Chapter 3 :Framework and Methods of Decontamination Projects

3.1. Framework of Decontamination Projects

3.1.1. The Act on Special Measures and Emergency Response Implementation Policies

(1) Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials

As the pollution of the environment caused by radioactive substances released by nuclear power station accidents caused by the Great East Japan Earthquake occurred and it was an urgent task to quickly reduce the impact on human health and living environment, the "Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials Discharged by TEPCO Nuclear Power Station Accidents Associated with the Tohoku District – Off the Pacific Ocean Earthquake That Occurred on March 11, 2011" (Act No. 110, August 30, 2011) was promulgated and fully entered into force on January 1, 2012.

Under this Act, the framework of measures such as the responsibilities of the national government, local governments, related nuclear power companies, disposal of waste contaminated with radioactive materials, and decontamination of soil contaminated with radioactive materials, etc. were established, and the Minister of the Environment was empowered to formulate basic policies and set standards.

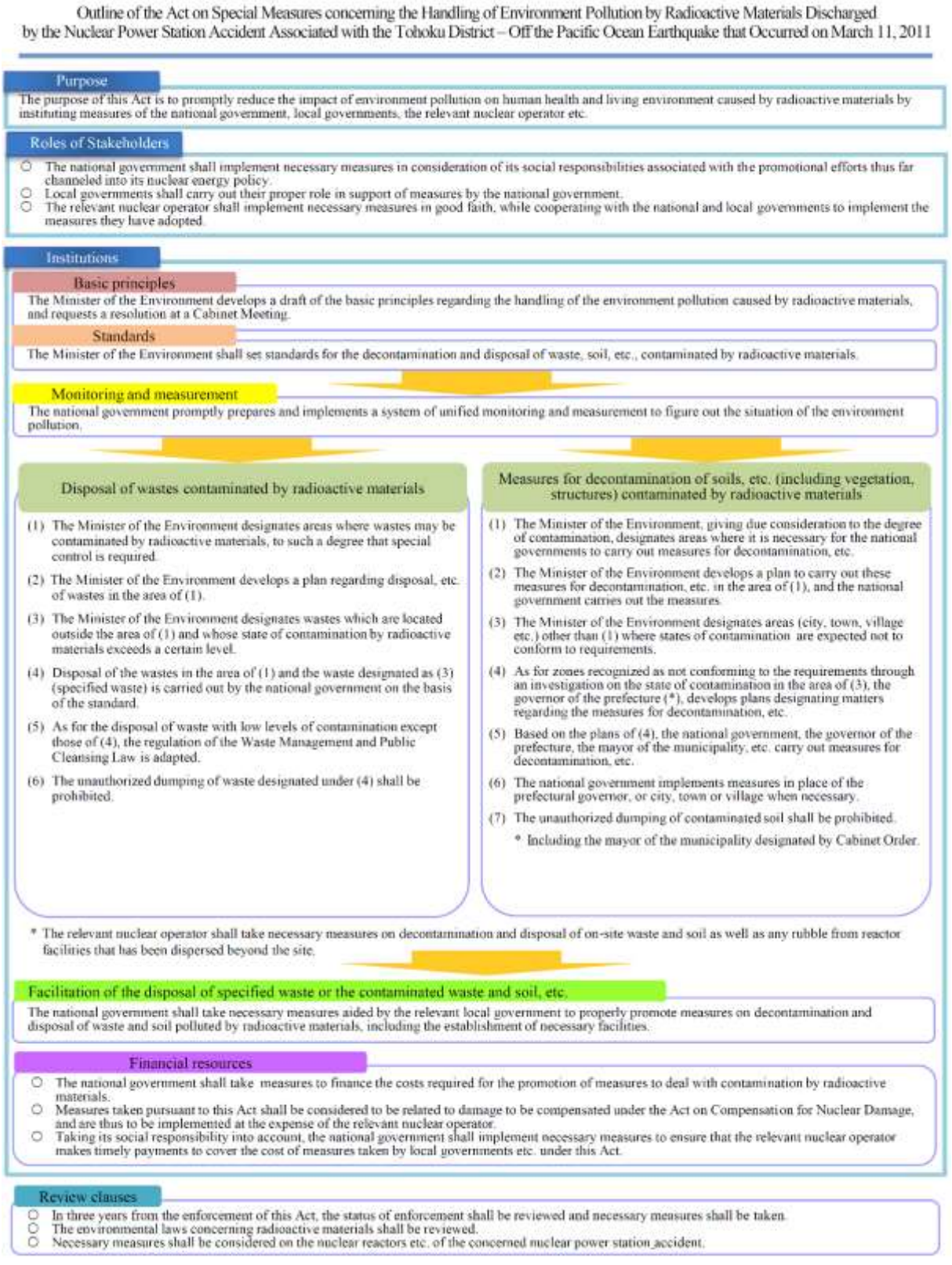


Figure 3-1 Outline of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials

Commentary	Development of a new legislative framework to deal with contamination by radioactive materials

In Japan, since approaches had not been established for protective measures in cases where radioactive substances associated with a nuclear power disaster exist (or remain) in the environment for a long period of time, it was necessary to have a new legislative framework to deal with waste and soil contaminated by radioactive materials.

For the Ministry of the Environment, it was imperative to process the disaster waste generated by the Great East Japan Earthquake as an immediate task. At that time, there was an exemption provision on radioactive substances in the environmental law system at the time, but since the disaster waste was likely to be contaminated with radioactive material, a "Disaster Waste Safety Assessment Committee" was held in order to consider how to handle it. Next, the "Investigative Committee on Remediation" was held to discuss basic policies and other matters based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials.

From September to December 2011, the Investigative Committee on Remediation was held four times to designate Special Decontamination Areas (SDA) and Intensive Contamination Survey Areas (ICSA), areas to define decontamination implementation plan, efficient decontamination methods, regulations concerning collection, transportation and storage of removed soil, and matters and basic policies stipulated in the Enforcement Rules for the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials. It also set up a working group consisting of experts, local governments, contractors, etc., to examine the guidelines specifically explaining measures for decontamination, etc. of soil, etc., under the Investigative Committee on Remediation, and the first edition was released in December 2011.

Through these steps, in January 2012 the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials was fully enacted, policies were established to deal with contamination by radioactive substances released in the environment (a framework describing who was to do what), and for the first time, measures against radioactive substances were addressed in the environmental administration.

Commentary	Radioactive substances and the Basic Environment Law

The Basic Environment Law (Act No. 91 of 1993) sets out basic policies concerning the preservation of the environment, and it stipulated that measures to prevent environmental pollution by radioactive materials were to be covered under the Atomic Energy Basic Act (Act No. 186 of 1955). However, the Basic Environment Law was revised according to the Act for Establishment of the Nuclear Regulation Authority (Act No. 47 of 2012) and the provision stipulating that it would be left to the Atomic Energy Basic Act, etc. was deleted.

As a result, exclusionary provisions on radioactive materials were deleted from the Air Pollution Control Act and the Water Pollution Control Law (Act No. 138 of 1970), and the Environmental Impact Assessment Law (Act No. 81 of 1997), and the Minister of the Environment was given various roles including monitoring.

The Central Environment Council submitted a special recommendation from the council chair, with recommendations including that MOE to take initiative in responding to environmental pollution caused by radioactive materials scattered in the environment in April 2011, and in November 2011, comments were submitted on the development of environmental legislation related to provisions on the exemption of radioactive materials.

Commentary	Decontamination by municipalities

According to the conventional concept of disaster response, municipalities were supposed to take disaster measures as their responsibilities (municipal affairs) under the Disaster Countermeasures Basic Act .

Also, as municipalities are familiar with local circumstances, discussion was carried out in principle by municipalities implementing decontamination.

However , it was decided that in regions in which it was difficult to sufficiently fulfill administrative functions owing to evacuation orders, the national government would implement the decontamination.

In the "Basic Policy for Emergency Response on Decontamination Work" (Nuclear Emergency Response Headquarters, August 26, 2011), it was decided that "the planned decontamination in the community unit is most effective since administrative functions are in the area, residents are living there, and it is easy grasping circumstances and residents' needs."

(2) Basic Policy for Emergency Response on Decontamination Work

The Nuclear Emergency Response Headquarters adopted the "Basic Policy for Emergency Response on Decontamination Work" on August 26, 2011, and indicated the policy of decontamination until the enactment of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials.

The Basic Policy, in areas under evacuation orders, indicates that the national government carries out decontamination, as long-term goal, in the area of 20 mSv or less per year, the aim for additional radiation dose is 1 mSv or less per year, and the national government provides technical and financial support for the creation and implementation of municipal decontamination plans..

<Provisional Target for decontamination implementation>

① Based on Basic Recommendations from the International Commission on Radiological Protection (ICRP) in 2007 and the "Basic Approach" of the Nuclear Safety Commission, the aim is to step-by-step and quickly reduce the size of areas in an emergency exposure situation (additional annual radiation dose of over 20 mSv/y).

② As a long-term goal, the aim is to bring the additional annual radiation dose to less than 1 mSv/y in existing exposure situations (less than 20 mSv/y).

③ The aim is to realize a state in which estimated annual radiation dose of the general public is reduced by about 50% within two years in areas contaminated with radioactive materials. (Due to natural decay of radioactive materials and natural factors such as wind and rain, the estimated annual radiation dose at the end of two years will be reduced by about 40% compared to the present time. The aim is to realize the above by reducing contamination by decontamination by at least about 10%, and promote further reductions).

④ By thoroughly decontaminating the living environment of children, such as schools and parks over the next two years, the aim is to realize a situation in which estimated annual radiation dose of children is reduced by about 60% within two years. (Due to natural decay of radioactive materials and natural factors such as wind and rain, the estimated annual radiation dose at the end of two years will be reduced by about 40% compared to the present time. The aim is to realize the above 60% by reducing contamination by decontamination by at least about 20%, and promote further reductions.)

⑤ The above goals will be repeatedly revised through regular reviews such as detailed monitoring and data accumulation, investigation of children's actual radiation doses, decontamination model projects, etc., and regularly review the targets.

<Treatment of soil, etc., arising from decontamination>

① Regarding the treatment of soil, etc., it is the responsibility of the national government to secure landfill sites that require long-term management and to ensure their safety, and to promptly make and publish a road map for their construction.

② It is realistic to have Temporary Storage Sites in each municipality or community for the soil, etc., currently arising from decontamination, and the national government will make every effort on financial and technical aspects to support efforts by municipalities.

(3) Basic Policy on the Act on Special Measures

On November 11, 2011, the Cabinet decided on the Basic Policy based on the Act on Special Measures on Handling of Environment Pollution by Radioactive Materials, and it summarized approaches concerning monitoring and measuring the situation of pollution of the environment, treatment of waste contaminated by radioactive materials from the accident, and measures for decontamination, etc., of soil, etc. In addition, adopting the approach in the "Basic Policy for Emergency Response on Decontamination Work," it also specified that for areas where the additional annual radiation dose is less than 20 mSv/y, the additional radiation dose should be 1 mSv/y or less as a long-term goal. In addition, it was decided that MOE would decontaminate Special Decontamination Areas.

Therefore it was decided to promote measures including the removal of contamination by radioactive materials in order to quickly reduce the impacts of environmental pollution on human health or living environment by radioactive materials from the accident.

According to the Basic Policy, the following goals were set and it was decided that reviews should be carried out as necessary based on the effects of measures for decontamination of the soil, etc.

① Areas where the additional annual radiation dose is 20 mSv/y or more.
- Reduce the size of area step by step and as quickly as possible.
- Keep in mind that long-term efforts are necessary for areas with particularly high doses.

② Areas where the additional annual radiation dose is less than 20 mSv/y
- Reduce the additional radiation dose to 1 mSv/y or lower over the long-term.
- Reduce the additional annual radiation dose the public is exposed to by around 50% (including the physical decay of radioactive materials) by the end of August 2013 from the level at the end of August 2011.
- Reduce the additional annual radiation dose affecting children by around 60% (including the physical decay of radioactive materials) by the end of August 2013 from the level at the end of August 2011.

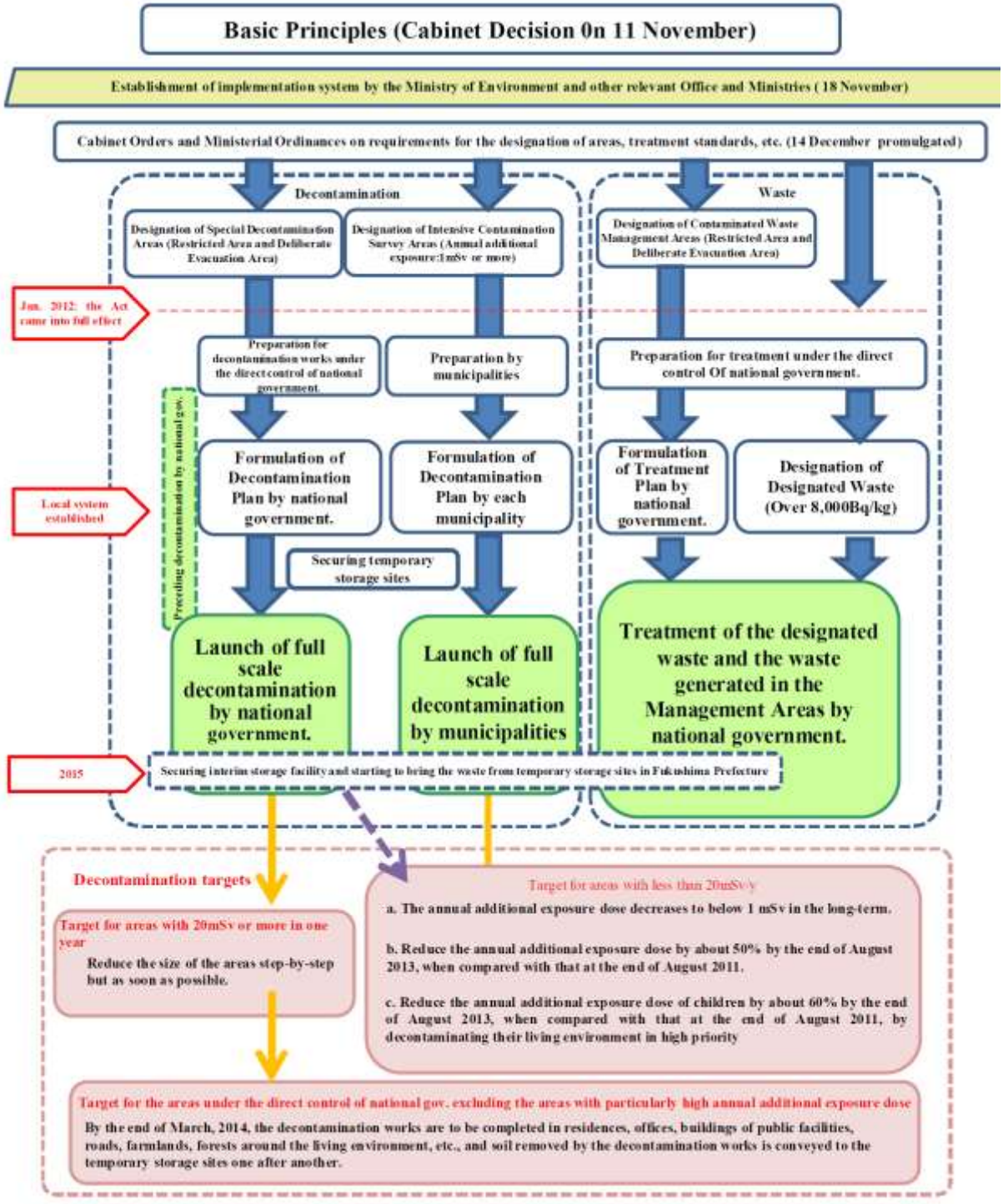


Figure 3-2 Efforts based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials

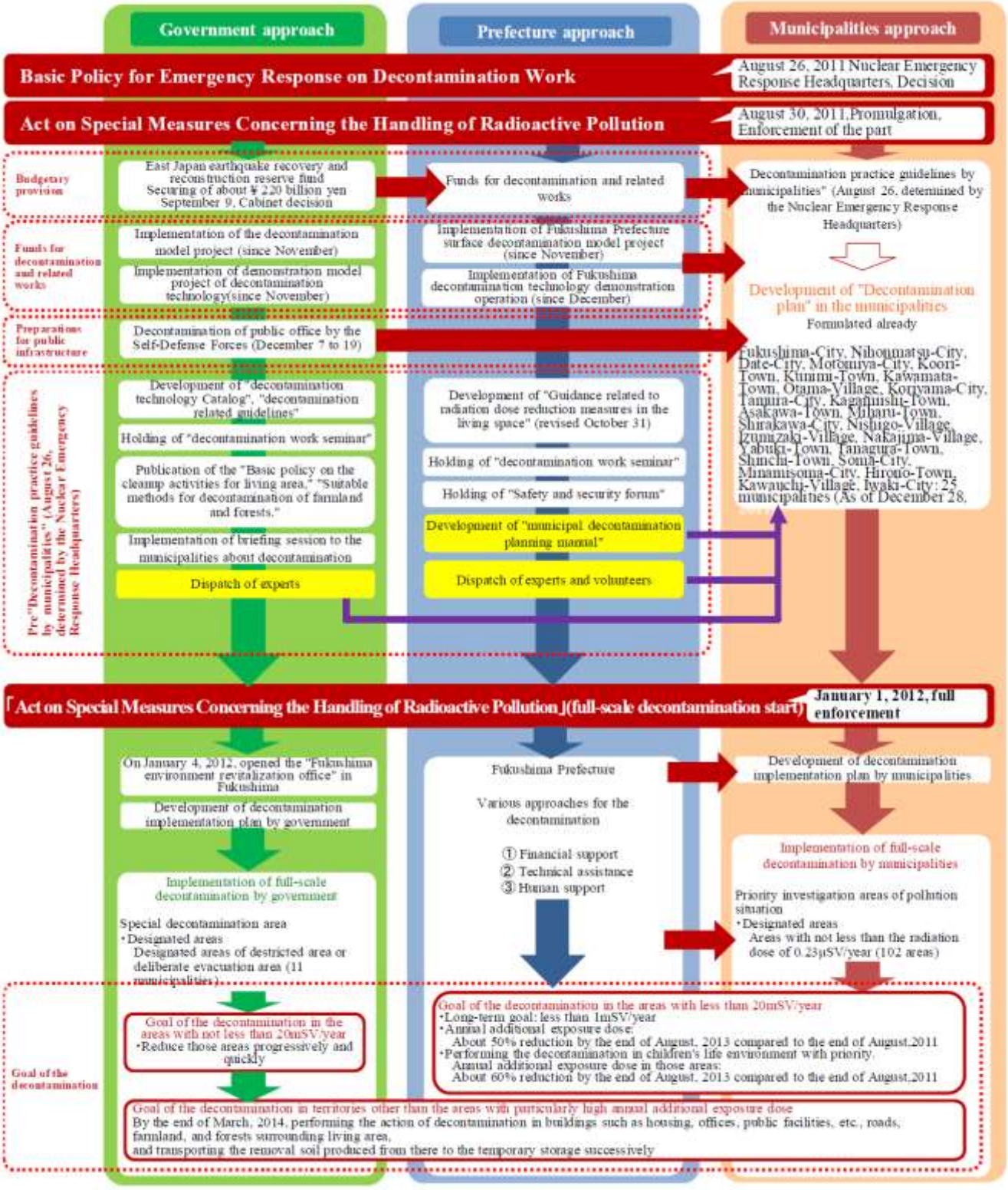


Figure 3-3 Efforts of national, prefectural, and municipal governments concerning decontamination

(4) Special Decontamination Areas (SDA) and Intensive Contamination Survey Areas (ICSA)

The Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials defines Special Decontamination Areas (SDA) and Intensive Contamination Survey Areas (ICSA). A Ministerial Ordinance to Specify Criteria for Area Designations was promulgated on December 14, 2011. Based on this ministerial ordinance, on December 28, 2011 and February 28, 2012, 11 municipalities were designated as SDA (population approx. 80,000 people before evacuation, area approx. 1,150 km^2), and 104 municipalities in 8 prefectures were designated as ICSA (population approx. 6.9 million people, area approx. 24,000 km^2) (of which 4 municipalities overlap with SDA).

1) Special Decontamination Areas (SDA)

Special Decontamination Areas were designated where the whole area or most of the area is or was a Restricted Area or Deliberate Evacuation Area, and it was decided that MOE would establish decontamination implementation plans and implement decontamination.

Specifically, this applied to Naraha Town, Tomioka Town, Okuma Town, Futaba Town, Namie Town, Katsurao Village and Iitate Village, as well as Tamura City, Minamisoma City, Kawamata Town, and Kawauchi Village, which had been Restricted Areas or Deliberate Evacuation Areas, while most of the area of Naraha Town had been designated as a Restricted Area, so the whole area was designated as a Special Decontamination Area.

Regarding how to decontaminate in Special Decontamination Areas, MOE formulated a policy for decontamination (Decontamination Roadmap) as described below.

2) Intensive Contamination Survey Areas (ICSA)

The Minister of the Environment has focused on areas where environmental contamination caused by radioactive materials from the accident does not conform to the requirements specified by MOE (radiation dose less than 0.23 μSv/h) or where there is a risk of environmental contamination Survey Designate as an area that needs to be measured. In municipalities designated as Intensive Contamination Survey Areas (ICSA), decontamination is to be carried out after establishing decontamination implementation plan, for decontamination implementation areas that meet certain criteria based on survey results.

Under the Basic Policy of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials (adopted by Cabinet decision on November 11, 2011) those areas and districts are specified as areas (or districts) where the additional radiation dose of the area (or district) is 1 mSv/y or more. Under an ordinance of the Minister of the Environment established on December 14, 2011 based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, where it is difficult to ascertain the additional radiation dose quickly and in detail and to reduce additional exposure as promptly as possible by decontamination. And from the viewpoint of reduction by additional radiation dose, 0.23 μSv/h, which is the value obtained by replacing the annual 1 mSv/y with the air dose rate using an estimation formula making assumptions on the safe side, was used as the criterion for judging the areas (or districts).

As Intensive Contamination Survey Areas (ICSA), 102 municipalities were designated in December

2011, and then two towns were designated in February 2012. Of the 104 designated municipalities, the designation was lifted for 12 municipalities by the end of December 2017.

