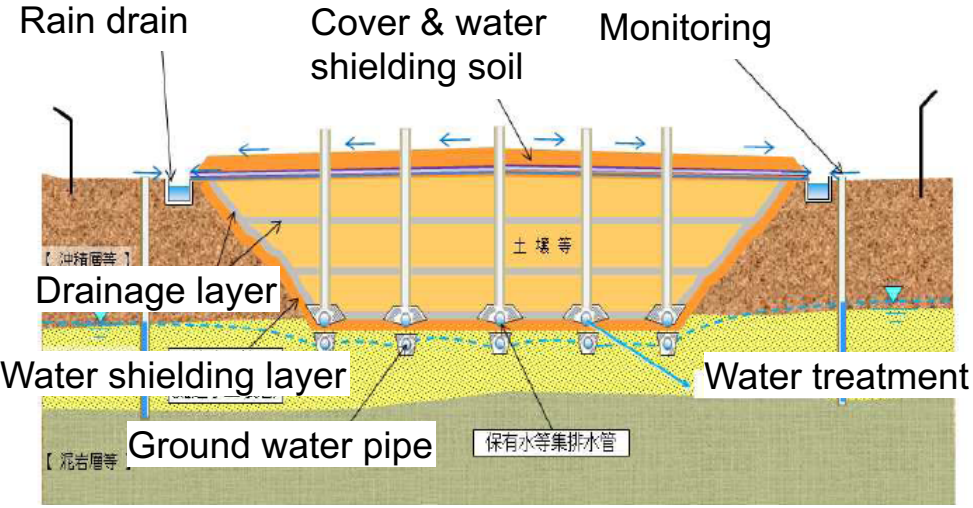
Soil storage facility type I
Low land
Cs < 8 kBq/kg



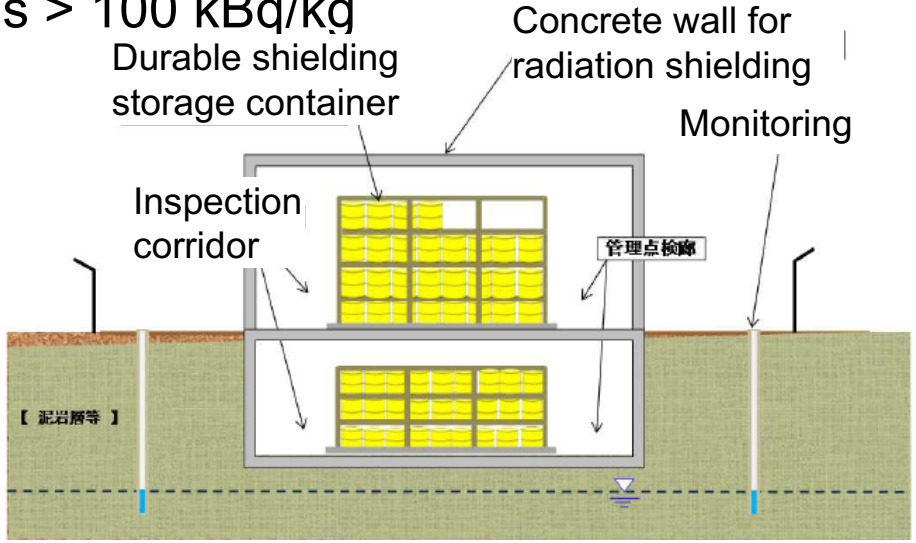
Soil storage facility type IIA
Hill
Cs > 8 kBq/kg



Soil storage facility type IIB
Hill
Cs > 8 kBq/kg



Wastes storage facility
Hill
Cs > 100 kBq/kg



Management procedures

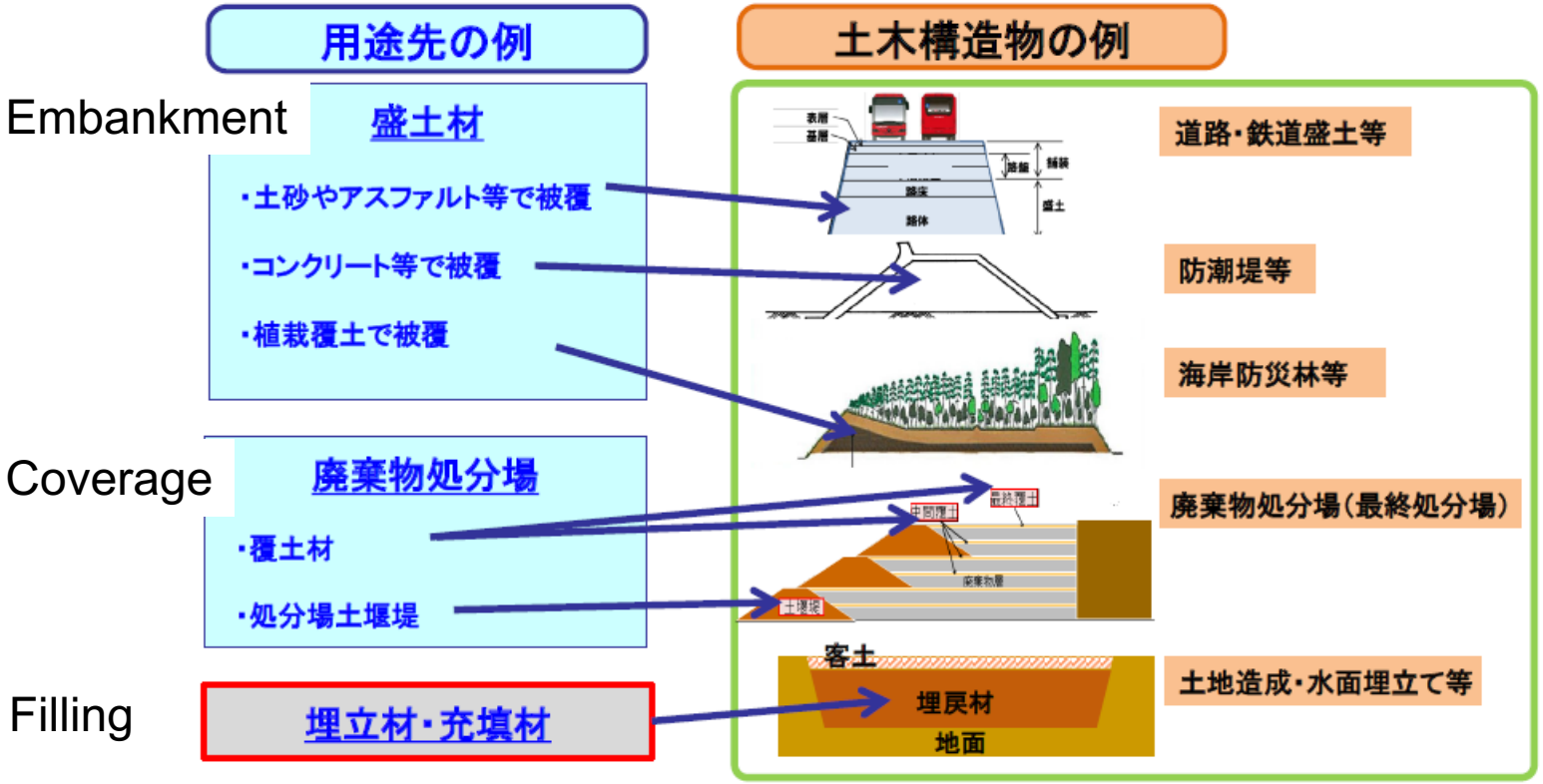
Temporary storage
Incineration treatment
Landfill disposal
Interim storage
Contaminated soil recycling　汚染土再生利用

Application use in the soil recycling

Basic principle : limited utilization

- 利用先を管理主体や責任体制が明確となっている公共事業等における人為的な形質変更が想定されない盛土材等の構造基盤の部材に限定した上で、追加被ばく線量を制限するための放射能濃度の設定、覆土等の遮へい、飛散・流出の防止、記録の作成・保管等の適切な管理の下で再生資材を限定的に利用する。

（再生資材化した除去土壌の安全な利用に係る基本的考え方について（抜粋））



出典：環境省

除去土壌の再生利用に関する基本的考え方
（クリアランスレベルとの対比）

Basic principle of the contaminated soil utilization comparing with “clearance level”

	限定再利用 Limited utilization	無限定再利用（クリアランスレベル） Non-limited utilization (Clearance level)
許容限度 Tolerable limit	・一般公衆、作業者ともに追加被ばく線量が1mSvを超えない（追加対策で供用時に0.01mSv以下を確保） Additional exposure dose : <1mSv/y ・放射性セシウムは概ね8,000Bq/kgに相当 corresponding to 8,000Bq/kg of r-Cs	・一般公衆、作業者ともに追加被ばく線量が0.01mSvを超えない Additional exposure dose for public and worker : 0.01mSv/y ・放射性セシウムは100Bq/kgに相当 corresponding to 100Bq/kg of r-Cs
用途 Application use	土地改変（掘り起し）を伴わない構造基盤への利用 Structural basis without land reformation	あらゆる用途に利用可能 No limitation for use
事業主体 Project entity	公共利用に限る Public entity (National government)	特に限定なし No limitation
情報管理 Information management	長期的な管理が必要 Long –term management	特に必要なし No need
適用法規 Regulation	放射性物質対処特別措置法 Act on Special Measures concerning the Handling of Radioactive Pollution	原子炉等規制法 Nuclear Reactor Regulation Law