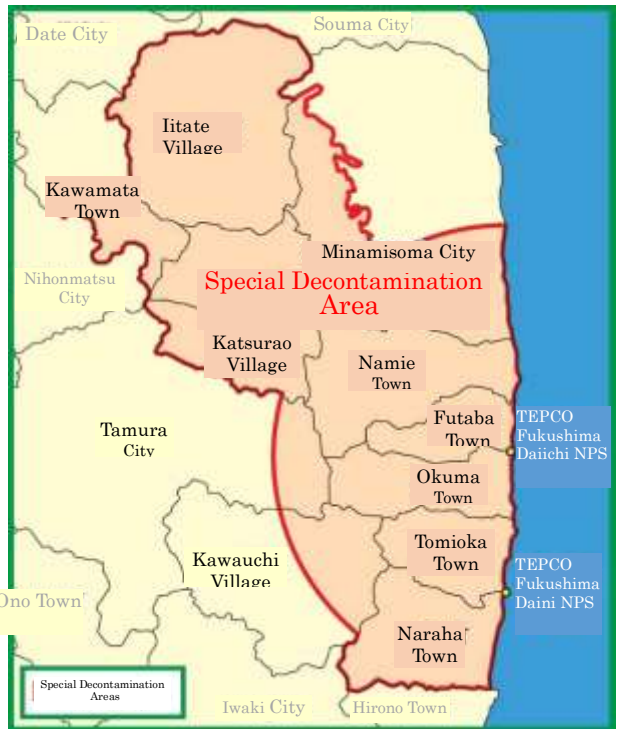


Figure 3-4 Special Decontamination Areas (SDA)

Figure 3-5 Intensive Contamination Survey Areas (ICSA) (at peak)

Table 3-1 Designation status of Intensive Contamination Survey Areas (ICSA)

(as of the end of December, 2017)

Prefecture	Intensive Contamination Survey Areas	Designation lifted
Fukushima Pref. (41)	Fukushima City, Koriyama City, Iwaki City, Shirakawa City, Sukagawa City, Soma City, Nihonmatsu City, Date City, Motomiya City, Koori Town, Kunimi Town, Otama Village, Kagamiishi Town , Tenei Village, Aizubange Town, Yugawa Village, Aizumisato Town, Nishigo Village, Izumizaki Village, Nakajima Village, Yabuki Town, Tanagura Town, Samegawa Village, Ishikawa Town, Tamagawa Village, Hirata Village, Asakawa Town, Furudono Town, Miharu Town, Ono Town, Hirono Town, Shinchi Town, Tamura City, Minamisoma City, Kawamata Town, Kawauchi Village (36)	Mishima Town, Showa Village, Yanaizu Town, Yamatsuri Town, Hanawa Town (5)
Iwate Pref.(3)	Ichinoseki City, Oshu City, Hiraizumi Town (3)	
Miyagi Pref. (9)	Shiroishi City, Kakuda City, Kurihara City, Shichikashuku Town, Ogawara Town, Marumori Town, Watari Town, Yamamoto Town (8)	Ishinomaki City (1)
Ibaraki Pref. (20)	Hitachi City, Tsuchiura City, Ryugasaki City, Joso City, Hitachiota City, Takahagi City, Kitaibaraki City, Toride City, Ushiku City, Tsukuba City, Hitachinaka City, Kashima City, Moriya City, Inashiki City, Tsukubamirai City, Tokai Village, Miho Village, Ami Town, Tone Town (19)	Hokota City (1)

Prefecture	Intensive Contamination Survey Areas	Designation lifted
Tochigi Pref.(8)	Kanuma City, Nikko City, Otawara City, Yaita City, Nasushiobara City, Shioya Town, Nasu Town (7)	Sano City (1)
Gunma Pref. (12)	Kiryu City, Numata City, Shibukawa City, Midori City, Shimonita Town, Takayama Village, Higashiagatsuma Town, Kawaba Village (8)	Katashina village,Minakami Town, Annaka City、Nakanojo Town (4)
Saitama Pref. (2)	Misato City, Yoshikawa City (2)	
Chiba Pref. (9)	Matsudo City, Noda City, Sakura City, Kashiwa City, Nagareyama City, Abiko City, Kamagaya City, Inzai City, Shiroi City (9)	

Note: Numbers in () are the number of municipalities

Table 3-2 Numbers of Intensive Contamination Survey Areas (ICSA)

	Date of designation or cancellation	Name of municipality (prefecture)	Remaining designated municipalities
Designated	December 28, 2011	Designated 102 Municipalities simultaneously	102
Designated	February 28, 2012	Watari Town (Miyagi Pref.), Yanaizu Town (Fukushima Pref.)	104
Lifted	December 27, 2012	Showa Village (Fukushima Pref.), Katashina Village, Minakami Town (Gunma Pref.)	101
Lifted	June 25, 2013	Ishinomaki City (Miyagi Pref.)	100
Lifted	November 17, 2014	Mishima Town (Fukushima Pref.)	99
Lifted	March 14, 2016	Hokota City (Ibaraki Pref.)	98
Lifted	March 31, 2016	Sano City (Tochigi Pref.)	97
Lifted	September 8, 2016	Yamatsuri Town (Fukushima Pref.)	96
Lifted	November 29, 2016	Yanaizu Town, Hanawa Town (Fukushima Pref.)	94
Lifted	March 22, 2017	Annaka City, Nakanojo Town (Gunma Pref.)	92

3.1.2. Relevant Guidelines etc.

(1) Decontamination Roadmap

After the promulgation of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, basic policies and ministerial ordinances were prepared, and Special Decontamination Areas were designated for the national government to implement measures for decontamination, etc.

Based on that, most areas that at the time corresponded to Restricted Areas or Deliberate Evacuation Areas were designated as the Special Decontamination Areas, and after listening to opinions of the municipal mayors concerned, etc., it was decided that the Minister of the Environment would formulate

“Decontamination Implementation Plans in Special Areas” concerning implementation of measures for decontamination, etc., and based on these plans, MOE would proceed with decontamination while obtaining cooperation, including human resources, from the relevant ministries and agencies.

On January 26, 2012, MOE publicly released the “Policy for Decontamination in Special Decontamination Areas” (Decontamination Roadmap), which specified the series of steps consisting of decontamination model projects, preliminary decontamination, and whole area decontamination and processes, etc., for each of the areas as the policy for decontamination in Special Decontamination Areas. Furthermore, it deemed that the goal of lifting the evacuation orders would be the return of the residents and the rebuilding of their lives, so the development of life infrastructure and the restoration of municipal office functions, etc. were to be advanced together.

In the Special Decontamination Areas, the basic idea is that the Cabinet Office and MOE will carry out preliminary decontamination for municipal offices and infrastructure, and then proceed to whole area decontamination. For whole area decontamination, access is required for decontamination sites, as it is necessary to proceed with the consent of people concerned with the land, as shown in the figure.

Also, as decontamination generates a large amount of removed soil, it is necessary to secure Temporary Storage Sites.

In the Special Decontamination Areas, areas are classified based on radiation dose and the difficulty of decontamination varies accordingly, so it was decided to start decontamination with areas that had a low dose, and with the exception of Areas where Returning is Difficult, to aim for wide area decontamination and to transport materials to the Temporary Storage Sites by the end of March 2014.

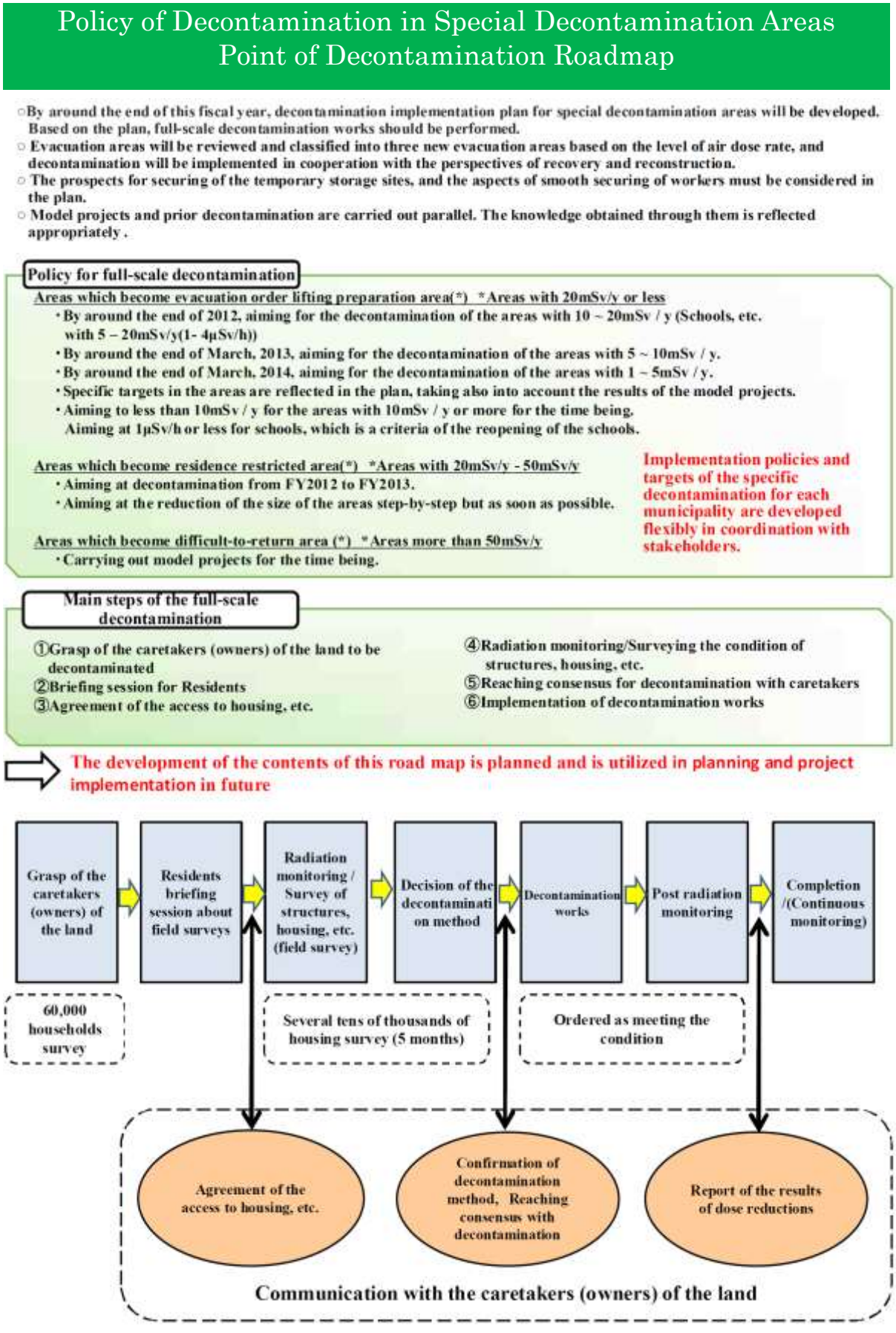


Figure 3-6 Outline of Decontamination Roadmap (January 2012)

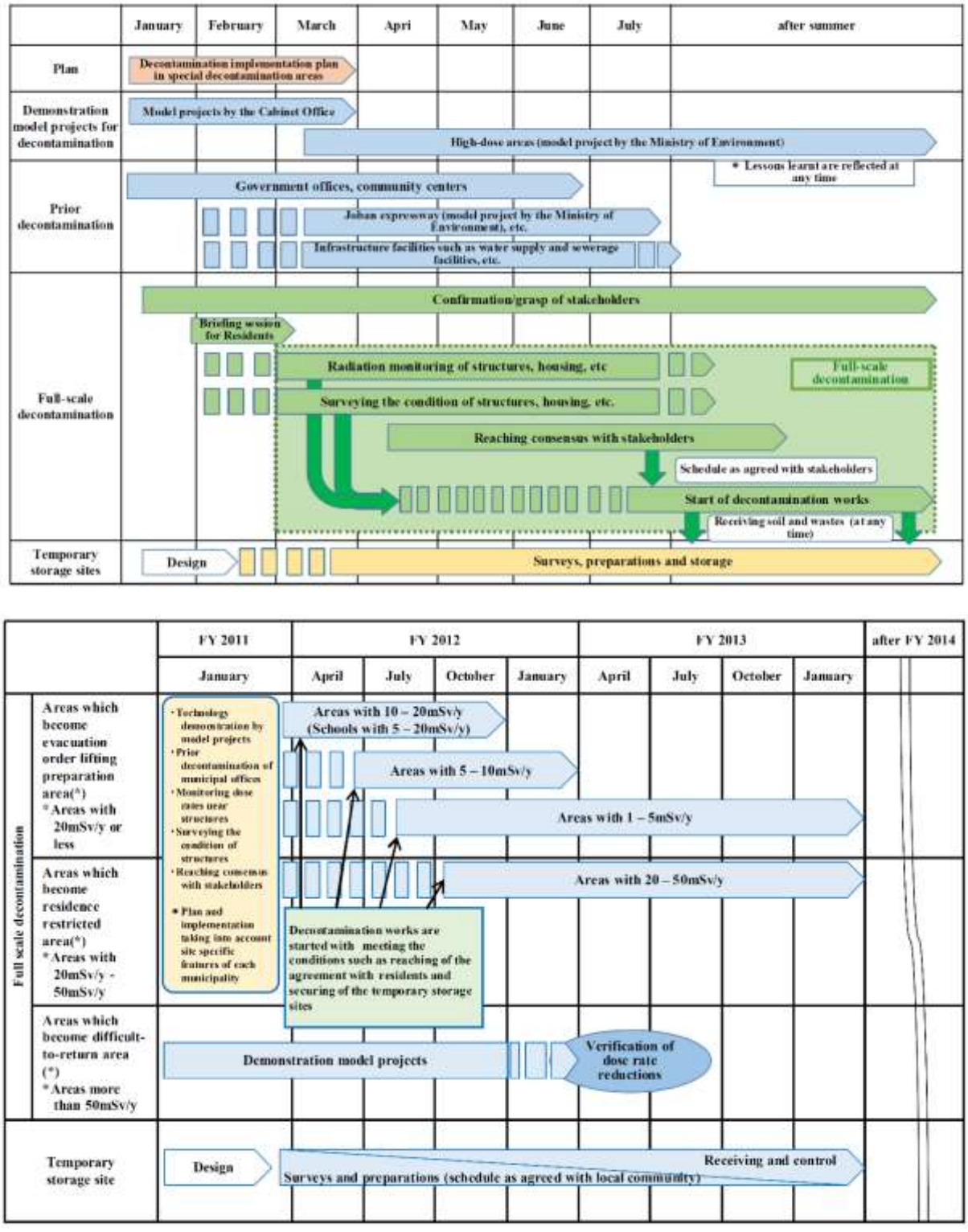


Figure 3-7 Process chart of the Decontamination Roadmap (January 2012)

(2) Concepts on Soil and Waste Treatment Accompanying Decontamination

The soil and waste (hereinafter referred to as "removed soil, etc.") removed by the decontamination work of radioactive materials released following the TEPCO Fukushima Daiichi Nuclear Power Station incident must be stored properly until final disposal.

According to the "Basic Policy for Emergency Response on Decontamination Work" (August 26, 2011 Nuclear Emergency Response Headquarters) regarding the disposal of waste and soil contaminated with radioactive materials, the national government is responsible for securing landfill sites that require long-term management and for ensuring their safety. Meanwhile, it takes time to secure and prepare landfill sites that require long-term management, so in order to promote decontamination quickly, the policy states that for the time being it is practical to have the removed soil stored at Temporary Storage Sites in each municipality or community.

In response to this, on October 29, 2011 MOE released a statement on "About basic concepts of Interim Storage Facility, etc., necessary for coping with environmental pollution caused by the TEPCO Fukushima Daiichi Nuclear Power Station accident." Within Fukushima Prefecture, it was decided that removed soils, etc., associated with decontamination would be temporarily stored in onsite storage and Temporary Storage Sites, and thereafter all would be stored in Interim Storage Facility. For other prefectures, it was expected that the amount of removed soil would be relatively small, and the degree of contamination relatively low, it was decided to proceed with the use of existing controlled-type landfill sites, etc., and not to think about Interim Storage Facility.

(3) Decontamination Implementation Plans

1) Preparation of decontamination implementation plans for Special Decontamination Areas

Based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, MOE formulated a decontamination implementation plan for each municipality and set out basic policies and targets concerning the implementation of decontamination and basic matters concerning measures necessary for achieving the goals. The MOE conducted decontamination according to these plans.

The situation and circumstances in each municipality differed, though there were various ideas about decontamination and timing, but it was decided to proceed with decontamination starting with the plans that could be formulated for each municipality.

The Minister of the Environment was to formulate the decontamination implementation plans, listening to the opinions of the heads of the municipalities concerned and the governor of the prefecture. The plans were formulated after meetings with the concerned municipalities and explanations and opinion exchanges with residents, regarding the radiation and pollution situation, decontamination methods and effects, etc.

Table 3-3 Formulation of decontamination implementation plans

Municipality	Timing of formulation of decontamination implementation plan
Tamura City	Formulated April 13, 2012
Naraha Town	Formulated April 13, 2012, revised in October, 2012
Kawauchi Village	Formulated April 13, 2012
Iitate Village	Formulated as of May 24, 2012, partly revised on December 26, 2013
Minamisoma City	Formulated on April 18, 2012, partly revised on December 26, 2013
Katsurao Village	Formulated on September 28, 2012, partly revised on December 26, 2013
Kawamata Town	Formulated on August 10, 2012, partly revised on December 26, 2013
Namie Town	Formulated November 21, 2012, partly revised December 26, 2013
Okuma Town	Formulated December 28, 2012
Tomioka Town	Formulated as of June 26, 2013, partly revised on December 26, 2013
Futaba Town	Established July 15, 2014

Table 3-4 Examples of contents of Decontamination Implementation Plans in Special Decontamination Areas

1. Policy concerning implementation of measures for decontamination, etc.
2. Goal of Decontamination Implementation Plans in Special Areas
3. Basic matters concerning measures necessary for achieving the goal of Decontamination Implementation Plans in Special Areas

(1) Target and schedule of measures for decontamination, etc.
(2) Methods concerning measures for decontamination, etc.
(3) Process relating to measures for decontamination, etc.
① Identifying persons concerned with buildings, land, etc.
② Obtaining permission for entering land etc.
③ Measurement of radiation doses, etc., investigation of condition of buildings, land etc.
④ Determination of methods concerning measures for decontamination, etc.
⑤ Explanation of methods concerning measures for decontamination, etc.; securing consent for measures for decontamination, etc.
⑥ Conducting work on measures for decontamination, etc.
⑦ Measurement of post-work dose
⑧ Reporting of results etc.

4. Other necessary matters concerning implementation of measures for decontamination, etc., concerning Special Decontamination Areas

(1) Measures for decontamination, etc., of wide-area infrastructure
(2) Promotion of risk communication
(3) Measures of radiation protection for the workers
(4) Review of Decontamination Implementation Plans in Special Areas

2) Decontamination implementation plans in Intensive Contamination Survey Areas (ICSA)

In municipalities designated as Intensive Contamination Survey Areas (ICSA), each municipality investigates the pollution situation of the environment with radioactive materials and judges the necessity of decontamination implementation. In conducting decontamination, the municipal mayor, based on the results of the survey, formulates the decontamination implementation plan, specifying the area where decontamination is to be carried out, the implementation method, the implementing body, the priority of decontamination, and the execution timing, etc. In addition, where decontamination is carried out by the national government, a or prefecture, independent administrative agency, national university corporation, etc., as the administrator of a facility, etc., it is necessary to cover the decontamination of that facility within the decontamination implementation plan of the municipality where the facility, etc., is located. Consultation with the Minister of the Environment is necessary for formulation of the plan, and MOE is to confirm the appropriateness of the plan content.

As a result of radiation dose measurement, the radiation dose in an area can in some cases fall due to natural decay, etc., below 0.23 μSv/h, which is the designation criteria for Intensive Contamination Survey Areas (ICSA), and so decontamination implementation plans are not formulated for them, but among the 104 municipalities designated as Intensive Contamination Survey Areas (ICSA), decontamination implementation plans were formulated and decontamination was implemented in 93 municipalities based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials.

3.2. Decontamination Implementation Systems

3.2.1. National Systems

(1) Overall Government System

In order to promote emergency measures for the TEPCO Fukushima Daiichi Nuclear Power Station accident, in accordance with the Special Measures Law for Nuclear Emergency Preparedness Measures, on March 11, 2011, immediately after the accident, the "Nuclear Emergency Response Headquarters for the 2011 TEPCO Fukushima Daiichi and Daini Nuclear Power Station Accident" was established at the Prime Minister's official residence.

In addition, the Cabinet Office established "nuclear disaster victim life support team" under the Nuclear Emergency Response Headquarters (NERHQ) on March 29, 2011.

On August 24, 2011, in order to promote decontamination in Fukushima Prefecture, the Fukushima Decontamination Promotion Team was established consisting of government officials (10 members from the Cabinet Office, 6 members from MOE, and 22 experts of the Japan Atomic Energy Agency) in Fukushima City, and it worked in cooperation with the Nuclear Emergency Response Headquarters to support communication and coordination with municipalities, support the formulation of decontamination implementation plans (by dispatching experts, etc.), and promoting activities of the national government including model decontamination projects.

In addition, the "Basic Act on Reconstruction in Response to the Great East Japan" (Act No. 76 of 2011) was promulgated on June 24, 2011, with the aim of promoting smooth and prompt reconstruction from the "Basic Act on Reconstruction in Response to the Great East Japan Earthquake" and revitalizing Japan, and based on this basic philosophy, the "Act on Special Measures for the Reconstruction and Revitalization of Fukushima" (Act No. 25 of 2012) was promulgated on March 31, 2012 to promote the reconstruction and recovery of Fukushima from the nuclear disaster. In accordance with the East Japan Great Earthquake Disaster Recovery Basic Act, the "Reconstruction Agency Establishment Act" (Act No. 125 of 2011) was passed on December 9, 2011, and the Reconstruction Agency was established on February 10, 2012.

In order to strengthen the implementation functions on the ground in terms of measures related to the reconstruction of Fukushima from the nuclear disaster, and quickly make judgments at the site of the affected areas, "Fukushima Reconstruction and Revitalization Administration" was established in Fukushima City on February 1, 2013 as an organization to oversee the Fukushima Reconstruction Bureau of the Reconstruction Agency, the Fukushima Decontamination Promotion Team, MOE, the Fukushima Environmental Revitalization Office, and the Nuclear Emergency Response Local Headquarters.

In addition, the Fukushima Decontamination Promotion Team was reorganized in April 2013 to become the Fukushima Environmental Revitalization Headquarters, and the Fukushima Office for Environmental Restoration became the Fukushima Regional Environmental Office in April 2017.