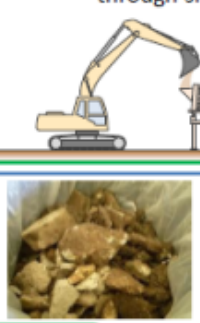
Demonstration project of contaminated soil recycling（汚染土の再生利用実証事業）

Demonstration project is currently being implemented in Minamisoma City, studying specifically on handling radiation during the procedure of recycling and ensure the quality of the recycled soil as construction material in order to promote safe recycling and reuse of the removed soil in a step by step manner.

1. Preliminary treatment / quality control process (April 2017-)

1. Open sandbags and remove large stones and debris
   Open large sandbags and remove large foreign materials
2. Further eliminate smaller debris
   Eliminate small foreign materials through sieves
3. Classify soil by concentration
   Measure radiation and classify soil
4. Control quality
   Control quality of soil to be used for embankment (such as water content and grain sizes)

vegetation



stones

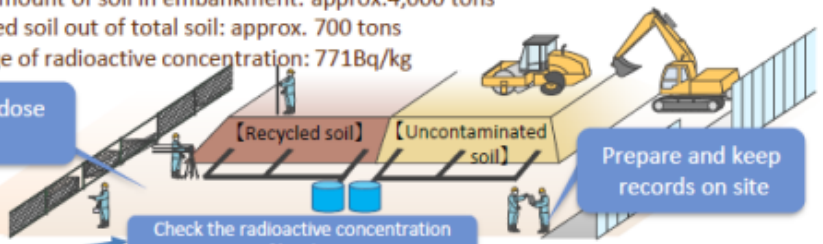
pebbles

2. Test embankment process (May 2017-)

5. Construct test embankment / Monitoring

- Construct a test embankment (covered with uncontaminated soil by 50cm)
- Continue to measure the air dose rate and other indicators

- Total amount of soil in embankment: approx.4,000 tons
- Recycled soil out of total soil: approx. 700 tons
- Average of radioactive concentration: 771Bq/kg



Air dose rate was not much changed before and after opening of sandbags of the removed soil

During period of May - Sep. Not detectable for all radioactive materials in leachate

【Result of council of advisers】
- ◆ Confirmed safety in this method for recycling demonstration
- ◆ To accumulate data continuously conducting demonstration project

Views of the demonstration project （1）

Views of the demonstration project （2）

Views of the demonstration project （3）

Views of the demonstration project （4）

Technological challenge in the future
将来の技術課題

Necessity for R&D on volume reduction technologies 県外最終処分に向けた減容化技術開発の必要性

除去土壌と焼却灰
Contaminated soil and incineration ash

減容化技術
Volume reduction and separation of r-Cs

低濃度生成物（多量）
Large amount of much lower r-Cs level material

有効利用
Utilization

高濃度生成物（少量）
Little amount of much higher r-Cs level material

最終処分
Final disposal

Main technologies

1. Wet sieving/washing treatment 分級・洗浄処理

・セシウムが粒度の小さな粘土に付着しやすいという特性を踏まえ、除去土壌をふるいにかけ、研磨や洗浄することで、小さな粘土分のみを分離する方法。焼却飛灰には洗浄技術が有効。

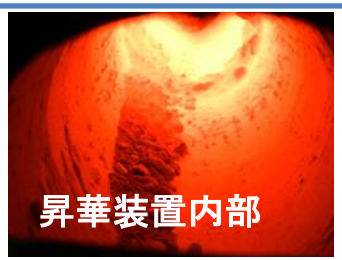

土壌分級装置

2. Chemical treatment 化学処理

・薬剤と熱で土壌の有機分を分解し、土壌表面に作用させることでセシウムを分離し、吸着材で回収する方法。

3. Thermal treatment (sintering, melting, etc.) 熱処理（昇華・溶融等）

・熱により、土壌からセシウムを揮発させて分離し、バグフィルタで吸着させ回収する方法。


昇華装置内部

※ Revised MOE's material

Environmental renovation in Fukushima and sustainability

福島の環境再生と持続可能性

Difficulty in social consensus for the contaminated soil utilization　汚染土再生利用における社会合意の困難性

除去土壌の再生利用に関するリスクガバナンス戦略
Risk governance strategy on the contaminated soil utilization

- 社会的な公正を保つ
  Social equity
- 手続き的公正を保つ
  Procedural equity
- 信頼を得られる事業スキーム
  Reliable project scheme
- 信頼感のある技術
  Reliable technology

社会的公正を保つ　Social equity

社会的影響のシェア

Sharing social impacts brought from the contaminated soil utilization

社会的影響と便益のバランス

Balancing the social impact and benefit of the soil utilization

再生利用していくことへの意義の社会合意

Social consensus for significance of the soil utilization

手続き的公正を保つ Procedural equity

合意形成手続きの合意

Consensus for consensus building procedure

中立公平な立場の第三者の関与による議論

Discussion under coordination of a neutral-positioned third party

プロセスの透明化

Transparency of the consensus procedure

信頼を得られる事業スキーム Reliable project scheme

事業主体は公共 Project by public entity

第三者を含む事業管理体制

Project management with supervising by the neutral third party

トレーサビリティ/モニタリングの必要性

Traceability and monitoring

情報の透明化

Information disclosure

長期継続的な情報管理

Long-term continuing information management

その他　etc.

信頼感のある技術　Reliable technology

権威化された環境品質基準の明確化

Authorized environmental quality standard

環境品質確保の技術的方法論

Technical methodology to ensure the environmental quality standard

技術実証事業の必要性

Demonstration project

その他　etc.

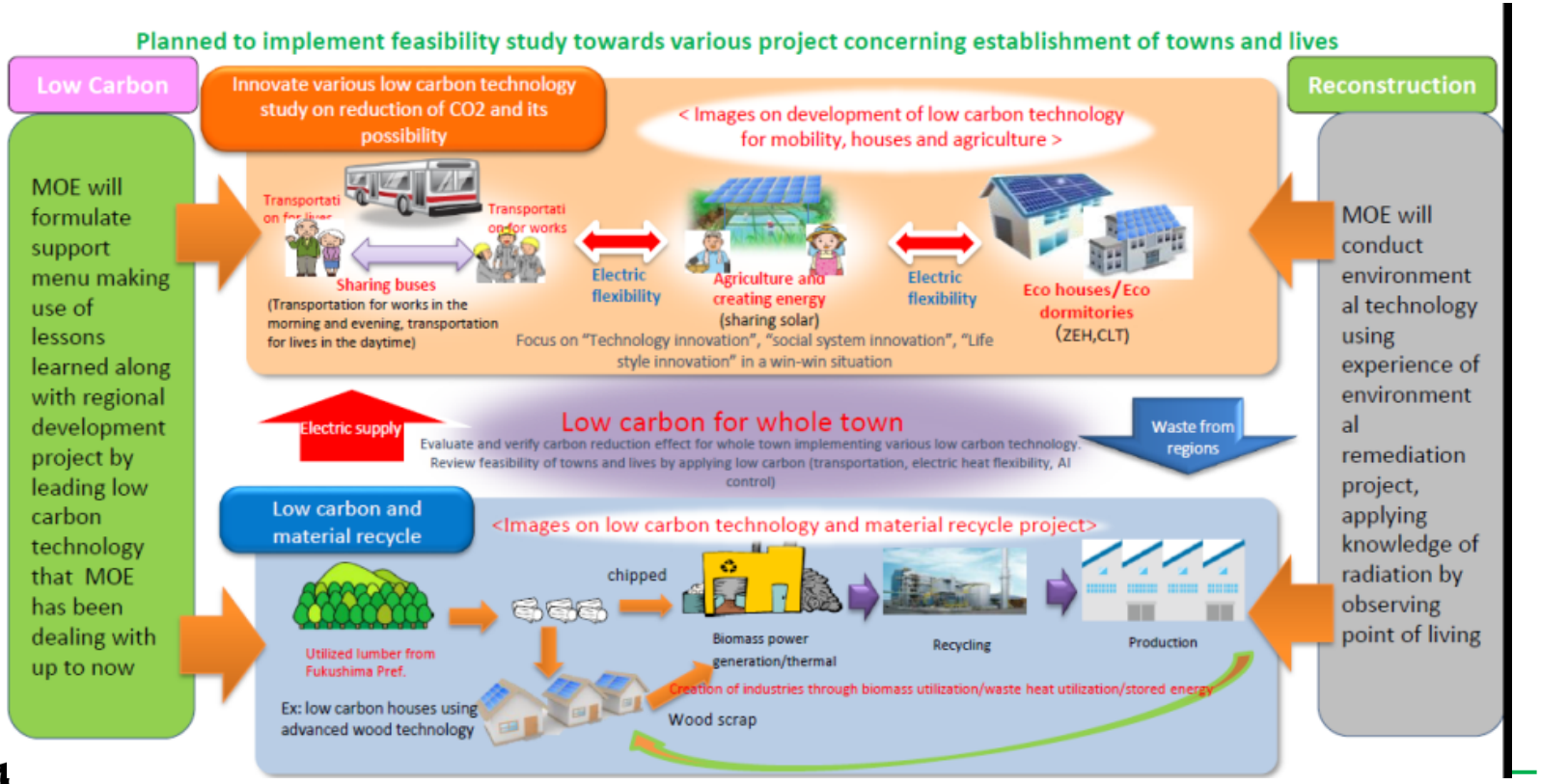
Environmental renovation in Fukushima and sustainability
福島の環境再生と持続可能性