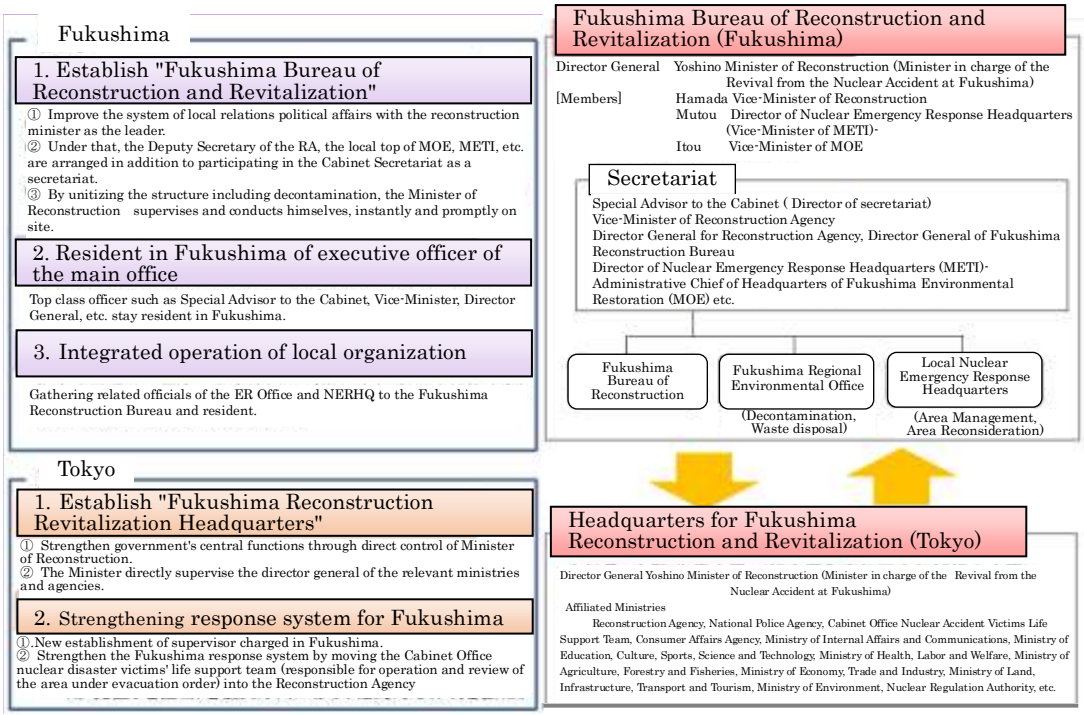


Figure 3-8 Organization of the Fukushima Reconstruction and Restoration Administration

(as of February 2018)

(2) The Ministry of the Environment

After the Great East Japan Earthquake, MOE responded immediately after the accident, including attending the government's emergency disaster headquarters and dispatching staff of MOE to the emergency response local headquarters in Fukushima Prefecture. However, from the environmental legislation at the time, matters concerning pollution of the environment with radioactive substances are excluded from the Basic Environment Law (Act No. 91 of 1993), so concerning radioactive substances, MOE only conducted surveillance of environmental radiation, etc., on remote islands. Therefore, at the time of the accident, there was no one in MOE within the concept of "decontamination to eliminate environmental pollution by radioactive substances," and few people with specialized knowledge.

In that context, as an immediate problem, it was necessary to promptly process the disaster waste generated from the Great East Japan Earthquake, so from April 2011, MOE's Waste and Recycling Department (at the time) considered how to deal with disaster waste that was contaminated by radioactive material. Furthermore, regarding the measures for soil contaminated with radioactive material, from around the same time, discussions began mainly by personnel in the Soil Environment Management Division, Environmental Management Bureau (MOE), which has expertise in dealing with soil contamination caused by hazardous waste. Since the contents of consideration varied widely, a team was launched on June 1, within Environmental Management Bureau to discuss decontamination. At the time of launch, it was composed of 15 members including a chief of operations, and it was later officially recognized as the "Action Team for the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials."

Thereafter as well, based on the existing organization within the ministry, such as the Waste Management and Recycling Department and Environmental Management Bureau, cross-organizational teams such as the Decontamination Team and Designated Waste Management Team moved ahead with decontamination efforts while expanding the organization.

Furthermore, as reconstruction reached a new stage, in order to accelerate the entire Ministry's recovery and reconstruction efforts for the environmental restoration of the affected areas, starting on July 14, 2017, the measures to deal with integrated waste and recycling measures against radioactive materials pollution, and reorganized into the Environmental Regeneration and Materials Cycles Bureau.

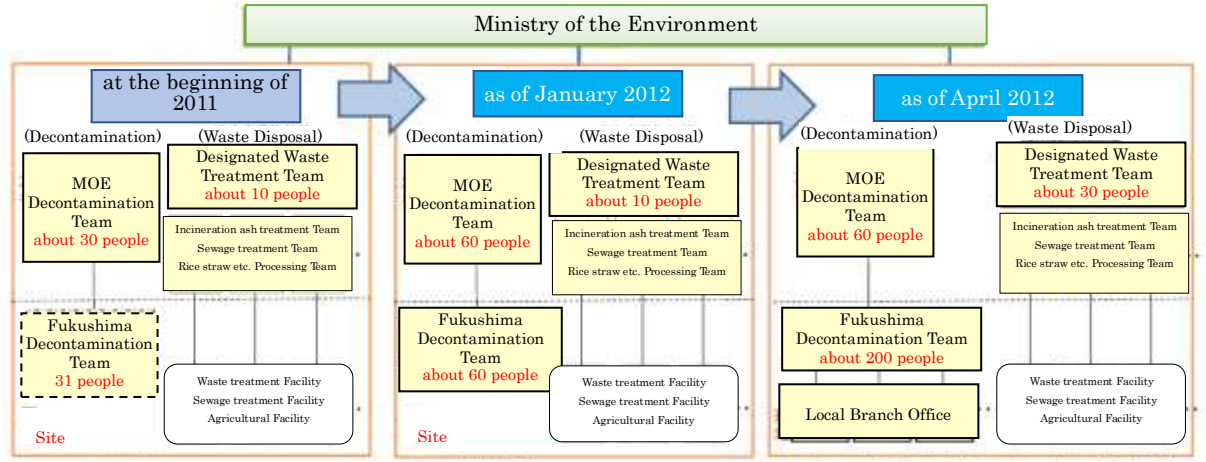


Figure 3-9 Evolution of expansion of Ministry of the Environment organization for decontamination and waste disposal (2011-2012)

(3) Fukushima Regional Environmental Office (formerly the Fukushima Office for Environmental Restoration)

In order to implement decontamination and support of municipalities on the ground in Fukushima Prefecture and other areas, the Fukushima Decontamination Promotion Team was established on August 24, 2011, and MOE personnel began to be stationed there. From immediately after promulgation of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, the Team assisted in the formulation of decontamination implementation plans (including the dispatch of experts) in cooperation with the Nuclear Emergency Response Local Headquarters, in communication and coordination with municipalities, and in collaboration with JAEA. In addition, it cooperated in the promotion of the national government's decontamination model projects implemented by the Cabinet Office in 12 municipalities that had Restricted Areas and Deliberate Evacuation Areas (note that model projects were actually prepared and organized in 11 municipalities).

In accordance with the full enforcement of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, new organizational personnel numbers were approved based on a supplemental budget, and on January 4, 2012, the Fukushima Office for Environmental Restoration was opened in Fukushima City as a base for promoting decontamination in Fukushima Prefecture and other areas, promoting the disposal of contaminated waste, and promoting environmental restoration.

Initially the number of personnel was 69 (31 from the Fukushima Decontamination Promotion Team of MOE, 15 as loaned staff from the Ministry of Agriculture, Forestry and Fisheries, and 23 hired from the private sector).

In April 2012, in order to work closer with the local community and respond to the growing scale of the decontamination work, MOE increased the number of personnel to 210 persons, and five branch offices were established in Fukushima Prefecture. In addition, a decision was made to set up an accounting body within the Fukushima Office for Environmental Restoration, and from then on, any business concerning contracts to be executed locally was implemented centrally by the Fukushima Office for Environmental Restoration.

The number of personnel continued to increase due in part to the acceleration of decontamination work and dealing with Interim Storage Facility, etc., to the point that there were 591 personnel at the end of 2017. In addition, from December 5, 2014, the “Hamadori Office for Interim Storage Facility” was established to deal with Interim Storage Facility.

At the Fukushima Office for Environmental Restoration, MOE implemented projects to promote decontamination and proper management of removed soil in Special Decontamination Areas; implemented projects to dispose of contaminated waste; implemented coordination work with 11 municipalities for Special Decontamination Areas; and conducted collaboration and cooperation with the Reconstruction Agency and Nuclear Emergency Response Local Headquarters, etc. In addition, the Office provided consultation and coordination regarding planning and details of decontamination work performed by municipalities in Iwate Prefecture, Miyagi Prefecture, and Fukushima Prefecture, and dispatched personnel responsible for decontamination to municipal branch offices, etc., to provide fine-grained support to

municipalities. The Kanto Regional Environmental Office is in charge of consultation and coordination concerning planning and details of decontamination work performed by municipalities in Ibaraki Prefecture, Tochigi Prefecture, Gunma Prefecture, Saitama Prefecture, and Chiba Prefecture.

In addition, MOE and Fukushima Prefecture established a “Decontamination Information Plaza" (currently the Environmental Restoration Plaza) in front of Fukushima Station in January 2012. The Plaza provided information on decontamination and radiation to the general public. With cooperation from JAEA and TEPCO, it also dispatched experts in decontamination and radiation protection to the schools as one of its activities.

The Fukushima Office for Environmental Restoration was initially started to function as the Tohoku Regional Environmental Office, but starting in July 14, 2017, it became the Fukushima Regional Environmental Office. Meanwhile, the Fukushima Decontamination Promotion Team established in 2011 became the Headquarters for Fukushima Environmental Restoration in April 2013, and was made responsible for overall coordination, including the Fukushima Regional Environmental Office.

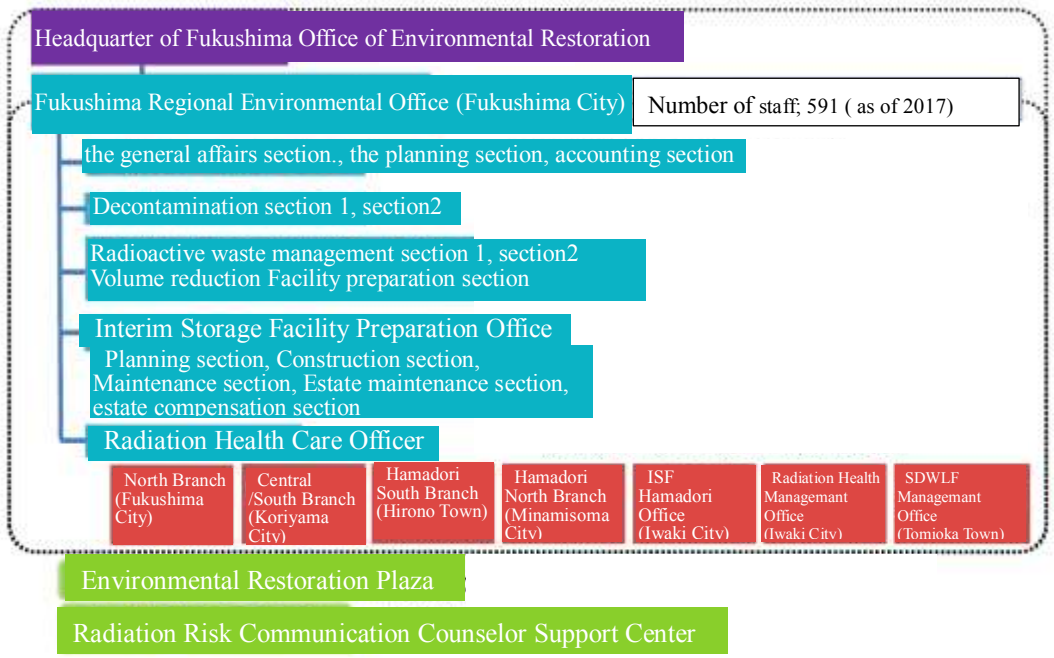


Figure 3-10 Responsibilities and organization of the Fukushima Regional Environmental Office

(as of September 2017)

Table 3-5 Outline of Fukushima Regional Environmental Office (Branch Offices)

(as of November 2016)

Branch name	Location	Municipality responsible
North Prefectural Branch	Fukushima City	Kawamata Town, Iitate Village, Fukushima City, etc. and Outside of Fukushima Pref.(Iwate Pref. Miyagi Pref.)
Mid and South Prefectural Branch	Koriyama City	Tamura City, Tomioka Town, Futaba Town, Katsurao Village, Koriyama City, Sukagawa City, etc.
Aizu Branch	Aizuwakamatsu City	Okuma Town, Aizubange Town, Yugawa Village, Aizumisato Town, etc.
Hamadori North Branch	Minamisoma City	Minamisoma City, Namie Town, Soma City, etc.
Hamadori South Branch	Hirono Town	Naraha Town, Iwaki City, Kawauchi Village, Hirono Town, etc.
Interim Storage Facility Hamadori Office	Iwaki City	-
Radiation Health Management Office	Iwaki City	-

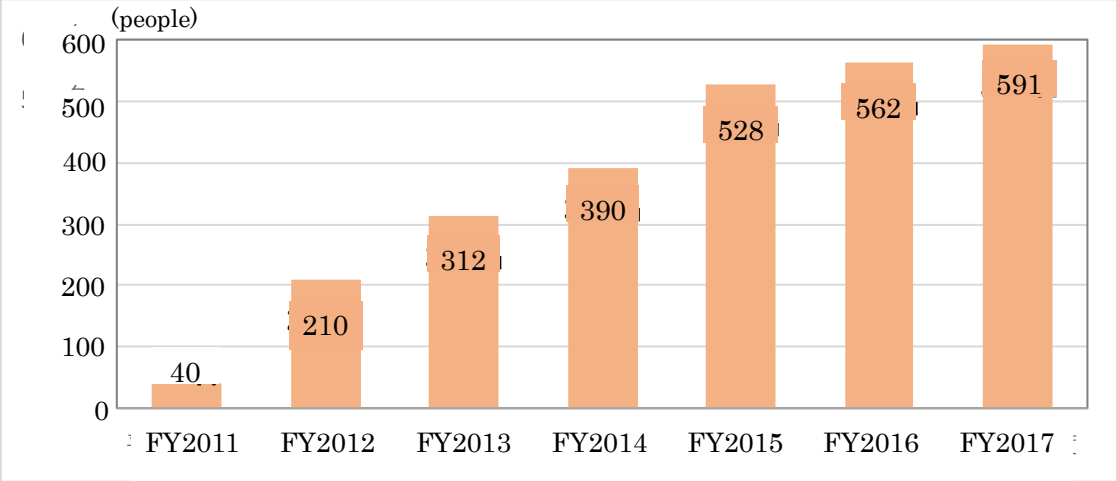


Figure 3-11 Personnel numbers at the Fukushima Regional Environmental Office

Column	“Decontamination projects and personnel at Fukushima Office for Environmental Restoration” Mr. Takashi Omura, Committee Member.

In decontamination work in Special Decontamination Areas, the Fukushima Office for Environmental Restoration conducted a series of tasks including declaration of decontamination implementation plan, coordination with local municipalities and prefectures concerning this, securing of Temporary Storage Sites, acquisition of consent from owners of decontamination target land and buildings, the ordering and supervision of decontamination work, the implementation of preliminary and supplemental monitoring, and reporting to residents, etc. (Initially, preliminary monitoring was ordered by MOE.)

In addition to personnel dispatched from MOE, the Fukushima Office for Environmental Restoration also employed personnel dispatched from the Ministry of Agriculture, Forestry and Fisheries who had experience in public works projects, as well as personnel newly hired by MOE for a term of three years. Among them were many people who were evacuated and living life under evacuation, those who had previous local employment related to nuclear power but had lost their jobs, or people from distant places such as Kyushu and the local area who wanted to serve for reconstruction. I believe their motivation was generally high. Meanwhile, this was also the first time to do this kind of work in Japan, so the value of experience and rules were not yet clear, and we had to improvise as we went along.

Regarding the initial decontamination plans, there was a shared understanding that decontamination work should be started as quickly as possible because of the idea that wide-area decontamination should be performed within about two years. This came from the aim of having evacuees being able to return within three years of the disaster to Preparation Areas for Lifting of Evacuation Orders and Habitation Restricted Areas. That reflected appeals from leaders in evacuation areas based on prior experience with the evacuation of the Oshima Islands who knew that evacuees’ willingness to return will decline if evacuation lasts for more than three years.

Although decontamination work was carried out in accordance with the rules of public works in Japan, the methods such as productivity, quantification methods and process controls were not well developed and were not clear. It is a so-called “large-scale cleaning” that eliminates invisible radiation source. Despite the availability of Decontamination Guidelines, decontamination work on site had to be implemented in a trial and error manner. MOE personnel who faced many challenges gradually solved the problems with the cooperation of personnel from Fukushima Prefecture.

MOE personnel gradually felt confidence and made rules by their own. Meanwhile, we must not forget that they had to face the anger and criticism of evacuees living away from their devastated communities, and the administrative agencies, as well as the frustration of residents who were being expected to provide space for Temporary Storage Sites even though the decontamination work was supposedly a matter for the national government.

Although the decontamination work started in Tamura City, where the preparation was set at first, the personnel from other municipalities also joined the decontamination work and learned how the work should be implemented as on-the-job training. .

Perhaps the national government could have done more to document the innovations and improvements occurring on the ground and to apply them broadly at other municipal decontamination

sites. However, in the context of a small number of people being overwhelmed with the day-to-day efforts and continually attempting new methods and improvements, it appears to have been extremely difficult in practice to solidify and transfer what was being learned. Nevertheless, it was fortunate that such knowledge was indeed shared and spread by the decontamination contractors and the Society for Remediation of Radioactive Contamination in Environment.

The staff who worked for decontamination work directly in Fukushima did not only explain the decontamination to the local residents , but also had to address various problems such as compensation, treatment of residue, contamination from radioactive materials, and so on .However, they could not address the all the questions because besides decontamination matters, not all the information was shared with them. From my point of view, the staffs in local government and those in central government could not share consciousness about what is the problem in affected areas. From this, it should be remembered that there was considerable stress among personnel. On the other hand, however, the point was appreciated that the authority to the Fukushima Office for Environmental Restoration was granted in the "Decontamination Promotion Package" (see 1.4.2).

Column	"To promote decontamination in the northern part of Hamadori" Hamadori Kita Branch, Fukushima Regional Environmental Office

Fukushima Regional Environmental Office Hamadori Kita Branch

The Hamadori North Branch office of the Fukushima Office for Environmental Restoration (as named at the time) was established in Minamisoma City in April 2013 in order to provide support for municipal decontamination of Soma City, Minamisoma City and Shinchi Town, in addition to decontamination and waste disposal directly done by the national government in Minamisoma City and Namie Town. Initially, it was established with 19 people, but nearly half of the staff were from the local area and they were victims themselves from the earthquakes and tsunami damage. Initially it was difficult to secure staff housing in Minamisoma City so some people stayed in hotels, but some had trouble when the hotel became full the next month. If the residence was not secured, some of them had to commute over an hour and a half from Fukushima City until November 2013, when a government-owned apartment was secured.

Under these circumstances, the office was responsible for information briefings for local residents towards the start of decontamination, etc., with coordination with local governments, and meetings with construction contractors, but this was the first such work for MOE, so we were forced to proceed through trial and error. Although the residents sometimes showed distrust in the national government and anxiety about radiation doses, the personnel in Hamadori explained consistently about the acquisition of Temporary Storage Sites, acquisition of consent for decontamination, and waste disposal, etc. Such efforts were gradually understood by local residents and the work also got on track, so the evacuation order was lifted in Minamisoma City in July 2016 and in Namie Town in March 2017. In the future, in addition to supplemental decontamination work, the office will make efforts to eliminate the Temporary Storage Sites and decontaminate in Specified Reconstruction and Revitalization Base (SRRB) in Areas where Returning is Difficult.

3.2.2. Local Government

(1) Fukushima Prefecture

Fukushima Prefecture set up an environmental recovery team in the Nuclear Safety Division of Disaster Countermeasures Headquarters on June 1, 2011 in order to start examination for environmental restoration from the nuclear disaster, and four people including an environmental coexistence section manager were assigned here. Then on October 13, 2011, Senior Policy Administrator of Environmental Recovery Sector and Decontamination Countermeasure Division was established in the Social Affairs and Environment Department. The division managed decontamination implemented by municipalities based on decontamination implementation plans, comprehensive support for dose reduction activities implemented by municipalities, decontamination of prefectural management facilities, etc. (ordering and work management was done by prefectural departments and divisions responsible for facilities management).

It also was engaged in the establishment of standards relating to design and quantification, support for quantification work, improvement of Technical Guidelines on Decontamination Operations and Temporary Storage Sites, technical support for implementation of data verification of municipal decontamination techniques, and managing Decontamination Countermeasure Business Grants relating to decontamination implemented by municipalities.

After October 2011, Fukushima Prefecture held decontamination work seminars for decontamination workers, field supervisors, and business managers, for the training of decontamination contractors and field managers.

Furthermore, to promote understanding of residents the Prefecture dispatched experts, etc., to residents' meetings, etc., and conducted decontamination information visualization projects and information dissemination through the Decontamination Information Plaza (currently the Environmental Restoration Plaza) which was under joint management with MOE.

(2) Municipalities

1) Municipalities in Special Decontamination Areas (SDA)

In municipalities in Special Decontamination Areas, not only residents but also local officials had to evacuate from the areas. Under these circumstances, the local officials responded to the consultation with residents about the decontamination work. They also cooperated in arranging meetings between local residents and MOE about the schedule of decontamination work. In obtaining the consent for decontamination, they also cooperated to secure the TSS with land owners and district managers.

Even during decontamination, in addition to responding to inquiries from residents, in coordination with MOE, etc., local officials also provided information such as the progress of decontamination and monitoring results of radioactive substances by website.

They set up reconstruction measures divisions, etc., to coordinate adjustment for lifting of evacuation orders, to formulate plans for reconstruction work, to help hold decontamination verification committee meetings for each municipality, and to explain decontamination results to the residents.

2) Municipalities in Intensive Contamination Survey Areas (ICSA)

In municipalities in Intensive Contamination Survey Areas (ICSA), decontamination was implemented according to decontamination implementation plans formulated by municipalities. Municipalities that implemented decontamination conducted measurements of the air dose rate, held residents‘ meetings, obtained consent for decontamination and Temporary Storage Sites, ordered decontamination work and conducted process control.

In each municipality, many departments related to radioactive contamination and decontamination projects were set up and operations were carried out in many cases. For example, some municipalities established a Radiation Comprehensive Measures Division and a Decontamination Control Division. Also, radiation experts were appointed as advisors in some municipalities.

However, since countermeasures against radioactive contamination, health care, damages, and decontamination required a lot of workers for municipalities in Fukushima Prefecture, which were also suffering from the earthquake and tsunami, those works became major burden. For this reason, in some cases, the municipalities received assistance from dispatched staff from other prefectures or employed temporary staff by subsidized projects.

3.2.3. Research Institutions

(1) National Institute for Environmental Studies

The National Institute for Environmental Studies (hereinafter referred to as NIES) from immediately after the disaster tackled on the research for disposal of waste such as residue and waste contaminated with radioactive materials, and treatment and disposal of radioactive materials. It also worked for disaster environmental research, such as environmental dynamics, impact on living organisms and ecosystems, environmental changes and impacts due to earthquakes and tsunamis, rebuilding community development in disaster areas and creating a local environment, and technical standards and guidelines in the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials. This means that NIES played a leading role for the research and development in academia and industry.

Especially, NIES set up three programs (Environmental Recovery Research, Environmental Renovation Research, and Environmental Emergency Management Research) to research environmental damage caused by the Great East Japan Earthquake, environmental pollution caused by radioactive substances released into the environment, the impacts of the pollution on the health of living things and humans, technology for removing pollution, technology for treating polluted waste, and technology for reconstruction. Environmental Recovery Research is aimed at establishing technologies and systems for treatment and disposal of waste contaminated with radioactive substances (research on contaminated waste), and elucidating environmental dynamics of radioactive substances, evaluating exposure doses, and assessing the impacts on living organisms and ecosystems (research on multimedia environments). Also, Environmental Renovation Research is investigating and researching the restoration and creation, etc., of the local environment after the disaster, while Environmental Emergency Management Research is investigating and researching building environmental management systems for future disasters.

Since 2016, NIES has established a branch office in the Fukushima Prefectural Centre for Environmental

Creation in Miharu Town, Fukushima Prefecture and is continuing research in the affected areas.

(2) Japan Atomic Energy Agency

National Research and Development Corporation Japan Atomic Energy Agency

The Japan Atomic Energy Agency (JAEA), as a core agency for research and development related to dealing with the TEPCO Fukushima Daiichi Nuclear Power Station accident, formed a Fukushima R&D Division, and established the Fukushima Research Base Creation Center and Collaborative Laboratories for Advanced Decommissioning Science (CLADS) to conduct R&D for reactor decommissioning, as well as the Fukushima Environmental Safety Center to conduct R&D related to environmental restoration for the reconstruction and restoration of Fukushima.

At the Fukushima Environmental Safety Center, from the time immediately after the accident, JAEA conducted a survey on the distribution of radioactive substances, development of decontamination guideline project, decontamination model projects, decontamination technology demonstration projects, radiation measurement technology development, prediction technology development of decontamination impacts, radioactive cesium environmental dynamics survey, removal of soil, and other technologies for recycling, etc.

JAEA also cooperated with and supported national and local governments such as cooperation and support for decontamination carried out by MOE and municipalities, communication activities and human resource development activities, and measurements using whole body counters.

The Fukushima Environmental Safety Center is located in the Centre for Environmental Creation (Miharu Town) run by Fukushima Prefecture and the Environmental Radiation Center (Minamisoma City), and is conducting research using facilities jointly with Fukushima Prefecture and the NIES.

(3) Fukushima Prefectural Centre for Environmental Creation

In February 2012, the Fukushima Prefecture established a Basic Concept Review Committee for an Environmental Creation Strategy to promote environmental restoration from nuclear disasters, and to create an environment where the prefecture can live safely in the future. Fukushima Prefecture, JAEA, and the NIES closely cooperated with each other to study the establishment of a base facility “Centre for Environmental Creation” to tackle the recovery and creation of the environment that was polluted by radioactive materials.

The functions of the Centre for Environmental Creation are to develop four centers in Miharu Town and Minamisoma City in the prefecture, with (1) monitoring, (2) research, (3) information gathering and dissemination, and (4) education, training and exchange. In July, the Centre opened, including attached facilities in Otama Village and Inawashiro Town.

JAEA and NIES are conducting research in four fields: (1) radiation measurement, (2) decontamination and waste, (3) environmental dynamics, and (4) environment creation. Research results are used for making policies related to decontamination work as and sharing the results with the public by web site and academic societies, etc.

In addition, “Commutan Fukushima” was established as a facility to spread correct information about

the nuclear disaster and Fukushima Prefecture's story, the current situation and radiation, and to support children's learning activities.

Overview of the Centre for Environmental Creation (above) and the relationship between four projects of the Center for Environmental Creation (left)

Figure 3-12 Fukushima Prefectural Centre for Environmental Creation

(4) Cooperation Between Fukushima Prefecture and the IAEA

Fukushima Prefecture, in order to promote unprecedented efforts such as the recovery of the environment from nuclear disasters and the realization of creation, it is necessary to combine the wisdom of the world and to deal with it. The Governor of Fukushima Prefecture delivered a request to Yukiya Amano, Director-General, International Atomic Energy Agency (IAEA), saying that he would like to invite international institutions to Fukushima, when IAEA mission came to Fukushima in December 2011. After that, through the coordination of the Ministry of Foreign Affairs with IAEA in August 2012, the governor visited the IAEA headquarters in Vienna and reached the agreement with Mr. Amano about cooperation projects in the field of decontamination and health management.

At the Ministerial Conference on Nuclear Safety held in December 2012 in Koriyama City (Fukushima), the Governor of Fukushima Prefecture and Mr. Amano, Secretary–General of IAEA announced that they had signed a memorandum of understanding collaborative activities with a priority on radiation monitoring, decontamination and human health.

Based on the MOU, Fukushima Prefecture and the IAEA after repeated discussions created two projects: Fukushima Prefecture Cooperation Projects (FCP) led by IAEA, and Fukushima Prefecture Initiative Projects (FIP) led by Fukushima Prefecture. The two projects started in December 2012.

Table 3-6 Project contents of FCP and FIP

FCP	FIP
① Decontamination in Fukushima ○ Dispatch IAEA team of IAEA and international experts to provide technical advice. ○ Hold local workshops to provide support relating to environmental monitoring, exposure pathway studies, potential to reduce or avoid exposure, radiation safety for daily life, and return of residents, etc. ② Management of radioactive waste generated from decontamination activities ○ Dispatch an IAEA team consisting of IAEA and international experts to provide technical advice. ○ Through interactions with the relevant local and governmental organizations, provide support relating to the storage of radioactive waste, treatment of radioactive waste, radiation exposure when handling radioactive waste, etc. ③ Use of environmental mapping technology for data from unmanned aerial vehicles (UAVs) ○ Develop prototype of mobile gamma ray spectroscopy system to mount on UAVs for monitoring in Fukushima. ○ Hold expert meetings and conduct field tests. Provide training and technical support. ④ Long-term monitoring of radioactive material in forests and associated countermeasures, plus support for radiation monitoring to develop understandable maps, and data utilization ○ Dispatch IAEA team consisting of IAEA and international experts to provide technical advice. ⑤ Radiation safety and monitoring, plus project management support ○ Appoint IAEA experts as IAEA liaison persons in Fukushima to coordinate cooperation projects between Fukushima and the IAEA and provide technical advice as required.	① Survey of radionuclide movement in river systems ○ Measure radioactive cesium concentrations in river water and suspended matter to determine concentration distribution, and use numerical model simulation to predict/verify contaminant migration. ② Survey of radionuclide movement with wildlife ○ Measure radionuclide concentrations in muscle tissue, stomach contents, etc., of wild boar and other wildlife, and conduct behavioral studies, including wildlife feeding habits, to determine radionuclide dynamics in wild animals. ③ Countermeasures for radioactive materials in rivers and lakes ○ Consider effective measures to deal with radioactive materials in Fukushima Prefecture rivers and lakes, by collecting and summarizing knowledge on radioactive materials, through field surveys and literature surveys in Japan and overseas, as well as knowledge on their environmental dynamics. ④ (Completed) Development of environmental mapping technology using GPS walking surveys ○ Study data analysis and mapping visualization methods, etc., for GPS walking surveys in conjunction with unmanned aerial surveys. ⑤ Study of the proper treatment of waste containing radioactive materials at municipal solid waste incinerators ○ Determine the relationship between combustion conditions and variations in the migration of radioactive materials to bottom ash and fly ash, by modifying combustion temperatures and other conditions in incineration facilities and measuring radionuclide concentrations in bottom ash and fly ash. ○ Investigate the leaching characteristics of radioactive cesium from incineration residue (bottom ash, fly ash), consider methods to remove or reduce leaching of radioactive cesium from incineration residue. ⑥ Study of simple and rapid analytical methods for radionuclides ○ Study methods for efficiently concentrating and measuring tritium in water samples, and separating and measuring organically bound tritium. ○ Study simple and quick methods for separating and measuring strontium-90 in the environment
(Signed December 15, 2012)	(① to ③ signed April 10, 2013, ④ and ⑤ signed October 30, 2013, ④ completed in FY2016, and ⑥ signed on October 25, 2016.)

(5) Universities and Scholars

Fukushima University started measuring the air dose rate immediately after the accident, and created a map. In April 2011, “Utsukushima Fukushima Future Support Center” was established in order to systematically work on reconstruction and support of Fukushima, and in July 2013, the “Environment Radioactivity Research Institute” was established, and research began on the dynamics study of radionuclides in the environment and the impact on ecosystems, etc. In order to contribute to academic, scientific and technological promotion and regional development, JAEA has a comprehensive collaboration agreement on research and human resource development, and cooperation research such as collaborative research on decontamination and exchange of human resources training, and joint research is being done with use of research facilities and equipment owned by both parties.

3.2.4. Decontamination Contractors and Relevant Institutions

(1) Decontamination Contractors (e.g., construction companies)

The works for decontamination are similar to large-scale civil engineering projects, and need a lot of workers. So construction contractors with know-how and experiences of large-scale constructions implemented decontamination work. In the decontamination work, the contractors carried out the preparation of decontamination plans, decontamination work, installation of Temporary Storage Sites, transportation of removed soil, and so on. They also disseminated information on the status of decontamination, participated in local meetings, held on-site tours for local residents, patrolled local areas, and so on.

Consultants were also involved in decontamination work, such as acquiring consent from residents for decontamination, conducing monitoring surveys of radiation, making guidelines, examining decontamination methods, and supporting on-site management. They checked and reviewed the technical methods and conducted data analysis at every stage of the decontamination work.

(2) Academic Societies and Industry Groups

In May 2011, the Japan Atomic Energy Society launched a “cleanup subcommittee” in order to actively cooperate with the recovery activities of environmental pollution by radioactive substances. In November 2011 “The Society for Remediation of Radioactive Contamination in Environment” was established and the “Decontamination and Waste Technology Council” by the industry was also established. The council played an important role for sharing technical knowledge.

Public benefit corporation The Japan Society of Civil Engineers established the “Civil Engineering Specific Theme Committee for Radioactive Contaminated Waste Countermeasures” in the “East Japan Great Earthquake Special Committee” and began full-scale activities from the beginning of 2012.

The Japan Construction Federation Association established the decontamination committee (currently the Interim Storage and Decontamination Subcommittee) under the Special Committee on Electricity Countermeasures in April 2012. Construction companies have prepared systems to cooperate in implementing the decontamination work.

(3) Cooperation with Police and Labor Bureau

In order to ensure the safety and security of the area, the police dispatched special regional police units to the affected prefecture from March 18, 2011 to conduct various activities by uniformed police officers and police cars to promote security.

Also, at the Committee to Promote Proper Decontamination, MOE prepared an “Action Plan for Improving the Reliability of Decontamination and Contribution to the Region.” MOE also held special lectures about the countermeasures for organized crime with Fukushima prefectural police, and about the management of decontamination workers with the Fukushima Labor Bureau.

(4) Cooperation with Local Residents

Decontamination work could only succeed with the cooperation of local residents. In particular,

concerning consent for decontamination and securing Temporary Storage Sites, MOE received great cooperation from residents.

Regarding consent for decontamination, MOE cooperated with concerned people such as landowners and building owners for on-site surveys, consent on decontamination work, on-site observation, and so on. In particular, in the Special Decontamination Areas, MOE asked landowners to come all the way to their house from the areas where they were evacuated and check how the decontamination was implemented.

When the decontamination started, it was necessary to secure Temporary Storage Sites for removed soil. In securing Temporary Storage Sites, MOE got support from the district leaders, landowners and people from the surrounding areas. Especially, MOE expressed sincere appreciation to the district leaders, who consolidated the opinions of residents and coordinated with local governments.

As part of efforts by local residents to cooperate, in Date City, for example, after receiving residents at 21 evacuation centers, support systems used by prefectural officials, city officials and volunteers to manage the centers were reviewed. As a result local leaders took care of the management of the centers. Also, after June 2011, security patrols of vacant houses were reinforced with the cooperation of Date City Police, Fukushima prefectural police headquarters and local police-related organizations.

In municipalities in evacuation areas, in addition to the patrols for vacant houses, decontamination work areas and Temporary Storage Sites were also patrolled.

Column	"Promote decontamination to advance reconstruction of Odaka-ku" Mr. Masayuki Yamagishi, Former Chairman of the Administrative District of the Odaka Western Region, former General manager, Otawa District, Minamisoma City

Q : When the decontamination work started in Otawa District, you were the general manager of the district. How did you feel when the decontamination project started?

A : The TEPCO Fukushima Daiichi Nuclear Power Station Accident was very painful for us. At that time, 31 families used to live here, but they evacuated to places apart. If decontamination work was not advanced and the evacuation order was not lifted, the regeneration of the district would not go on. For the regeneration, I felt it was crucial to secure the Temporary Storage Sites

Q : Please tell me about how did you coordinate to secure the Temporary Storage Sites with Minamisoma City, MOE and local residents when the decontamination started?

A : In the spring of 2012, there was a plan to combine two temporary sites in the western part of Odaka-ku. However, it did not go well, so in November 2012, Minamisoma City expressed the policy to set up a Temporary Storage Site in every administrative district with high dose rate. Then I decided to set up a Temporary Storage Site of Otawa administrative district in the site as the municipality proposed. In early December the explanation meeting was supposed to be held in the district so I talked with about ten landowners individually in advance and got consent of installation. At that time, MOE said that the site would be returned to the landowners in three years, but I did not think that would be possible. Instead, I

told the landowners that the lands they leased would be returned in five years.
In early December, the meeting to explain about the TSS was held. Although half of the participants agreed the plan for the installation of TSS, 10% of the participants were against the plan, so no decision was reached. So I said to the participants, “If you don’t participate in the next meeting, I think you will agree the plan.” Since a few residents joined the next meeting at the end of December, I thought many residents agreed to the plan and the decision was made.
I went to Odaka-ku office in January 2013, reported that the residents and landowners agreed to establish temporary sites, and MOE started the project.

Q : In Minamisoma City, the Temporary Storage Site in the Otawa district became the first one, After that, the installation of TSS proceeded smoothly in other administrative districts in the western part of Odaka-ku, but are there any other difficulties?

A : At the time, I was also chairman of the Odaka western district administrative district .While in 5 of the 12 Odaka Western Region administrative districts, each district has its own TSS, in other districts, the City asked the residents to consolidate the Temporary Storage Site in one or two places. Also, Odaka Chubu district was located in the center of the old Odaka-ku, so it is difficult to install Temporary Storage Site in the district. So the City asked me whether the residents and I would receive the wastes from other districts or not. Regarding this, a formal request was also issued by the chairman of the administrative district of Odaka Chubu in June 2013.
Meanwhile, there was a huge hurdle to accept waste from other administrative districts. I talked to the related district leaders again and again and asked them to accept the wastes from other districts. Finally I decided to accept them in seven western districts of Odaka-ku and the central part of Odaka-ku in Oya temporary storage site. That was a difficult time.

Q : As decontamination progressed, improper decontamination occurred in Minamisoma City. How did you feel about the overall decontamination work at that time?

A : As the decontamination went on, various troubles occurred. However, such troubles can happen anywhere at school or at a company. Rather, I was pleased that thousands of decontamination workers gathered from all over the country and implemented decontamination quickly. I am grateful to them for their hard work.

(5) Volunteers and NPOs

Since there are many natural disasters in Japan, the response to large disasters has always proceeded with the help of local residents to assist evacuees, to prevent damage, and in the recovery, etc. In this decontamination work, there were also a lot of residents’ understanding and cooperation.

Initially some decontamination was done voluntarily by parent-teacher associations (PTA) and local

community groups around schools due to concern about health impacts of radiation on children. For example, in Date City, the demonstration test of decontamination at elementary school by Date City Decontamination Project Team was carried out in July 2011. In this demonstration, local residents and volunteers participated by the call of PTA. The experts such as JAEA and Radiation Safety Forum (NPO) also joined the demonstration work.

Voluntary decontamination by PTA and neighborhood association was carried out in many areas. Fukushima Prefecture financially supported these activities. In July 2011, Fukushima Prefecture also issued the "Guidance on measures to reduce radiation dose in living space" which summarized the details necessary for decontamination activities in living spaces.

The voluntary decontamination by residents was carried out in various parks and school roads until around the year of 2014, before the start of decontamination by contractors. Many people implemented decontamination of their houses by themselves.

Such voluntary decontamination for reducing doses showed great results especially in the early days, but declined as decontamination work became in full-scale. After that, however, cooperation between municipalities and residents, still went on such as in selection of Temporary Storage Sites, management of removed soil, surveillance, monitoring, etc. Decontamination was a major project cooperating with national government, prefectures, municipalities, residents, related nuclear power companies, and others.

(6) Tokyo Electric Power Company

As a party to TEPCO Fukushima Daiichi Nuclear Power Station accident, from June 2011, TEPCO conducted radiation measurement to ascertain the spread of contamination and monitoring in detail, for formulating decontamination implementation plans and so on. Thereafter, in January 2012, the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials came into force, and TEPCO has been responsible for cooperating with decontamination implemented by the national or local governments. MOE commissioned about 650 TEPCO workers (as of November 2017) as "Staff for promoting decontamination activities."

They stayed in Fukushima City from March 2012 and helped monitoring radiation making decontamination implementation plans, implementing on-site management and radiation management, and operating screening points based on the requests from the national and local governments. On January 1, 2013, "Fukushima Revitalization Headquarters" was established in the facility of J Village and "Decontamination Promotion Office" was based in Fukushima City centered on personnel with radiation knowledge. Cooperation has been made to various requests relating to decontamination implemented by the national government and local governments, with staffing ranging from the initial 140 persons to 300 persons at the peak.

Regarding whole area decontamination of Special Decontamination Area (SDA), based on requests from the national government, the commissioned workers supported activities from the planning stage to the practical stage in various ways such as pilot decontamination and quality control, and so on. As decontamination progressed, for lifting evacuation orders, they considered policies and investigated additional measures to reduce the air dose rates, made the investigation plan for each house regarding supplemental decontamination. They also cooperated in monitoring for restarting infrastructure such as

the Joban Expressway and JR Joban Line.

In Intensive Contamination Survey Areas (ICSA), in response to the requests of local governments, they supported a wide range of activities, such as developing decontamination implementation plans, conducting verification tests on effective decontamination methods, confirmation of effectiveness, holding training sessions on decontamination for workers and work supervisors, surveying to determine the necessary decontamination ranges, and they made efforts to implement appropriate and prompt decontamination. In some facilities, they implemented simplified measures to deal with radiation. In the case of local governments' requests, they monitored local events and school roads even after decontamination. The manpower and technical support to the ICSA were provided in almost all areas in the prefecture.

Other electric power companies all over Japan also conducted monitoring of schools based on the request of the national government in 2011. In April 2012, TEPCO sent "decontamination experts" to support decontamination activities in Fukushima Prefecture. TEPCO dispatched them to decontamination activities conducted by the local government and residents in Fukushima Prefecture and also responded to requests for dispatch from the "Decontamination Information Plaza" (currently the Environmental Regeneration Plaza)..

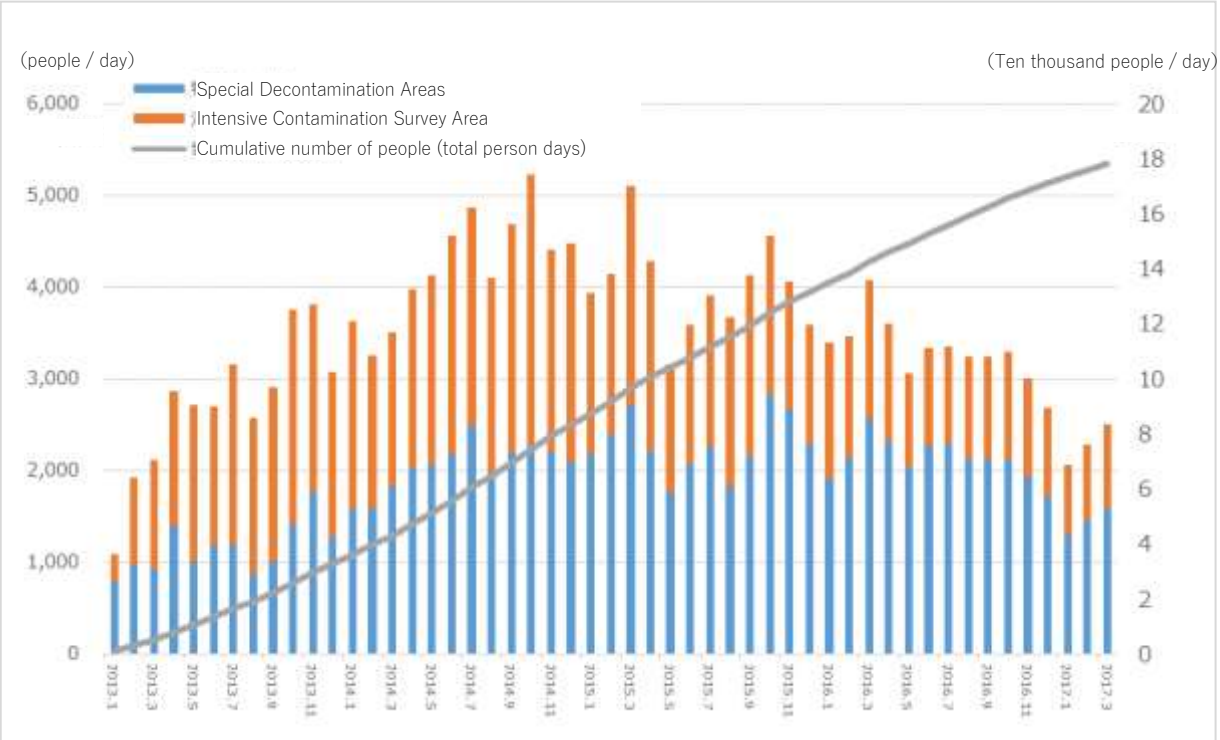


Figure 3-13 Number of people assisted by TEPCO for measures by national and local governments

Column	“Inauguration of The Society for Remediation of Radioactive Contamination in Environment (SRRCE)” Mr. Masatoshi Morita, Committee Member.