Learning from Fukushima experiences
福島の経験からの学び

⇒

Socially matureness
社会の成熟

Forward-looking efforts on reconstruction for the new stage in Fukushima



Sustainability in environmental policy
環境政策における持続可能性

Integrative improvement of environment, economy and society
環境、経済、社会の統合的向上

http://www.unic.or.jp/files/sdg_logo_en_2.pdf

The Fifth Environmental Basic Plan newly established

第五次環境基本計画の概要

環境省
Ministry of the Environment

環境基本計画について

- 環境基本計画とは、環境基本法第15条に基づき、環境の保全に関する総合的かつ長期的な施策の大綱等を定めるもの。
- 計画は約６年ごとに見直し（第四次計画は平成24年4月に閣議決定）。
- 平成29年2月に環境大臣から計画見直しの諮問を受け、中央環境審議会における審議を経て、平成３０年４月９日に答申。
- 答申を踏まえ、平成３０年４月１７日に第五次環境基本計画を閣議決定。

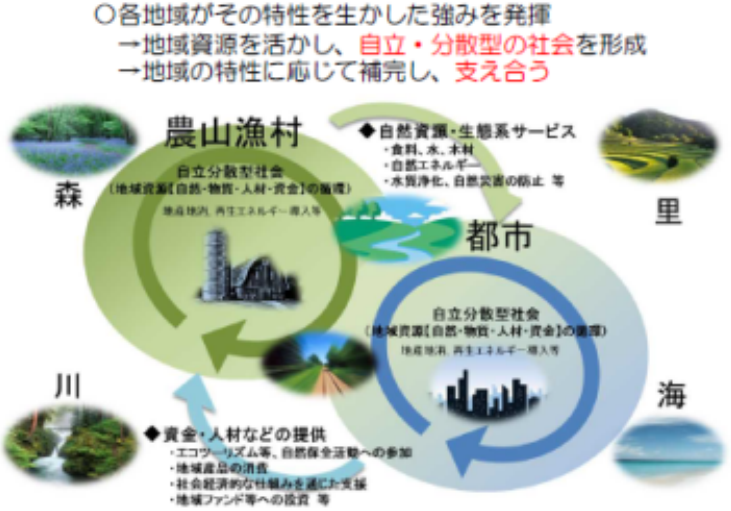
現状・課題認識

- 我が国が抱える環境・経済・社会の課題は相互に連関・複雑化
- ＳＤＧｓ、パリ協定等、時代の転換点ともいえる国際的潮流

持続可能な社会に向けた基本的方向性

- SDGｓの考え方も活用し、環境・経済・社会の統合的向上を具体化
  - ・環境政策による、経済社会システム、ライフスタイル、技術などあらゆる観点からのイノベーション創出や、経済・社会的課題の同時解決に取り組む
  - ・将来にわたって質の高い生活をもたらす「新たな成長」につなげていく
- 地域資源を持続可能な形で活用
  - ・各地域が自立・分散型の社会を形成し、地域資源等を補完し支え合う「地域循環共生圏」の創造を目指す
- 幅広い関係者とのパートナーシップを充実・強化

これらを通じて、持続可能な循環共生型の社会（「環境・生命文明社会」）を目指す



施策の展開

- 分野横断的な６つの「重点戦略」（経済、国土、地域、暮らし、技術、国際）を設定
- 環境リスク管理等の環境保全の取組は、「重点戦略を支える環境政策」として揺るぎなく着実に推進

Thank you for your attention !

Masahiro OSAKO

Director of CMW
NIES, JAPAN