The accident at the TEPCO Fukushima Daiichi Nuclear Power Station due to the Great East Japan Earthquake on March 11, 2011, was an enormous accident that exceeded our imagination and caused extensive environmental radioactive contamination. The realization that this contamination was a serious environmental pollution problem over a long period of time and also a serious social problem led us to establish the Society for Remediation of Radioactive Contamination in Environment on November 28, 2011.

For this radioactive contamination, researchers from isotope laboratories of universities throughout the country, from nuclear power centers of local governments, and other persons involved in nuclear power started pioneering research immediately after the accident. Meanwhile, for environmental remediation, a comprehensive approach was needed, including an understanding of the pollution situation as well as decontamination techniques and social engineering. Thus, this forum was established to enhance discussion among many experts.

Professor Keiichiro Fuwa became the first president of SRRCE. He had been involved in the analysis of so-called "death ashes" (nuclear fallout) of atomic bomb experiments on the Bikini Atoll with Professor Kenjiro Kimura from the University of Tokyo. SRRCE held its first meeting in Fukushima City in May 2012. About 500 experts participated, 150 papers were submitted, and there were enthusiastic discussions. In June of the same year, the Journal of SRRCE was first published as a periodical. On the environmental side, since MOE has knowledge accumulation of decontamination technology for heavy metal and risk assessment, and MOE is responsible for decontamination work, SRRCE works closely with MOE and related organizations.

About 10 nuclear accidents have occurred in the world, including the Chernobyl accident in 1986. Although there are voices desiring to completely shut down nuclear power stations for safety reasons, the energy from nuclear reactions vastly more than conventional energy, so one of the most important issues is the safe use of nuclear energy. I hope that future scientists could tackle the safe control of radioactive wastes, taking advantage of nuclear energy.

Column	"About TEPCO's decontamination efforts" Mr. Shoichi Muto, General manager of Decontamination Promotion Office of Fukushima Revitalization Headquarters, TEPCO Holdings, Incorporated.

We sincerely apologize for causing so much trouble and concerns due to the TEPCO Fukushima Daiichi Nuclear Power Station Accident.

Our commitment to decontamination began with cooperation with environmental radiation monitoring in 2011when the accident occurred. In January 2013, when Fukushima Revitalization Headquarters were established, the "Decontamination Promotion Office" was established and prepared for organizational support. About 350 people were engaged in Fukushima City, Koriyama City, Iwaki City and Minamisoma City as of 2017.

Meanwhile, under the request from MOE for "Staff for promoting decontamination activities," we are providing manpower and technical support for promotion and acceleration of decontamination while hearing the requests from the national government and local governments. Regarding the costs of decontamination that the government requests us we are also dealing with carefully listening to the details about the content and we will continue to respond appropriately.

A wide range of decontamination work has a lot of inexperience for us as well. With little knowledge, for the purpose that decontamination will be finished as soon and good as possible, we have been cooperating on practical stage by developing technologies of measuring how to decontaminate, taking measures to reduce radiation exposure, maintaining the quality of decontamination work, and so on. While being involved in the huge decontamination work, I felt the seriousness of the accident. I often heard the thoughts of residents about fears and anxiety. And I also saw that many people such as the national government, local governments, decontamination contractors, and experts, sacrificed all comforts and devoted themselves to promotion of decontamination and they sometimes faced difficult situations. I regret what they had to go through.

From immediately after the accident to now, I have been engaged in radiation contamination problems in the environment. The cumulative total number of persons related to decontamination in our organization are 650. I think that what we could do was small compared to the scale of the problem. Planned decontamination almost ended in 2016, so we reached one milestone, although I think that new issues will arise in addition to the remaining ones. There are various problems such as resident's mental and physical health, returning home, the economy, and environmental restoration, in addition to matters associated with Areas where Returning is Difficult (ARD), Interim Storage Facility, waste disposal and recycling.

I think it is more important than anything that our company will never let the past fade away. We need to continue to pass on the baton over time. We will continue to do our best for Fukushima and society and to fulfill our responsibilities for Fukushima in the future.

3.3. Budgetary Measures

3.3.1. Budgetary Measures

(1) Budgetary Measures relating to Decontamination Project and Claims for Compensation

The general reserve funds for FY2011 were the starting point for the budget for decontamination work (hereinafter referred to as "decontamination budget"), and the third supplemental budget was established after a Diet debate at the 179th extraordinary session of the Diet.

In FY2012, the Special Account for Reconstruction from the Great East Japan Earthquake was established in order to improve the transparency of the flow of funds of the national government relating to the recovery from the Great East Japan Earthquake and to appropriately manage the redemption of reconstruction bonds. From then on, the decontamination budget was included as part of the "expenses related to reconstruction from the nuclear disaster," one of the eight pillars of this special account.

The cumulative decontamination budget totaled 3,253.2 billion yen by FY2017 (3,075.4 billion yen excluding the unused funds each year), and expenditures amounted to 2,625 billion yen by end of FY2016 (see Table 3-7 for budgetary measures and execution status for each year).

Also, in order to further accelerate reconstruction and restoration of Fukushima, on December 20, 2013, "For Accelerating the Reconstruction of Fukushima From the Nuclear Disaster" was adopted as a statement by Cabinet Decision based on the proposals of a few ruling parties. As one direction for the decontamination budget in order to clarify the division of roles between the government and TEPCO, it listed seeking compensation from TEPCO after the project implementation, estimated total costs, and methods of recovering the equivalent of decontamination costs, etc. Furthermore, in order to further enhance recovery measures based on the fact that evacuation had been going on for a long period, at more than five years and nine months since the disaster, "Basic Guidelines for Accelerating Fukushima Reconstruction from Nuclear Disaster " were adopted by Cabinet Decision on December 20, 2016, and the estimated amount of decontamination cost was increased to 4,200 billion yen (including 3,420 billion yen for decontamination, excluding disposal of contaminated waste) due to factors such as tight supply and demand in the disaster-affected areas (see Table 3-8 for breakdown of expenses).

In addition, the Act on Special Measures for the Reconstruction and Restoration of Fukushima was revised in May 2017 to address the reconstruction and rebuilding of Areas where Returning is Difficult as quickly as possible. Budgetary measures of 30.9 billion yen were listed for FY2017, the initial year, for government-funded work for decontamination and waste treatment necessary based on reconstruction and revitalization plans for Zones Designated for Reconstruction and Recovery in each municipality (zones that aim for lifting of evacuation orders and to enable residents to return).

Costs of measures taken under the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials are to be borne by TEPCO as stipulated in Article 44, Paragraph 1 of the Act, and the national government is to seek compensation from TEPCO for expenditures required for decontamination and other measures .

In accordance with Article 44, Paragraph 2 of the Act, when compensation is sought from TEPCO for expenditures required for decontamination and other measures, TEPCO is required to make an effort to pay promptly, and in order to enable prompt compensation and proper implementation, the Nuclear

Damage Compensation and Decommissioning Facilitation Corporation issues funds to TEPCO.

Table 3-7 Budget measures and execution status of decontamination work

(unit: hundred million JPY)

Year	Budgeted			Expenditures (Final)		
	National Government	Munucipalities	Total	National Government	Munucipalities	Total
FY2011 reserved	157	1,922	2,080	136	1,922	2,058
FY2011 supplement	949	1,047	1,997	137	858	994
FY2012 initial	2,678	1,043	3,721	2,561	1,012	3,573
FY2013 initial	2,949	2,029	4,978	2,892	1,996	4,889
FY2013 supplement	4	800	804	4	800	804
FY2014 initial	1,188	1,394	2,582	1,145	1,356	2,502
FY2015 initial	2,414	1,760	4,174	2,324	1,748	4,072
FY2015 supplement	66	717	783	66	717	783
FY2016 initial	2,920	2,330	5,250	1,544	2,329	3,873
FY2016 supplement	1,392	1,915	3,307	787	1,915	2,702
FY2017 initial	1,618	1,237	2,856	—	—	—
Total	16,335	16,194	32,532	11,596	14,653	26,250

Table 3-8 Breakdown of decontamination / contamination wastes disposal expenditures (JPY)

Contents		Estimated December 2016
Decontamination related		3,210 billion
(Details)	○ Main decontamination costs (including supplemental decontamination cost)	2,180 billion
	○ Establishment and operation cost of Temporary Storage Sites / volume reduction facilities	970 billion
	○ Technology development expenses ○ Public information expenses for mass media ○ Model projects ○Children's environment restoration projects ○ Supplemental monitoring ○ Research costs ○ Administrative costs	60 billion
Contaminated wastes disposal related		810 billion
(Details)	○ Designated waste treatment ○ Agriculture and forestry waste (8,000 Bq / kg or less) ○ Monitoring assistance for waste disposal facilities ○ Waste disposal within local areas	
Cabinet Office, etc. portion (decontamination, treatment of polluted waste)		220 billion
Total		4,200 billion

(2) Enforcing Budgetary Measures

1) Decontamination administered by the national government

For Special Decontamination Areas in Fukushima Prefecture, on January 1, 2012, the Fukushima Office for Environmental Restoration was established (currently the Fukushima Regional Environmental Office) and the decontamination budget is being implemented there as work administered by the national government, from procurement of decontamination work to contracts and work management.

For the decontamination of national government-owned property located within Intensive Contamination Survey Areas (ICSA), the decontamination budget is being implemented directly under the jurisdiction of each ministry concerned.

2) Fiscal measures for local governments

Prefectures and municipalities are implementing fiscal measures on radiation dose reduction measures implemented based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials in order to reduce the effects on human health or the living environment from the nuclear accident caused by the Great East Japan Earthquake. The MOE issues direct subsidies to local governments; for municipalities designated as Intensive Contamination Survey Areas (ICSA) there are five types of projects (decontamination implementation plan formulation, decontamination projects, dose reduction community activity support projects, child's living environment restoration projects associated with decontamination, and post decontamination monitoring projects), while for all municipalities there are expert dispatch projects. For municipalities in Fukushima Prefecture, the Fukushima Prefecture Citizens' Health Management Fund established in Fukushima Prefecture is funded through subsidies from MOE, and individual projects are under way funded by Decontamination Countermeasure Business Grants that Fukushima Prefecture provides to the municipalities.

3.3.2. Situation regarding Budget Implementation and Compliance with Claims for Compensation

(1) Implementation of Expenses relating to the Nuclear Disaster

The amount spent from FY2011 to FY2015 on three projects under the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials comes to about 1,822.7 billion yen, of which expenses related to measures for decontamination, etc. of contaminated soil, etc., are 1,633.7 billion yen.

Expenditures for "Emergency decontamination implementation projects" implemented urgently starting before the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials entered into force were over 215.1 billion yen (including expenditures other than decontamination), while expenditures for "Radiation emergency reduction countermeasures projects, etc." were over 20.9 billion yen.

The total expenditures of these projects related to measures to reduce radiation dose by decontamination and other measures totaled more than 1,869.8 billion yen.

(2) Implementation of Expenses other than those relating to the Nuclear Disaster

In addition to decontamination implemented as nuclear disaster-related expenses, local governments are implementing improvement of topsoil as measures to reduce radiation doses. These are not subject to measures for decontamination, etc. based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, so they are not eligible as supplemental projects, but are implemented by local governments as their own projects. As a result, some of the project costs are subject to the special allocation tax for earthquake disaster reconstruction.

The total amount of special allocation tax for earthquake disaster reconstruction related to measures to reduce radiation from FY2011 to FY2015 was about 5.4 billion yen for 138 cases in 7 prefectures.

(3) Claims for Compensation from Tokyo Electric Power Company

Measures to be taken under the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials are to be implemented under the burden of Tokyo Electric Power Company under the provisions of Article 44, Paragraph 1 of the Act, and the national government is to take measures for decontamination, etc., and make claims for compensation from TEPCO for the required expenses. According to Article 35 of the same Act, in the Intensive Contamination Survey Areas (ICSA), the national government is to implement measures for decontamination, etc., of the land within the decontamination implementation areas and controlled by the national government, and not only the Ministry of the Environment, but also the Ministry of Justice, Ministry of Finance, Ministry of Education, Culture, Sports, Science and Technology, and others are to take measures for decontamination, etc., and make claims for compensation from TEPCO.

As for MOE, in February 28, 2018, it requested approximately 1,989.4 billion yen for expenses related to measures for decontamination, etc., and approximately 1,388.3 billion yen was accepted. The amount not accepted has not been paid at the present time, due to reasons such as TEPCO requiring time to confirm evidence documents.

3.4. Establishment of Decontamination Methods

3.4.1. Selection and Establishment of Decontamination Methods

(1) History of the Selection of Decontamination Methods

In April 2011, Date City and Koriyama City began decontamination as soon as possible in school yards, etc., and decontamination was carried out by removing topsoil and concentrating it in the ground and turning the soil over (deep plowing). This work was the decontamination of specific local facilities, and there were differences in decontamination methods among municipalities.

Against this backdrop, the Japan Atomic Energy Society announced on August 12, 2011, that it had translated the results of the EURANOS project conducted by the European Commission for the purpose of preparing for emergency situations involving radiation such as nuclear power accidents, the "Comprehensive Handbook for Residential Area Management," with the title (in Japanese) as the "EURANOS Data Sheet." It contains 59 decontamination technologies for the residential environment.

In addition, the Japan Atomic Energy Society announced the "Decontamination Technical Catalog" on October 27, 2011, describing decontamination techniques based on the EURANOS Data Sheet, 64 technologies with the perspective of applicability to Japan (of which 27 are non-residential environment and 20 are unique to Japan).

The Cabinet Office announced a "Decontamination Technical Catalog" on November 22, 2011 based on the results of decontamination activities so far and the "EURANOS Data Sheet" and "Decontamination Catalog" prepared by the Japan Atomic Energy Society. This catalog lists 23 decontamination techniques for applicable for decontamination.

Regarding farmland, field trials were conducted from May 2011 mainly by the Ministry of Agriculture, Forestry and Fisheries, and on September 30, 2011, "Publication of appropriate methods of decontamination of farmland" was compiled.

Meanwhile, the Cabinet Office commissioned JAEA to ascertain the decontamination effects in a relatively wide range of areas including land uses, such as housing, roads, and vegetation, etc., so from November 2011, it implemented "Decontamination Model Projects" and "Decontamination Technique Demonstration Test Projects." The MOE also implemented "Decontamination Technique Demonstration Projects" starting from December 2011 to identify techniques that can be utilized for decontamination work. Fukushima Prefecture as well, starting from November 2011, implemented "Fukushima Prefecture Whole Area Decontamination Model Projects" for confirming decontamination techniques and decontamination effects for whole area decontamination, as well as the "Fukushima Prefecture Decontamination Technology Demonstration Project" for spreading efficient and effective methods.

The findings obtained by these projects were incorporated into the "Decontamination Guidelines" prepared by MOE. In addition, knowledge based on experiences of the decontamination contractors was appropriately fed back to the project, and on May 17, 2013, the "Collection of Good Practices in Decontamination" was compiled by the Fukushima Office for Environmental Restoration of MOE and distributed to decontamination contractors, and the decontamination related guidelines have subsequently been revised and expanded.

(2) Decontamination Model Projects

1) Cabinet Office (JAEA) Model Demonstration Project

In response to the Basic Policy for Emergency Response on Decontamination Work, in November 2011, the Cabinet Office commissioned JAEA to implement Decontamination Model Projects in order to establish efficient and effective decontamination measures related to decontamination of soil and other materials (mainly targeting areas with high radiation doses where the additional annual radiation dose exceeds 20 mSv/y), and policies to ensure safety measures relating to the radiation protection of workers.

Specifically, it was decided to select target zones of a certain land area in 11 municipalities (Tamura City, Minamisoma City, Kawamata Town, Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Namie Town, Katsurao Village, Iitate Village) within Restricted Areas and Deliberate Evacuation Areas, test applicable decontamination methods and technologies, analyze the decontamination effects, and utilize the findings to develop whole area decontamination implementation plans and conduct decontamination work.

These efforts found that decontamination could reduce the air dose rate to a considerable extent, but also that current decontamination technologies had limitations.

Besides decontamination techniques, the decontamination model projects provided much valuable information, including the importance of monitoring to avoid overlooking hotspots, the importance of preparing the work environment (obtaining water, materials for decontamination, etc.), the impact of winter weather on decontamination, effective measures to maintain the quality of large-scale decontamination work, effective measures to prevent recontamination, the possibility of recontamination, and effective measures to reduce waste, etc. The projects also highlighted residents' concerns about decontamination and the importance of caring for decontamination workers.

Group / Municipalities		Target Areas
A	Minamisoma City	Around Kanabusa Elementary School
	Kawamata Town	Sakashita Area
	Namie Town	Tsushima Area, Gongendo Area
	Iitate Village	Kusano Area, Base point etc.
B	Tamura City	Jikenjo Area
	Katsurao Village	Around Village Office
	Tomioka Town	Yonomori Park, Tomioka Daini Junior High School
C	Hirono Town	Chuodai / Nawashirogae Area
	Okuma Town	Around Town Office Ottozawa Area
	Naraha Town	Kamishigeoka Area Minami Industrial Estate
	Kawauchi Village	Kainosaka Area

Note) Not conducted in Futaba Town.

Figure 3-14 Target area of model demonstration project Source :MOE "About the transition of the air dose rate after the Decontamination Model Projects" (August 4, 2017)

2) Fukushima Prefecture Whole Area Decontamination Model Project

In Fukushima Prefecture, in order to verify the effect of radiation dose reduction effect of implementing decontamination using decontamination methods indicated in "Guidelines for Municipal Decontamination Work" (August 26, 2011 Nuclear Emergency Response Headquarters), the "Fukushima City Whole Area Decontamination Model Project" was implemented for about 10 ha of the Onami district of Fukushima City starting in November 2011.

As a result of comparing the rate of reduction of radiation doses for each decontamination method indicated in the Guidelines for the entire human living area including regular houses, meeting places, shrines, residential areas including elementary schools, farmland, forests, and roads, etc., it was found that the rate of reduction of radiation dose by dyeing (surface dose rate of the subject of decontamination) greatly differs, from 0 to 80%, due to differences in subject and method. The rate of reduction of air dose rate by whole area decontamination was 34%, so the effectiveness of whole area decontamination was confirmed to reduce radiation doses throughout the region.

The findings were summarized regarding prior notification and explanations to residents, the amounts and treatment of decontamination waste, safety management, and about impacts on public water bodies, etc., and as a reference for municipalities to proceed with whole area decontamination, the knowledge was used in the preparation of "Technical Guidelines on Decontamination Operations" (January 2012), and a "Handbook for Whole Area Decontamination" (March 2012), etc.

3) Field trials on decontamination technology of agricultural soil (Ministry of Agriculture, Forestry and Fisheries)

On farmland, field trials on decontamination techniques for agricultural soil were conducted in Iitate Village and Kawamata Town, mainly by the Ministry of Agriculture, Forestry and Fisheries starting on May 28, 2011, and on September 30, 2011 the findings were summarized in "Publication of appropriate methods of decontamination of farmland."

After that, the Ministry of Agriculture, Forestry and Fisheries started a demonstration project for the development of decontamination techniques for farmland starting in February 2012, and from the verification at the work demonstration level, it carried out efforts toward practical application at the field level, and 2012 in February, the findings were summarized in the "Technical Document for Decontamination of Farmland," which summarizes features based on work method.

(3) Decontamination Technology Demonstration Projects

Commissioned by the Cabinet Office, JAEA implemented the "Decontamination Technology Field Trial Project" from November 2011 to February 2012 to invite submissions and discover promising new decontamination technologies that could be applicable, with the aim of evaluating effectiveness by conducting demonstration field trials.

The MOE conducted the "Decontamination Technology Demonstration Project" starting in December 2011 in order to discover technologies that can be utilized for decontamination work and to verify their

effectiveness in decontamination, as well as economic viability and safety, etc. An open call was made for decontamination technologies, which were then reviewed by an expert committee, and field trials were conducted on selected technology proposals. Demonstration projects have been conducted every year since then. In 2015 they were conducted under the title of "Decontamination and Volume Reduction Technology Demonstration Project," and since 2016 they have continued as the "Volume Reduction of Decontaminated Soil Technology Demonstration Project."

Fukushima Prefecture as well has conducted the "Fukushima Prefecture Decontamination Technology Demonstration Project" since November 2011 by making an open call for excellent decontamination technologies and publishing the results of their effectiveness, for the purpose of spreading effective and efficient methods and promoting decontamination activities in all areas of the prefecture in the future. Demonstration projects have been carried out every year since 2015 and are implemented at the Center for Environment Creation.

During the period from 2011 to 2015, 67 decontamination technology demonstration projects were implemented by MOE and 49 by Fukushima Prefecture. For decontamination technologies such as ultra-high pressure water cleaning, cutting and topsoil stripping, as well as radiation measurement techniques and volume reduction techniques, etc., efficient methods were demonstrated and adopted in the field.

Table 3-9 Decontamination Technology Demonstration Projects by MOE (1/2)

FY	Method	Features	Associated company
2011	High-pressure water washing	High-pressure water washing, wastewater collection, treatment, circulation	Fukushima Komatsu Forklift Co., Ltd.
	Extra high pressure washing	Adsorption / self-propelled type	Muramoto Corporation.
	Extra high pressure washing, peeling off	Large-sized, medium-sized, compact ultra-high pressure water cleaning device, coating peeling off	Toden Engineering Co., Ltd.
	Classification	Automation of wet classification, scrubbing washing (wet type), concentration residue treatment	Shimizu Corporation
		Mixed jet pump, helical classifier (wet type)	Maezawa Industries, Inc.
		Mixing pump, sieve type classification (wet type)	Radwaste and Decommissioning Center
		Disintegration / classification (dry type), surface polishing (dry type)	Fuji Furukawa Engineering & Construction Co. Ltd.
	Topsoil	Surface dose measurement by optical fiber, top soil stripping	IHI Corporation
	Coagulation precipitation	Coagulation sedimentation (high speed)	Mitsubishi Kakoki Kaisha, Ltd.
	Dredging	Dredging equipment, centrifugal separation classification (wet type)	Toyo Construction Co., Ltd.
	Biomass power generation, ethanol production	Gasification and carbonization by pyrolysis, utilization of generated gas	TEKKEN Corporation
		Ethanol production (herbaceous / woody series)	Contig-i Co., Ltd.
		Phytoremediation, ethanol production (polysaccharide plants) · Gasification power generation	Japan Groundwork Association

		Pyrolysis (carbonization / gasification), burning charcoal	Konoike Construction Co., Ltd.
	Washing	High-pressure water washing, wastewater collection, treatment, circulation	Aizudoken Co., Ltd.
		Adsorption / self-propelled type	Toonokousan Corporation.
	Solidification (superfluid method)	Solidification and volume reduction of incinerator ash by solidifying agent and external vibration	Hazama Corporation
	Washing	Cs elution from fly ash, Cs adsorption in Prussian blue	Koriyama Chip Industry Co., Ltd.
	grinding	Wet blast	Macoho Co., Ltd.
	Grinding / classification	Water solidification, grinding class (dry type)	Takasago Thermal Engineering Co., Ltd.
2012	Extra high pressure washing	Extra high pressure water / small amount of water wash, wastewater collection, treatment, circulation (portable type)	Shimizu Corporation
	Cutting	Special bits, thin layer cutting	NIPPO Corporation
	Topsoil	Unmanned high altitude digging machine	Fukasawa Construction Company Inc.
	incineration	Solidification with water glass, iron Ferro cyanide	Tokyo Institute of Technology
	Water treatment	Ion adsorption / filtration by functional carbide (portable type)	GAIA Institute of Environmental Technology Inc.
	Changing	Thin layer drift, thin layer covering sand	Taisei Corporation
	Carbonization	Carbonization by superheated steam	Shirakawa well Boring Co., Ltd.
	Abolition	Fuelization of low temperature thermal decomposition, non-contaminated fraction	Toonokousan Corporation.
	incineration	Incineration / disinfection (portable type) by in-furnace air-cooled incineration	Shinsei Engineering Co., Ltd.
	Washing	Water washing, surface contamination density measurement of wood (log with log)	Neonite Corporation
	Melting	Stabilization / extinction by incineration ash melting	Kobe Steel, Ltd.
	Solidification / non-dissolution	Solidification with composite synthetic resin	E & E Techno Service Co., Ltd.
		Granulation of incinerated ash by cement, washing after solidification	Obayashi Corporation
	Reuse	Utilization of concrete aggregate of polluted garret	Toda Corporation
	Other	Storage with multifunction embankment	Asahi Kasei Geotech Corporation
2013	Fluoride salt	Cs capacity using fluoride salt at normal temperature and normal pressure	Swing Corporation
	Vacuum pressurization	Solidification using cement and dehydration abatement by vacuum pressurization	Maeda Construction
	Classification	Classification of bottom sediment in situ	Aomi Construction Co., Ltd.
	Crushing / suction / recovery	Labor saving of green decontamination by crushing and suction system	Fukushima Komatsu Forklift Co., Ltd.
	Drying / crushing	Drying of mixture of plant and soil, classification after disruption	Obayashi Corporation
	Monitoring by unmanned	Creation of air dose rate map by ultra low altitude measurement by unmanned	Chiba University

	helicopter	helicopter and creation of vegetation / land cover situation map by hyperspectral technique	
	Container unit	Simple measurement of radioactivity concentration in container	Toshiba Corporation
	monitoring	High efficiency cleaning of Cs in incineration ash	Fujita Corporation
	Washing	Recovery of Cs from incineration fly ash using magnetic nanoparticles carrying adsorbent	Taisei Corporation
	Washing / magnetic separation	Decontamination of aluminum heat exchange crystals of vehicle by organic acid (main component)	E&E Techno Service Co., Ltd.
	Organic acid	Decontamination of recycled waste home appliances made by sodium bicarbonate blast	Chugai Technos Corporation

Table 3-9 Decontamination Technology Demonstration Projects by MOE (2/2)

FY	Demonstration theme	Associated company
2014	Decontamination of aluminum heat exchange crystals of vehicle by organic acid (main component)	E&E Techno Service Co., Ltd.
	Decontamination of recycled waste home appliances made by sodium bicarbonate blast	Chugai Technos Corporation.
	Filter traveling type filter-Demonstration operation for radiation exposure reduction using breath	Ishigaki Company, Ltd.
	Experiment of washing contaminated soil with radioactive materials and verification for reuse of soil after washing	Hitachi Kikai Ltd.
	Improvement of transportation efficiency and verification of safety and economic efficiency by demonstration of volume reduction and stabilization of organic matter contaminated with radioactive materials by bio-coking and volume reduction	Chugai Ro Co., Ltd.
	Safe treatment method of fishing nets left in the Areas under Evacuation Orders by thermal cracking method: waste difficult to process “	Nihon Plant Kensetsu Corporation
	Demonstration of safe volume reduction processing system of trapping harmful birds and beasts	Kyowa Kako Co., Ltd.
	Efficient construction technique of difficult-permeable soil layer using local excavated soil by simple crushing method	Taisei Corporation
	Demonstration of mass transit management system utilizing ETC wireless authentication technology related to transport of removed soil etc. in Fukushima prefecture	Hanshin Expressway Co., Ltd.
	Application demonstration of non-contact, highly efficient, energy-saving water jet cutter to flexible container breakage process at intermediate storage facility	Shimizu Corporation
	Large unloading and bag breaking equipment that does not require workers and technology for purifying rotting water in a flexible container	Obayashi Corporation
	Demonstration of concentration selection system for removed soil	AREVA NC - Japan Co., Ltd.
2015	Removal of radioactive cesium contained in incineration ash by hydrothermal extraction method, volume reduction of radioactive material, and demonstration of stabilization	Nagaoka University of Technology
	Development of technology for decontamination and volume reduction of contaminated soil fine granules using environment-friendly detergent and reuse of purified soil	Osaka University
	Demonstration and validation of soil improvement, reduction of volume by sieving, and promotion and reuse of agricultural land recycling system enabling selection and removal of plants contained in soil with high moisture content and high viscosity	Kajima Corporation
	Decontaminating Decontamination of Fine Granular Soil by	CDM Consulting Co., Ltd.

	Quasi-Continuous Subcritical Hydrothermal Explosion Treatment	
	Comparative verification of safety (exposure reduction / work safety) of sand bag measurement using backhoe type radiation measurement device, labor saving	Hitachi Power Solutions Co., Ltd.
	Technique for measuring transportable radioactive concentration at the time of transportation of removed soil etc. and technology for suppressing generation of dust etc. at the time of landfill	Obayashi Corporation
	Demonstration of rapid measurement technique of air dose by gamma ray visualization device from sky utilizing mini-server	Kikuchiseisakusho Co., Ltd.
	Technique for treatment of radioactive materials removal by cross flow shredder Auxiliary project	Kajima Environment Engineering Co., Ltd.
	Decontamination, volume reduction and materialization technology by melting decontamination of metal waste contaminated with radioactive cesium	Mitsubishi Materials Corporation

Source: Ministry of the Environment "Outline of FY2011 Decontamination Technology Demonstration Projects" (August 2012)
: Ministry of the Environment "Outline of FY2012 Decontamination Technology Demonstration Projects" (May 2013)
: Ministry of the Environment "Outline of FY2013 Decontamination Technology Demonstration Projects" (December 2013)
: Ministry of the Environment "Outline of FY2014 Decontamination Technology Demonstration Projects" (January 2015)
: Ministry of the Environment "Outline of FY2015 Decontamination and Volume Reduction Demonstration Projects" (January 2016)

Table 3-10 Decontamination Technology Demonstration Projects by Fukushima Prefecture

FY	Outline of decontamination technique, etc.	Associated company
2011	Decontamination technology using special polymer material	EARTH
	High pressure cleaning and polluted water recovery technology	Fukushima Building Maintenance Association
	Decontamination technology using special decontamination opportunities	Kageyama Kensetsu
	Decontamination technology related to pavement surface and side grooves such as public facilities and school roads (ND-S system)	Shimizu Corporation / THE NIPPON ROAD Co., Ltd. JV
	Technology for decontamination of houses by dry ice blasting and coating removers	Chiyoda Technol Corporation
	Safety, security, effective floor decontamination technology combining shot blasting, grinding machine and high pressure water cleaning	Takenaka Corporation
	Technology to manage waste etc. in decontamination using moving images and GPS	Earth Design International Inc.
	Decontamination technology of turf grass etc. by engine bloomers	Nishimaki Shokuen
	Decontamination technology related to pavement surface and side grooves such as public facilities and school roads (ND-S system)	Shimizu Corporation, THE NIPPON ROAD Co., Ltd. JV
	Technology for decontamination of houses by dry ice blasting and coating removers	Chiyoda Technol Corporation
	Safety, security, effective floor decontamination technology combining shot blasting, grinding machine and high pressure water cleaning	Takenaka Corporation
	Technology to manage waste etc. in decontamination using moving images and GPS	Earth Design International Co., Ltd.

	Decontamination technology of turf grass etc. by engine bloomers	Nishimaki Shokuen
	Decontamination method using coagulant for radioactive substances (contaminated water purification technology such as pool and irrigation pond)	Fukushima Construction Association / Kumaken Co., Ltd. JV
	Method for removing river water etc. using moth grass etc.	Shoken Technology Co., Ltd.
	Polluted soil removal technology by information communication technology construction	Kageyama Kensetsu
	Removal soil removal method using special soil conditioner	Highclay
	Fine particle decontamination method and solidification insolubilization technology of radioactive materials contaminated soil	EARTH
	Soil decontamination technology using new high performance flocculants	Kawasaki Heavy Industries, Ltd.
	Purification and volume reduction technology by classification and cleaning using scrubbing and flotation	Shimizu Corporation
	Decontamination and volume reduction technology of radioactive cesium contaminated soil using attrition classification washing and high performance flotation together	Nishimatsu Construction Co., Ltd.
	Separation decontamination technique using high pressure washer in soil containing crushed stone and gravel at the housing site	Yuichi Hirota
	Soil volume reduction technology using coagulant for radioactive materials	Fukushima Construction Association / Kumaken Co., Ltd. JV
	Decontamination by volatilizing radioactively contaminated soil, volume reduction technology	Sumitomo Mitsui Construction Co., Ltd.
2012	Decontamination of general houses by recycling recovery type radioactive decontamination machines	Aiwa Corp Co., Ltd.
	Econ / polyion construction method	Eco Bond Environmental Engineering Research Co., Ltd.
	Decontamination by dry coating of zeolite-containing polymer aqueous solution	Katsuri Inc.
	Sewage scattering zero / low pressure nano microscopic steam cleaning method	Shimizu Building Life Care Co., Ltd.
	Washing with diluted hydrogen peroxide solution	Shoken Technology Co., Ltd.
	Filler removal device in artificial turf field	Turf Cycle Co., Ltd.
	Decontamination of road surface (asphalt) etc. by blasting	Toda Corporation, Sankyo Kousan Co., Ltd.
	Decontamination technology using nano bubble natural surfactant washing solution	Binos Co., Ltd., Tokyo, Electric Power Environmental Engineering Co., Ltd., Hitachi-GE Nuclear Energy Ltd., Obayashi Corporation
	Technique for peeling contaminated soil in sheet form	A&A Material Corporation
	In-vehicle type water treatment equipment	Tokyu Construction
	Broad area contamination barrier system for agricultural water for the revitalization of the Fukushima brand	Maeda Corporation.
	Information construction technique using radiation dose planar distribution measurement system	Sumitomo Mitsui Construction Co., Ltd.
	Ares RXP reset coating peeling type decontamination method	Kansai Paint Co., Ltd.
	New integrated decontamination system in structures	Kikuchiseisakusho. Co., Ltd. (NPO) Physical Education Environment

		Invention Organization, Organic System
	Decontamination technology by combination of bio-extron method and wiping with iron chelating agent	Yamizo Material Inc.
	Ultra small portable fully automatic decontamination wastewater / sludge treatment system	Astec Tokyo
	Decontamination of agricultural water using side grooved radioactive cesium adsorbent	Kasai Co., Ltd.
	Ultrasonic Soil Cleaner	Aomi Construction Co., Ltd.
2013	Flexible container that combines safety and volume reduction of leaching water	Tatsuno Corporation
	Technology for reducing volatilization of agricultural lands and schoolyards and temporarily placed soils	Nichisuikan Giken
	Reduction technology of soil contaminated with cesium and dredged soil	Honma Corporation., Japan Port Consultants, Ltd., Kankyo Anetos Co., Ltd.
	Purification system for wastewater recovered during decontamination	Clean Tech Koizumi Corporation
	Decontamination technology such as fire prevention tank / pool / adjustment pond	Tokyu Construction
2014	Validation of effective decontamination techniques and methods in cracks on pavement surface	Obayashi Road Corporation, Tohoku Branch office
	Validation of effective decontamination technique of road side groove	Sato Forestry Co., Ltd
	Verification of effect by decontamination target etc. in housing decontamination	Pacific Consultants Co., Ltd., Japan Atomic Energy Agency, Pony Industry Co., Ltd., Matsuura Denkosha Co., Ltd.
	Validation of effective measuring technique in housing decontamination	Japan Radiation Engineering Co., Ltd., Hitachi Power Solutions Co., Ltd.
2015	Effect of decontamination due to differences in geographical conditions	Earth Design International, Inc.
	Efficient post-monitoring and creation of air dose rate map	Kokusai Kogyo Co., Ltd. Fukushima Sales Office
	Survey on distribution of radioactive materials after decontamination	Kanso Co., Ltd., Fukushima Office

Source: Fukushima Prefecture " 2011 Fukushima Decontamination Technique Demonstration Project Implementation Test Result" (April, 2012)

Fukushima Prefecture "2012 Report on the 1st Fukushima Decontamination Technique Demonstration Project Implementation Result Report" (February, 2013)

Fukushima Prefecture "2012 Report on the 2nd Fukushima Decontamination Technique Demonstration Project Implementation Results " (June, 2013)

Fukushima Prefecture "2013 Fukushima prefecture decontamination technology demonstration project implementation report" (June, 2014)

Fukushima Prefecture "2014 Fukushima prefecture municipal decontamination technology support project implementation report" March, 2015)

Fukushima Prefecture "2015 Fukushima prefecture municipal decontamination technology support project demonstration test result report" June, 2016)

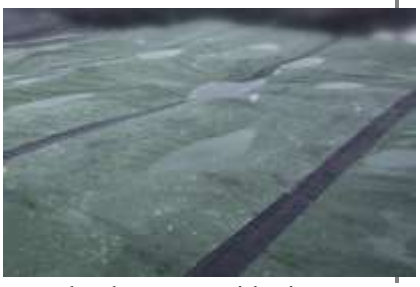
Commentary	Decontamination technology demonstration projects by Fukushima Prefecture

Status of Fukushima Prefecture decontamination technology demonstration projects

Project name	Decontamination technology demonstration projects			Municipal decontamination technology support projects		
Year	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Number of tested technologies	19	18	5	4	3	2

Recovery type high pressure water cleaning technology

Roadside gutter cleaning technology



Technology to avoid rainwater pooling on top of Temporary Storage Sites

Commentary	Decontamination in Joban expressway

Among infrastructure facilities, there were strong local requests for quick restoration of the Joban Expressway as it passes through areas with high air dose rates. Therefore, decontamination was necessary for to protect workers from radiation at the time of restoration work, so upon receiving an inquiry from the Ministry of Land, Infrastructure and Transport and the East Nippon Expressway Co. (NEXCO East Japan), MOE started a model demonstration project in March 7, 2012, in collaboration with the Reconstruction Agency and the Ministry of Land, Infrastructure and Transport.

The model demonstration project was completed on July 31, 2012, with the projection that even sections with the highest annual dose exceeding 200 mSv/y could be reduced to less than 50 mSv/y. Based on the results, work was carried out for decontamination of the Joban Expressway starting in December, 2012 and it was completed in June 2013.

Accordingly, as a result of restoration and maintenance work by NEXCO East Japan Ltd., after the reopening of the Joban Tomioka Interchange (IC) - Hirono IC section on February 22, 2014, the Namie IC to Minamisoma IC reopened on December 6, 2014, and Joban Tomioka IC to Namie IC opened on March 1, 2015, so all routes of the Joban Expressway were open for traffic.

For this decontamination work, new technology such as recirculating high pressure water washing was introduced. Decontamination was carried out in an integrated manner with restoration and maintenance work by NEXCO East Japan. The result was a positive example of achieving a significant reduction in radiation doses while at the same time reducing waste and minimizing the amount of time needed for the work.

3.4.2. Technical Guides and Guidelines

(1) Decontamination Guidelines

On December 14, 2011, MOE formulated and released the "Decontamination Guidelines," which systematically compiled decontamination methods and other information based on the Act on Special Measures concerning the Handling of Pollution by Radioactive Materials. The guidelines described clearly and in detail such topics as the investigation and measurement of the status of contamination, actual decontamination, and the processes for collecting, transporting and storing soil removed by decontamination. Below are its four sections.

Part 1: Guidelines on investigation and measurement methods for the status of environmental pollution in Intensive Contamination Survey Areas (ICSA)
Part 2: Guidelines relating to measures for decontamination, etc.
Part 3: Guidelines for the collection and transport of removed soil
Part 4: Guidelines for the storage of removed soil

Figure 3-15 Decontamination Guidelines

Although these guidelines mainly deal with decontamination done by municipalities, decontamination by the national government is also covered. They were revised as a second edition in May 2013 to incorporate knowledge obtained subsequently, as well as new technologies, and input from experts and local governments, etc., and in order to promote decontamination more effectively, supplements were added in December 2013, December 2014, and September 2016.

As for the matters such as the storage and treatment of waste contaminated by radioactive materials from the accident, "Guidelines for Waste" were formulated on December 27, 2011..

Part 1: Guidelines on investigation and measurement methods for the status of environmental pollution in Intensive Contamination Survey Areas (ICSA)

These guidelines are Part 1of the Decontamination Guidelines and as shown in Figure 3-16, they explain the investigation and measurement in Intensive Contamination Survey Areas (ICSA) of environmental pollution caused by radioactive materials from the accident, as well as measurement methods required for detailed measurement, decontamination, and storage of removed soil in decontamination implementation areas, plus recommended methods for making accurate measurements.

Part 2: Guidelines relating to measures for decontamination, etc.

These guidelines use specific cases to explain a ministerial ordinance of MOE concerning measures for decontamination, etc. of soil, etc., as stipulated in Article 40, paragraph 1 of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials.

Each municipality is to select appropriate methods from among the decontamination methods described in the guidelines based on the decontamination implementation plan formulated. The targets of decontamination include buildings, roads, and farmland, and forests within 20 m from the edge of the forest.

The document mentions that the decontamination methods described in the guidelines were deemed appropriate at the time of writing, but that they will be revised from time to time based on future knowledge and technological development, etc.

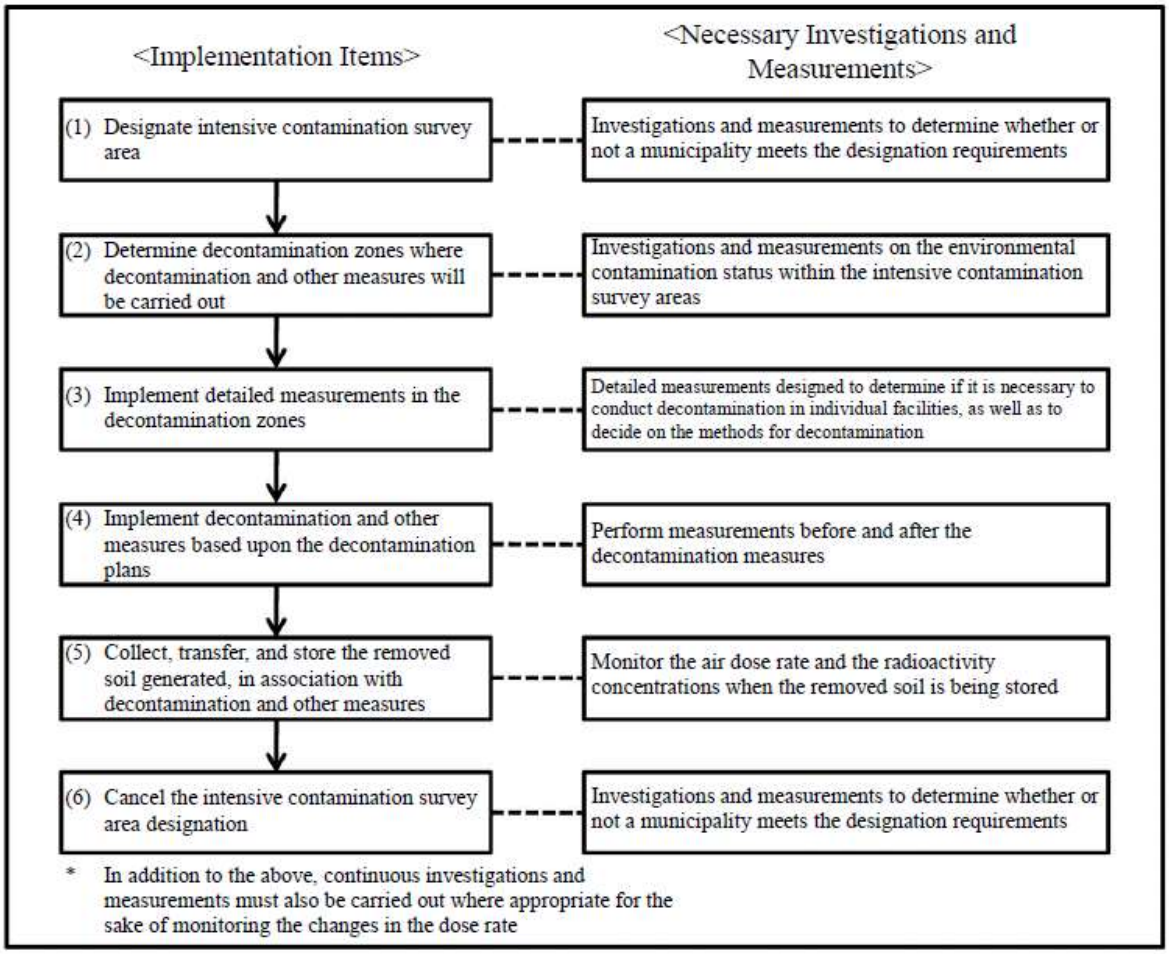


Figure 3-16 Details for implementing decontamination and the survey measurements (Part 1)

Part 3: Guidelines for the collection and transport of removed soil

These guidelines use cases to provide detailed explanations of a ministerial ordinance of MOE concerning the collection and transport of removed soil as stipulated in Article 41, paragraph 1 of the Act on Special Measures.

The document explains that when collecting and transporting removed soils, safety measures are required to prevent radioactive substances in the removed soil from damaging human health and the living environment, and for that it is necessary (1) to prevent radioactive materials from being scattered or discharged during loading, unloading and transporting, and (2) to limit public exposure to radiation from

the removed soil being collected and transported. For these safety measures, the guidelines refer to existing rules for the transportation of radioactive materials, summarize the key points for the collection and transport of removed soils, and explain in detail what needs to be done.

Part 4: Guidelines for the storage of removed soil

These guidelines use cases to provide detailed explanations of a ministerial ordinance of MOE concerning the storage of removed soil as stipulated in Article 41, paragraph 1 of the Act on Special Measures.

The guidelines cover two modes of storage ("on-site storage" and "storage at Temporary Storage Sites") and summarize the facility requirements and management requirements for safe storage. Details of the facility specifications and safety management that conform to these requirements and methods are also illustrated.

Table 3-11 Revision of Decontamination Guidelines

Time of revision	Main revisions / supplemental contents
May 2013 (Second edition)	Over a year after the first edition, after exchanging opinions with experts and concerned local governments based on the accumulation of knowledge from decontamination work etc., based on questions and discussion points the following revisions were made. (1) Including new technology · Extra high pressure water washing, recovery type high pressure water washing, steam cleaning, decontamination of artificial turf, etc. (2) Including know-how of decontamination work, incorporating effective and efficient methods, clarifying decontamination targets. · Descriptions of points to be noted for enhancing the decontamination effect for each decontamination method: decontamination of roofs (cautions for wiping, high pressure water washing), decontamination of plants (method of deep cutting of turf), etc. · Organization and enhancement of measurement description (surface contamination density, GM survey meter, time constant etc.) · Positioning of agricultural drainage channels subject to decontamination (3) Responding to improper decontamination · Describe concrete methods concerning wastewater treatment · Describe concrete methods concerning cleaning etc. of tools (4) Improving understandability · Flowchart of decontamination work procedure · Full replacement and addition of photos (5) Improving explanations from risk communication perspective · Description of solubility of radioactive substances in water and data on adsorption to soil · Presentation of data on groundwater monitoring at storage (Temporary Storage Sites)
Dec. 2013 (Second edition supplement)	Based on "Current arrangements on forest decontamination methods" etc., reflected technical information such as new knowledge and decontamination methods in forests. (1) Addition of knowledge on the dynamics of radioactive substances in forests (2) Addition of knowledge on effective decontamination methods
Dec. 2014 (Second edition supplement)	Based on the "Summary of ideas of countermeasures in rivers, lakes, etc." reflected technical matters such as new knowledge and decontamination methods in rivers, lakes and the like.
Sep. 2016 (Second edition supplement)	Measures for decontamination, etc. in forests and details of strengthening management systems reflected. (1) Change of title, etc. · "Measures for decontamination, etc. of plants" was changed to "Measures for decontamination, etc. of plants and forests" (2) Measures for decontamination, etc. of places where people routinely enter the forest · Regarding measures for decontamination, etc. at places where people routinely enter in forests such as satoyama around dwellings, a description related to the range of decontamination and the way of thinking of measurement points was added (3) Measures to prevent sediment discharge · Addition of descriptions pertaining to ideas and installation examples of application points concerning sediment discharge measures to be implemented as necessary as measures for decontamination, etc. of forests (4) Update / addition of knowledge

Time of revision	Main revisions / supplemental contents
	· Addition of knowledge updated after December 2013 (5) Response in case of disaster in collection, transportation and storage of removed soil · September 2015 - Added a description on countermeasures against disasters in order to prevent the recurrence of soil runoff, etc. during disasters such as the Kanto and Tohoku heavy rains

(2) Other Technical Guidelines

1) Guidelines on Handling Local Areas Contaminated by Radioactive Materials (Ministry of the Environment)

While the "Decontamination Guidelines" indicate decontamination methods based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, locations outside of those covered by the Act were also confirmed to have localized contamination, so on March 12, 2012 MOE released the "Guidelines on Handling Local Areas Contaminated by Radioactive Materials."

These guidelines summarize key points on specific methods such as efficient ways to discover these localized contaminated sites, particularly where soil and the like has been contaminated by rainwater drainage containing radioactive substances, as well as detailed investigation methods after discovery, and the implementation of measures to deal with them.

2) Technical Guidelines on Decontamination Operations and Handbook for Whole Area Decontamination (Fukushima Prefecture)

In order to ensure that municipalities could implement decontamination consistently when doing decontaminating in Intensive Contamination Survey Areas (ICSA) based on decontamination implementation plans, there was a need to provide concrete and concise decontamination procedures and management standards. Thus, based on the "Decontamination Guidelines," Fukushima Prefecture prepared the "Technical Guidelines on Decontamination Operations" and released them on January 31, 2012.

These technical guidelines indicate decontamination methods, how to ensure safety in work related to decontamination, decontamination work management standards, safe facility installation standards (roads), and so on.

In addition to the technical guidelines, based on knowledge gained from model projects, as a reference for municipal officials when municipalities conduct whole area decontamination, Fukushima Prefecture, released the "Handbook on Whole Area Decontamination" in March 2012, showing basic procedures, how to proceed with administrative tasks, and points to keep in mind.

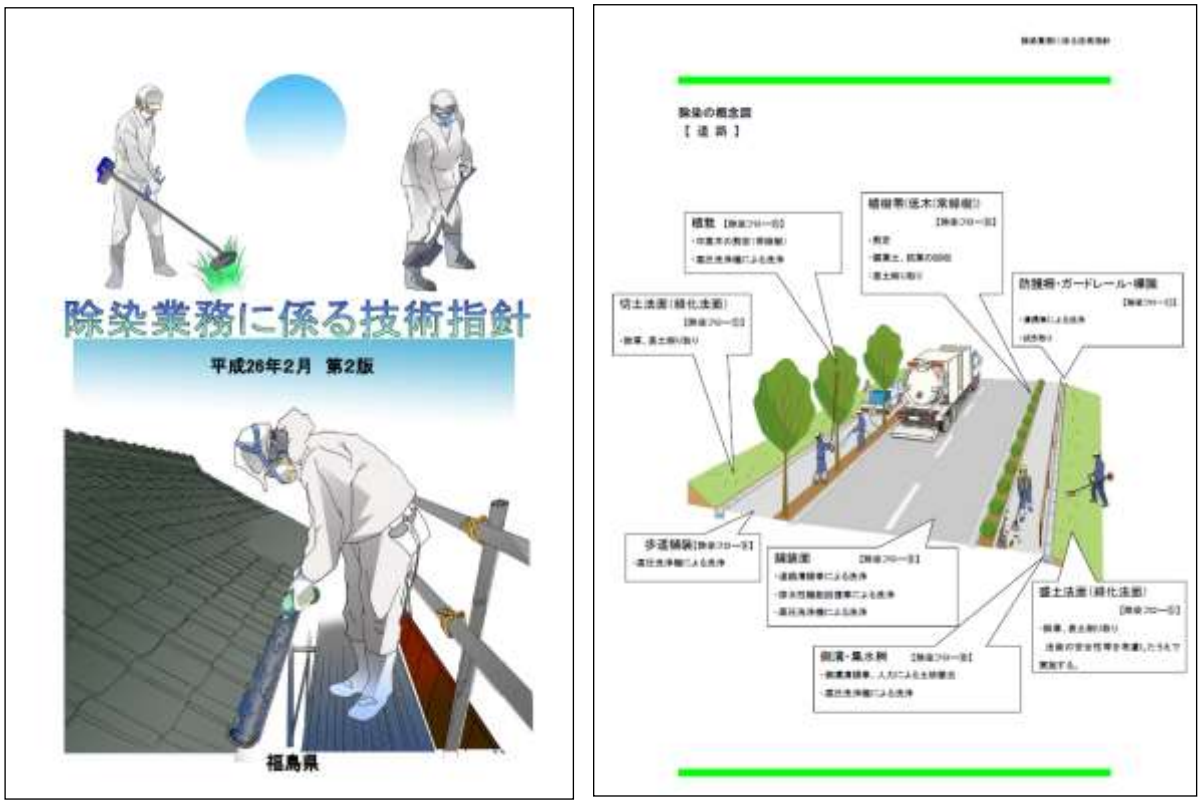


Figure 3-17 Technical Guidelines on Decontamination Operations (Fukushima Prefecture)

3) Technical Guidelines on Removal and Control of Scattering of Radioactive Materials in Forests

The Ministry of Agriculture, Forestry and Fisheries summarized approaches and implementation methods for measures to deal with radioactive substances in forests based on the results of the field trials and released the "Technical Guidelines on Removal and Control of Scattering of Radioactive Materials in Forests" on April 27, 2012.

The technical guidelines describe the characteristics of forest contamination, approaches for measures to deal with radioactive substances, such as removal of sedimentary organic matter such as fallen leaves and removal of branches and leaves.

4) Technical Manual for Decontamination of Agricultural Land

The Ministry of Agriculture, Forestry and Fisheries compiled information on survey, design, accumulation, construction management etc. necessary for implementation of decontamination of farmland based on the results of demonstration projects for decontaminating farmland, and on February 22, 2013, released the "Technical Document for Decontamination of Farmland."

This technical manual is composed of four parts ("Survey and Design," "Work Process," "Quantification," and "Reference Materials"). "Survey and Design" describes the content of preliminary surveys necessary for undertaking farmland decontamination, methods for measuring radioactive materials, approaches for determining work zones and work periods for farmland decontamination work, an outline

of methods implemented in demonstration work, and design approaches.

For each type and item of work and the "Work Process" part describes key points for each type of work, method, and process, as well as preparatory and temporary work. The "Quantification" part summarizes productivity measurements for each work stage based on productivity studies from the demonstration trials.

5) Measurement technology, etc.

On October 21, 2011, the Ministry of Education, Culture, Sports, Science and Technology formulated and announced "Guidelines on Radiation Measurement" as guidelines concerning handling and methods of measuring using measurement instruments.

In the above-mentioned "Decontamination Guidelines" (MOE), Part 1 describes the survey and measurement methods for the state of contamination, and Part 2 describes methods for measurement prior to and after decontamination.

Commentary	Implementation methods for decontamination of farmland (deep plowing and burden stripping)

Regarding farmland, there was a strong desire among farmers in Areas under Evacuation Orders to have the topsoil removed as they could not accept cesium remaining in their fields. On the other hand, after the accident, farm practitioners tried various efforts to lower the concentrations of radioactive materials in crops, with the support of agricultural experts and technicians. Some farmers had a strong resistance to the removal of the cultivation layer that they had developed with great care (soil to a depth of about 15 to 30 centimeters which greatly affects crop growth), so it was decided to explore decontamination techniques that would not involve topsoil removal.

In this context, on September 14, 2011, the Ministry of Agriculture, Forestry and Fisheries summarized the results of research to date and announced its approach, saying, "On farmland with of radioactive cesium concentrations at 5,000 Bq/kg or lower (which is the criterion for determining areas where rice planting is to be restricted), as necessary, it is appropriate to take measures to reduce the migration to agricultural crops and reduce the air dose rates, by inversion tillage, etc."[42] The Nuclear Emergency Response Headquarters announced a similar message on September 30 that year.

On September 30, 2011, the government released a "Publication of appropriate methods of decontamination of farmland" (Nuclear Emergency Response Headquarters). For areas with planting restrictions or voluntary refraining from cultivation being encouraged, the government said, "It would normally be appropriate to scrape off the surface soil layer containing radioactive cesium, but considering the radioactive cesium concentration in the soil, the current condition of the site, and conditions of the soil, etc., in addition to scraping the topsoil, it is also possible to have the option of soil stirring with water, removal, and inversion tillage, etc.. As for areas that had already been plowed, the government issued a guideline saying that inversion tillage and deep tillage should be performed.

Therefore, from 2011 onward, in areas where farming continued, rather than removing the cultivation

[42] the Ministry of Agriculture, Forestry and Fisheries "About radioactive materials removal technology (decontamination technology) of agricultural soil" (September 14, 2011)

layer, it was decided to use inversion tillage or deep tillage to reduce the radioactive concentrations in the cultivation layer and to reduce the air dose rate, and sludge in waterways was to be removed as necessary. On the other hand, in areas with planting restrictions or voluntary refraining from cultivation, as grasses and shrubs would take over or fields would grow wild if farmland was left uncultivated for a half-year to several years , rather than having a resistance to removing the cultivation layer, many farmers commented that they wanted to remove the radioactive materials properly and be able to resume farming.

As for MOE, in the Special Decontamination Areas, while offering the option of deep plowing and deep tillage for farmland with comparatively low concentrations, in other areas the top soil was stripped. Among Intensive Contamination Survey Areas (ICSA), while deep plowing and deep tillage were done outside of Fukushima Prefecture, inside the prefecture, burden stripping and inversion tillage were done, depending on the conditions of contamination.

3.4.3. Tenders for Decontamination Work

(1) History of Tender Methods

For decontamination work contracted out by MOE in the Special Decontamination Areas, just as with public works projects, based on government procurement procedures, public announcements were made for public tenders for decontamination work for procurement on the basis of specification documents, and then decontamination contractors were selected and work contracted out. For individual tasks in decontamination work, just as there are many similarities with public works projects, the general tendering processes for public works were applied, but some additional matters were adopted that applied specifically to decontamination work.

For decontamination work contracted out in Special Decontamination Areas MOE provided common specifications for the work, and in order to ensure consistency in the interpretation of the details of bid contracts and design drawings as well as to specify other essential matters and ensure the proper execution of contracts, MOE formulated Common Specifications for Decontamination and Other Work. Also, for each individual tender, in accordance with the actual situation of the area and site where decontamination was to be done, MOE prepared unique specifications stipulating the specific technical requirements based on the Common Specifications for Decontamination and Other Work, did procurement for specific decontamination projects based on both the Common Specifications for Decontamination and Other Work and the special specifications.

If after consent has been obtained from the landowner or stakeholder and the decontamination method for each decontamination target had been determined and a decision made to initiate government procurement procedures for decontamination– then MOE would contract out decontamination work in the Special Decontamination Areas, based on an approximate estimate of quantities (e.g., area to be decontaminated and the number of buildings, for each type of target to be decontaminated and method of decontamination), on the basis of the results of a preliminary survey. In the process of actually proceeding with decontamination work, the decontamination method for each target of decontamination would be decided and the quantity for decontamination work area and number of buildings would be determined, so the approach used in the contracts between MOE and the decontamination contractors was to settle the

monetary payment for the work contract based on the unit price for work and amount of work actually performed. Thus, MOE issued the "Provisional Quantification Standards for Decontamination Work in Special Decontamination Areas" (First Edition) specifying unit costs in May 2012. Thereafter, productivity surveys were conducted and changes made as needed based on the results, with the tenth edition being released April 2017.

(2) Tenders for Decontamination Work, etc.

For decontamination, etc., work contracted out MOE in Special Decontamination Areas, a public announcement was done using documentation including the Common Specifications for Decontamination and Other Work, special specifications, and Provisional Quantification Standards for Decontamination Work, etc., in accordance with government procurement procedures. An open call was made for technical proposals from decontamination contractors, submissions were evaluated and reviewed, and then bids were entered and opened, and winning bids were decided based on a comprehensive evaluation method on the basis of price points and technical evaluation points. For whole area decontamination, MOE made a public announcement on May 11, 2012, that the first project would be in Tamura City.

In Intensive Contamination Survey Areas (ICSA), local municipalities formulated decontamination implementation plans and placed orders with decontamination contractors based on those plans, and the decontamination contractors implemented the decontamination work. Regarding municipalities outside of Fukushima Prefecture, decontamination work proceeded using funding from the national government's Radiation Reduction Countermeasures Special Emergency Project Cost Subsidy. For municipalities within Fukushima Prefecture, decontamination work proceeded with MOE providing a subsidy to the Fukushima Prefecture Citizens' Health Management Fund, which was set up by the prefectural government, and the prefecture then administering the Decontamination Countermeasure Business Grant. Decontamination methods were prescribed in the Decontamination Guidelines, and implementation was also done based on detailed rules prescribed in decontamination-related Q&A.

(3) Maintaining Business Environments

In order to decontamination work with some unknowns and on a large scale, it is important to have procedures and mechanisms in place that enable smooth progress with the ordering and execution of work. Since MOE had limited resources of personnel who possessed experience with direct implementation of public works projects, MOE benefited from the capacity of highly experienced personnel from the Ministry of Land, Infrastructure, Transport and Tourism and Agriculture, Forestry and Fisheries and made use of those ministries' existing rules and systems. The decontamination work began with MOE provisionally formulating standard specifications, which were essential for decontamination work being commissioned directly by the national government. Subsequently, efforts proceeded through trial and error, depending on the actual situation at the decontamination sites, and over time the specifications and other documentation were gradually improved. As a result, the details became more clearly established, from the overall framework of decontamination work to specific work methods, making it possible to initiate decontamination work in a timely way and ensure work quality.

On the other hand, in the case of conventional public works, detailed design drawings can be prepared in advance, whereas for decontamination, work is contracted before all the consent forms are received, so the order is issued based on approximate numbers. For this reason, it was necessary to agree in advance on matters such as unit prices so that payment adjustments could be settled after decontamination work was actually performed.

Also, when orders were being issued, it is necessary to present documentation on work productivity for each decontamination target, but it was difficult to accurately determine this productivity in advance. Therefore, based on the results of the Cabinet Office's model projects and the decontamination work conducted independently by municipalities and Fukushima Prefecture, trial calculations by ministry personnel experienced in public works at the Ministry of Land, Infrastructure, Transport and Tourism and Ministry of Agriculture, Forestry and Fisheries made it possible for MOE to order work in a timely way.

At actual decontamination sites, there were various situations such as places where trees grew in after the earthquake disaster, so the circumstances did not necessarily agree with the situation in model projects. For this reason, MOE actively pursued the PDCA (Plan-Do-Check-Act) cycle, which corrects the situation according to the actual situation at the work site and feeds back the results. Decontamination on-site may have to be implemented in ways not stipulated in the Decontamination Guidelines and Common Specifications. In this case, national government supervisory personnel and decontamination contractors proceeded through trial and error and mutual communication. Such knowledge was shared among supervisory personnel, and reflected as appropriate in standard specifications documentation, etc.

(4) Specifications for Decontamination in Special Decontamination Areas (SDA)

1) Common Specifications for Decontamination and Other Work

Common Specifications for Decontamination and Other Work describe prior to work being done the typical technical requirements and work details necessary for work such as work sequence, quality of materials to be used, quantities, degree of completion, and work methods, etc.

The types of work indicated in this documentation was for work methods in Special Decontamination Areas where radiation doses were high, so some decontamination work types done by municipalities in Intensive Contamination Survey Areas were not listed.

The first edition was developed in May 2012, and based on experience gained through decontamination work, MOE made updates such as the addition of other decontamination work methods, and in April 2017 released the tenth edition of Common Specifications for Decontamination and Other Work. Tables 3-12 to 3-21 provide lists of the work types listed in Common Specifications for Decontamination and Other Work.

When procurement was being done for a specific decontamination project, the Common Specifications for Decontamination and Other Work were supplemented in light of the actual situation of the target area to be decontaminated and the site conditions, using special specifications prepared separately for the technical requirements particular to the work in question.

In addition to Common Specifications for Decontamination and Other Work, MOE also developed Common Specifications for Decontamination-related Operations and Common Specifications for Supervisory Operations.

Table 3-12 List of methods for decontamination work, etc. (Residential area, etc.)

Details			Decontamination method	Outline
1. Residential areas, etc.	1.1 Roofs, rooftops	1.1.1 Roof (Other than concrete)	1.1.1.1 Removal of deposits	Sediments such as fallen leaves, moss, mud and the like are removed with rubber gloved hands and scoops.
			1.1.1.2 Wiping	Wipe carefully with waste cloth moistened with water or the like.
			1.1.1.3 Brush cleaning	Clean carefully with deck brush or scrubber. Pour water before brushing and rinse with water after brushing.
		1.1.2 Roof (concrete)	1.1.2.1 Removal of deposits	Same as 1.1.1.1.
			1.1.2.2 Wiping	Same as 1.1.1.2.
			1.1.2.3 Brush cleaning	Same as 1.1.1.3.
	1.2 Walls, Fences	1.2.1 Other than earth wall	1.2.1.1 Wiping	Same as 1.1.1.2. A brush or the like is used instead of waste cloth or the like.
			1.2.1.2 Brush cleaning	Same as 1.1.1.3.
		1.2.2 Mud wall	1.2.2.1 Wiping	Same as 1.1.1.2. Instead of cloth or the like, carefully remove it with a brush or the like in a dry state.
	1.3 Gutters	1.3.1 Eaves gutter	1.3.1.1 Removal of deposits	Remove accumulated fallen leaves, moss, mud and the like with a hand wrapped with rubber gloves, a brush or a brush.
			1.3.1.2 Wiping	Same as 1.1.1.2.
			1.3.1.3 High-pressure water cleaning	Washing with high pressure water of about 5 MPa or less and about 2 L/m by using a high pressure washer centering on a part where wiping work is difficult.
		1.3.2 Downspouts	1.3.2.1 High-pressure water washing	If deposits are present, remove them in advance. Wash with high pressure water of 5 MPa or less and 2 L/m using a high pressure washer.
			1.3.2.2 Wiping	Same as 1.1.1.2.
	1.4 Gardens, etc.	1.4.1 Unpaved surfaces	1.4.1.1 Removal of deposits	Sediments such as fallen leaves, moss, mud and the like are removed with a rake or the like.
			1.4.1.2 weeding, lawn mowing	Prior to removal of deposits and top soil, weeds that interfere with work are weeded and mowed by a shawl type mowing machine or human power.
			1.4.1.3 Deep cutting of turf	Deep-grass turf with a hand-guided lawn mower (sod cutter etc.) (about 3 cm). Leave the root mat layer.
			1.4.1.4 Stripping of grass and lawn	Peel off turf with human power (about 5 cm).
			1.4.1.5 turf	When stripping off the lawn, replace the same type of turf as before.
			1.4.1.6 High-pressure water cleaning of gravel, crushed stone	Use a high pressure water washer at 5 MPa or less, and wash it with water of about 20 L/m^2. Gravel, crushed stone is placed in a tank, and high pressure water washing is performed.
			1.4.1.7 Removal of gravel and crushed stone	Gravel and crushed stone are removed homogeneously by scoop etc. (about 5 cm).
			1.4.1.8 Cover of gravel, crushed stone	When gravel and crushed stone are removed, it covers up to the present condition height with the same kind of

				gravel and crushed stone as before.
			1.4.1.9 Scraping of topsoil	Using screeching etc., homogeneously scrape off the soil of the garden soil (about 5 cm).
			1.4.1.10 Land surface coverage	When removing the top soil, cover it to the original height, generally by the same kind of soil as before. Leveling the top soil and leveling.
			1.4.1.11 Removal of topsoil such as near the root of trees	Take a scoop with shovels, rakes, etc. to collect the fallen leaves and soil.
			1.4.1.12 Branching of garden tree	Branching and pruning of garden trees and hedges by pruning machines and branch cutting shears to the extent that there is no significant influence on the growth of trees.
			1.4.1.13 Logging of troubled trees	Troubled trees of diameter 6 cm or more at a breast height are cut from the root using a chainsaw or the like.
			1.4.1.14 Damaged trees	Cut off the troubled trees of diameter 6 cm or more at a breast height, using a chainsaw or the like, and extract it.
			1.4.1.15 Deep plowing	Peel off the surface layer soil by about 10 cm and the lower soil by about 20 cm, uniformly, flatten the surface soil, level the lower soil, and level the surface.
			1.4.1.16 Wiping outdoor equipment	Wipe off outdoor equipment such as water heater and outdoor unit of air conditioner.
			1.4.1.17 Removal of obstacles around houses	Collecting, transporting, and accumulating obstacles that interfere with work for decontamination, etc. around houses.
		1.4.2 Pavement surface	1.4.2.1 Removal of deposits	Same as 1.4.1.1.
			1.4.2.2 Brush cleaning	Same as 1.1.1.3.
			1.4.2.3 High-pressure water cleaning	Wash with high pressure water of about 20 MPa and 20 L/m^2 using a suction type high pressure water washer.
			1.4.2.4 Scraping	Using a hand-held cutting machine, the surface is homogeneously scraped off (about 5 mm).
			1.4.2.5 Blast	Apply to a relatively wide paved surface. Grind the surface uniformly by knocking the abrasive on the surface with a shot blasting machine.

Table 3-13 List of methods for decontamination work, etc. (School)

Details			Decontamination method	Outline
2.School	2.1 Roof roof top	2.1.1 Roof · roof top	2.1.1.1 Removal of deposits	Same as 1.1.1.1.
			2.1.1.2 Wiping	Same as 1.1.1.2.
			2.1.1.3 Brush cleaning	Same as 1.1.1.3.
			2.1.1.4 High pressure water cleaning	Wash with high pressure water of about 15 MPa and 20 L/m^2 using a high pressure water washer. Collect the wastewater in a rainwater cell.
	2.2 Outer wall, fence	2.2.1 Exterior wall / fence	2.2.1.1 Wiping	Same as 1.2.1.1.
			2.2.1.2 Brush cleaning	Same as 1.1.1.3.
			2.2.1.3 High pressure water cleaning	Wash with high pressure water of about 15 MPa and 20 L/m^2 using a high pressure water washer. Collect the wastewater in a rainwater cell.
	2.3 Rain gutter		※Same as 1.Residential area、1.3Rainwater gutter	
	2.4Ground etc.	2.4.1 Sediments	2.4.1.1 Removal of deposits	Same as 1.4.1.1.
		2.4.2 Grass, lawn	2.4.2.1 weeding, lawn mowing	Same as 1.4.1.2.
			2.4.2.2 Deep cutting of turf	Deep-grass turf with a large lawn mower, hand guided lawn mower (about 3 cm). Leave the root mat layer.
			2.4.2.3 Grass and grass stripping	Remove the grass and turf with backhoe (about 5 cm).
			2.4.2.4 Turf	Same as 1.4.1.5.
		2.4.3 Gravel, crushed stone	2.4.3.1 High-pressure water cleaning of gravel, crushed stone	Wash with high pressure water of 5 MPa or less and about 20 L/m^2 using a high pressure water washer. Gravel, crushed stone is placed in a tank, and high pressure water washing is performed.
			2.4.3.2 Removal of gravel and crushed stone	Gravel and crushed stone are removed homogeneously by backhoe etc. (about 5 cm).
			2.4.3.3 Cover of gravel, crushed stone	If gravel or crushed stone is removed, it covers up to the present condition height with the same kind of gravel and crushed stone as before.
		2.4.4 Soil	2.4.4.1 Removal of topsoil such as drainage outlet, near the eaves	Same as 1.4.1.11.
			2.4.4.2 Scraping of topsoil	Remove the top soil homogeneously by backhoe etc. (about 5 cm).
			2.4.4.3 Land surface coverage	When topsoil is removed, cover it up to the original thickness by the same kind of soil as before. Leveling the top soil and leveling.
			2.4.4.4 Deep Plowing	Peel off the surface layer soil by about 10 cm and the lower soil by about 20 cm, uniformly, flatten the surface soil, level the lower soil, and level the surface.
		2.4.5 Planting	2.4.5.1 Removal of topsoil near the root of trees	Same as 1.4.1.11.
			2.4.5.2 Branch of planting	Same as 1.4.1.12.
			2.4.5.3 Logging of	Same as 1.4.1.13.

			troubled trees	
			2.4.5.4 Dropping a hindrance tree	Same as 1.4.1.14.
		2.4.6 Pavement surface	2.4.6.1 Removal of deposits	Same as 1.4.1.1.
			2.4.6.2 Brush cleaning	Same as 1.1.1.3.
			2.4.6.3 High-pressure water cleaning	Same as 1.4.2.3.
			2.4.6.4 - (1) (2) scraping	Using a road surface cutting machine or the like, the surface is scraped off (about 3 cm).
			2.4.6.5 Blast	Same as 1.4.2.5.
			2.4.6.6 Extra high pressure water cleaning	Use a super high pressure water washer (cleaning water recovery type) of 150 MPa or more to scrape the paved surface (about 5 mm).
			2.4.6.7 Resurfacing	When paving off the pavement, pave it so that it becomes the same as the original pavement surface.
	2.5 Play equipment	2.5.1 Play equipment	2.5.1.1 Wiping, cleaning, scraping	Wash with a brush or cloth, wash high pressure water washing parts of metal playground equipment, scrape off rust with sandpaper, etc. Wooden playthings wipe or polish with a waste cloth, brush or the like.

Table 3-14 List of methods for decontamination work, etc. (Park)

Details			Decontamination method	Outline
3. Park (small)	3.1 Roof · rooftop		※ Same as 2. School, 2.1 roof· rooftop.	
	3.2 Outer wall · fence		※ Same as 2. School, 2.2 outer wall.	
	3.3 rain gutter		※ Same as 2. School, 2.3 rain gutter.	
	3.4 Ground etc.		※ Same as 2. School, 2.4 ground etc. (except 2.4.4.1, 2.4.6.6, 2.4.6.7).	
	3.5 Playground equipment		※ Same as 2. School, 2.5 playground equipment etc.	
	3.6 Cemetery	3.6.1 Cemetery (in the block)	3.6.1.1 Wiping	Same as 1.1.1.2.
			3.6.1.2 Brush cleaning	Same as 1.1.1.3.
			3.6.1.3 High-pressure water cleaning of gravel, crushed stone	Same as 1.4.1.6.
			3.6.1.4 Removal of gravel and crushed stone	Same as 1.4.1.7.
			3.6.1.1 Wiping	Same as 1.4.1.8.
4. Park (Large)	4.1 Roof · rooftop		※ Same as 2. School, 2.1 roof · rooftop.	
	4.2 Outer wall · fence		※ Same as 2. School, 2.2 outer wall.	
	4.3 rain gutter		※ Same as 2. School, 2.3 rain gutter.	
	4.4 Ground etc.		※ Same as 2. School, 2.4 ground etc.	
	4.5 Playground equipment		※ Same as 2. School, 2.5 same as playground equipment etc.	

Table 3-15 List of methods for decontamination work, etc. (Large facility)

Details			Decontamination method	Outline
. 5.Large facility	5.1 Roof, rooftop		※ Same as 2. School, 2.1 Roof · rooftop.	
	5.2 Outer wall, fence		※ Same as 2. School, 2.2 Outer wall.	
	5.3 Rain gutter		※ Same as 2. School, 2.3 Rain gutter.	
	5.4Ground etc.	5.4.1 Deposits ~ 5.4.5 Planting	※ Same as 2. School, 2.4 Ground, etc. 2.4.1 Sediments ~ 2.4.5 Same as planting.	
		5.4.6 Parking lot (concrete, asphalt)	※Same as 2. School, 2.4 Ground, etc. 2.4.6 Same as paved surface	
	5.5 Playground equipment		※same as 2. School, 2.5 Playground equipment etc.	

Table 3-16 List of methods for decontamination work, etc. (Roads / Slope)

Details			Decontamination method	Outline
6.Roads	6.1 Paved roads	6.1.1 Sediment	6.2.1.1 Removal of deposits	Same as 1.4.1.1.
		6.1.2 Roads / sidewalks	6.1.2.1 High-pressure water cleaning	Same as 2.4.6.3.
			6.1.2.2 Scraping	Same as 2.4.6.4 - (1) (2).
			6.1.2.3 Blast	Same as 1.4.2.5.
			6.1.2.4 Ultra High Pressure Water Cleaning	Same as 2.4.6.6.
			6.1.2.5 Resurfacing	Same as 2.4.6.7.
			6.1.2.6 Cleaning by road cleaning vehicle	Clean up with a road cleaning vehicle to prepare for decontamination work or maintain it.
	6.2 Unpaved roads	6.2.1 Road Surface (Soil)	6.2.1.1 - (1) weeding	Same as 1.4.1.2
			6.2.1.1- (2) Removal of sediment	Same as 1.4.1.1.
			6.2.1.2 Topsoil scraping	Remove the topsoil with homogeneous elevation by backhoe etc. (About 5 cm

				from maximum height).
			6.2.1.3 Land surface coverage	When topsoil is removed, cover it up to the original thickness by the same kind of soil as before. Leveling the top soil and leveling.
			6.2.1.4 Deep plowing	Same as 2.4.4.4.
		6.2.2 Road Surface (Gravel, Crushed Road)	6.2.2.1 - (1) weeding	Same as 1.4.1.2.
			6.2.2.1- (2) Removal of sediment	Same as 1.4.1.1.
			6.2.2.2 High-pressure water cleaning of gravel, crushed stone	Same as 2.4.3.1.
			6.2.2.3 Removal of gravel and crushed stone	Remove the topsoil with homogeneous elevation by backhoe etc. (About 5 cm from maximum height).
			6.2.2.4 Cover of gravel, crushed stone	When topsoil is removed, cover it up to the original thickness by the same kind of soil as before. Leveling the top soil and leveling.
	6.3.Guardrail	6.3.1 Guardrail	6.3.1.1 Brush cleaning	Same as 1.1.1.3.
			6.3.1.2 High-pressure water cleaning	Same as 2.2.1.3.
			6.3.1.3 Wiping	Same as 1.2.1.1.
	6.4	6.4.1 Side grooves etc.	6.4.1.1 Removal of sediment	Sediments such as fallen leaves, moss, mud and the like are removed in advance using a scoop or the like. Use a drainage cleaning car etc. at around 14 MPa, and wash it with water of about 20 L/m^2.
	6.5.pedestrian overpass	6.5.1 pedestrian overpass	6.5.1.1 Removal of deposits	Same as 1.1.1.1.
			6.5.1.2 High pressure water cleaning	Same as 1.4.2.3. Stairway and passageway part.
			6.5.1.3 Wiping	Same as 1.1.1.2. Do a hand rail.
			6.5.1.4 Brush cleaning	Same as 1.1.1.3. Do a hand rail.
	6.6 Roadside Trees, Planting	6.6.1 Sediments	6.6.1.1 Removal of deposits	Same as 1.4.1.1.
		6.6.2 Grass	6.6.2.1 Weeding and lawn mowing	Same as 1.4.1.2.
		6.6.3Roadside Trees	6.6.3.1 Removal of topsoil near the roots of street trees	Same as 1.4.1.11.
			6.6.3.2 Branch of street trees	Same as 1.4.1.12.
7.Slope	7.1 Slope	7.1.1 Grasses, fallen leaves, sediment	7.1.1.1 Removal of grass, fallen leaves, sediment	Weed that interfere with work, weed and mow by a shawl type mowing machine or human power. Sediments such as fallen leaves, moss, mud and the like are removed with a rake or the like.

Table 3-17 List of methods for decontamination work, etc. (Farmland)

Details			Decontamination method	Outline
8.Farmland	8.1 Paddy Field	8.1.1Grass	8.1.1.1 - (1) Weeding by manpower	Use a shawl type grass cutter or the like and weed.
			8.1.1.1 - (2) Machine weeding	Using weed tractor etc. for weeding.
			8.1.1.1 - (3) Accumulation of weeded grasses	Using herbicide, grass clippings packing machines etc., collect herbicide.
			8.1.1.1- (4) Bag packing on container bag	Put the removed contents in large container bags by manpower
			8.1.1.1- (5) Small transport	Carrier dump etc. are used to carry small

			within the site	transportation of large container bags.
		8.1.2 Soil	8.1.2.1 - (1) Land conditioning	Use vibrating rollers and so on, and correct the unevenness of the topsoil.
			8.1.2.1 - (2) Sprinkling of surface hardening agent	The solution mixed with the solidifying material is sprayed using a seed spraying machine or the like. The amount of solidifying material is 15 t / ha, the solidified thickness is 2 to 3 cm, and the curing period is assumed to be 7 days.
			8.1.2.2 - (1) - ①② Scraping of top soil (standard construction method)	Use backhoe and scrape off the topsoil (about 5 cm).
			8.1.2.2 - (1) - ③ Bag packing on sand bags (standard construction method)	Use backhoes etc. to accumulate and bagging in large container bags.
			8.1.2.2 - (1) - ④Small transport (standard construction method)	Using backhoe with crane function, rough terrain carrier, etc., carry out small transport within the site.
			8.1.2.2- (2) - ⑤ Scraping of top soil (using sludge discharge / discharge car)	Backhoe, sludge evacuation vehicle, etc. are used, and the topsoil is scraped off (about 5 cm).
			8.1.2.2 - (2) - ② Bag packing in container bags	Collect them using bags with crane function and pack them in large container bags.
			8.1.2.2 - (2) - ③ Small transport	Same as 8.1.2.2- (1) - ④
			8.1.2.2 - (3) - ① Scraping of top soil (using a belt conveyor built-in type scraping machine)	Using a belt conveyor built-in type scraper, scrape off the topsoil (about 5 cm), and load the removed material to a rough terrain carrier and carry it.
			8.1.2.2 - (3) - ② Bag packing into large container bags	Collect Contents removed by 8.1.2.2- (3) - ① and pack them in large container bags.
			8.1.2.2 - (3) - ③ Small transport	Same as 8.1.2.2- (1) - ④
			8.1.2.2 - (4) - ① Scraping of top soil (using towing scraper)	Scrape off the top soil using a towing scraper (about 5 cm), load the removed materials into an uneven land transport vehicle and transport it.
			8.1.2.2 - (4) - ② Bag packing into large container bags	8.1.2.2- (4) - (1) Transport and accumulate the scraped off substances and pack them in large container bags.
			8.1.2.2 - (4) - ③ Small transport	Same as 8.1.2.2- (1) - ④
			8.1.2.4 - (1) Reverse cultivation (plowing 30 cm)	Reverse plowing is carried out once at a plowing depth of about 30 cm by tractor with plow.
			8.1.2.4 - (2) Reverse cultivation (plowing 45 cm)	Perform a reversal plowing once with a plowing tractor at a plowing depth of about 45 cm.
			8.1.2.4 - (3) Foundation ground	After reversal tilling, use disc harrows, laser levelers, etc. level the ground in the field.
			8.1.2.5 Deep tillage	Using a rotary tiller for deep cultivation, till and stir with about 30 cm in plowing depth and plow the field deeply.
			8.1.2.6 Additional soil	After scraping the soil, use the heavy

				machinery to do the loaming of the land, leveling, leveling, recovering to the present condition height.
			8.1.2.7- (1) Recovery of groundwater (soil improvement materials spraying)	Sprinkle the soil conditioner while pulling the spraying device with the tractor.
			8.1.2.7- (2) Recovery of fertility of soil (zeolite spraying)	Same as 8.1.2.7- (1). Sprinkle with zeolite instead of soil conditioner.
			8.1.2.7- (3) Double plowing	After sprinkling soil productivity recovery materials etc., use roundabout etc. to cultivate and stir. Tillage · stirring is twice as standard .
			8.1.2.8 Deep plowing	Same as 2.4.4.4.
		8.1.3 Mowing down willow~ Root removal	8.1.3.1- (1) Cutting down and crushing	Willow (leaves, branches, trunks), shreds and grinding of grass are done by shredder. Collect the crushed materials and pack it with roll baler.
			8.1.3.1 - (2) Stumping and grubbing	Dig up the root of the willow and separate the root and soil
		8.1.4 Willow withdrawal	8.1.4.1 Willow pull out / accumulation	Pull out the willow (leaf, branch, trunk, root) by backhoe with grabber. Loading, conveying, and accumulating in rough terrain vehicles.
		8.1.5 Full cutting of bamboos	8.1.5.1 Full cutting of bamboos	Cut the bamboos by chain saw, and do branches. Dig into the rhizome of bamboo and do root soil separation. Backfilling of digging place, leveling and rolling are performed.
		8.1.6 Handling of trouble trees	8.1.6.1 Logging of troubled trees	Same as 1.4.1.13.
			8.1.6.2 Dropping a hindrance tree	Same as 1.4.1.14.
	8. 2 Field		※8. Agricultural land, same as 8.1 paddy fields.	
	8.3 Pastures	8.3.1Grass	8.3.1.1 - (1) weeding	Weeding grassland by tractor etc. Grass it and pack it with a roll baler.
			8.3.1.1 - (2) Packing in container bags	Same as 8.1.1.1- (4).
			8.3.1.1 - (3) Small transport within the site	Same as 8.1.1.1- (5).
			8.3.1.2 Spraying greening base material	Restore the original state by spraying the greening base materials using the seed blower (for the customer).
			8.3.1.3 - (1) Sowing (spraying)	Tractor etc. are used to sow the past pasture seeds and apply fertilization to restore the ground power.
			8.3.1.3 - (2) Sowing (suppressing)	Use a tractor and so on to suppress the surface.
		8.3.2Soil	8.3.2.1 Scraping topsoil	Same as 8.1.2.2- (1)-① to ④.
			8.3.2.2 Reverse cultivation	Same as 8.1.2.4- (1) - (4).
			8.3.2.3 Northern cultivation	Same as 8.1.2.5.
			8.3.2.4 Additional soil	Same as 8.1.2.6.
			8.3.2.5 Geological recovery	8.1.2.7- (1) Same as (2).
	8.4 Waterway	8.4.1 Water channels	8.4.1.1 - (1) Removal of bottom sediment etc. (Earth lift)	Sediments such as fallen leaves, moss, mud and the like which are easy to remove are removed using a scoop or the like.

			8.4.1.1 - (2) Removal of bottom sediment etc. (bag filling in container bag)	Put into large container bags by man power.
			8.4.1.1 - (3) Small transport	Same as 8.1.2.2- (1) - ④
	8.5 Ridge	8.5.1 Ridge	8.5.1.1 - (1) Removal of sediment	Same as 1.4.1.1.
			8.5.1.1 - (2) weeding	Same as 1.4.1.2.
			8.5.1.2- (1) Scraping of topsoil	Strip the top soil homogeneously by the backhoe (about 5 cm).
			8.5.1.2 - (2) Bag packing into large container bags	Using a backhoe with crane function, bag it in a large container bags.
			8.5.1.2- (3) Small transport	Same as 8.1.2.2- (1) - ④
			8.5.1.3 Restoration of levees	After scraping the levee, clay using heavy machinery, build the levee, finish the legal surface and restore it to the current height.

Table 3-18 List of methods for decontamination work, etc. (Grassland and Orchard)

Details			Decontamination method	Outline
9. Grasslands, Strips	9.1 Shrub dense	9.1.1 Shrub (dense)	9.1.1.1 Cutting	Weeds, shrubs and the like are made by chainsaw etc. Those that cannot be conveyed, accumulated, or packed as they are, should be cut.
	9.2 Coarse shrub	9.2.1 Shrub (coarse)	9.2.1.1 Cutting	Weeds, shrubs, etc. are cut and shaved by a shawl type grass cutter or the like.
	9.3 Thinning of bamboos	9.3.1 Thinning of bamboos	9.3.1.1 Thinning of bamboos	Thinning is done by chain saw, and branch are cut off.
10. Orchard	10.1 Orchard	10.1.1 Deposits	10.1.1.1 Removal of deposits	Same as 1.4.1.1.
		10.1.2 Grass	10.1.2.1 weeding	Same as 1.4.1.2.
		10.1.3 Fruit trees	10.1.3.1 Stripping of rough skin	Remove the rough skin around the main trunk and upper and side portions of the main branch.
			10.1.3.2 High Pressure Water Washing of Bark	Wash bark with high pressure water wash.
			10.1.3.3 Fruit tree pruning	Prune old branches. Larger side branches are updated by thinning pruning. Peel off fallen leaves, deciduous leaves, mulch leaves and soil with shading etc.
			10.1.3.4 Logging of troubled trees	Same as 1.4.1.13.
			10.1.3.5 Rooting of troubled trees	Same as 1.4.1.14.
		10.1.4 Soil	10.1.4.1 Topsoil scraping	Using backhoe etc., scrape off the topsoil (about 5 cm).
			10.1.4.2 Customs	Same as 8.1.2.6.

Table 3-19 List of methods for decontamination work, etc. (Forest)

Details			Decontamination method	Outline
11. Forest	11.1 Evergreen	11.1.1 Sedimentary organic matter	11.1.1.1 - (1) (2) (3) Removal of deposited organic matter	Roughly scrape fallen leaves, falling branches etc. with a rake etc. as a guide about 5 cm from the surface. Remove to the extent that the mineral soil layer is not exposed. Those that cannot be packed as it is cut.
			11.1.1.1- (4) Removal of sedimentary organic matter (unmanaged area)	Rake off fallen leaves, falling branches etc. with rake etc. around 10 cm from the surface as a guide. Remove to the extent that the mineral soil layer is not exposed. Those that cannot be packed as it is cut.
			11.1.1.1- (5) Organization of cut-off materials	The undecomposed cut-off materials left in the forest accumulates in the edge of the forest.
		11.1.2 Soil	11.1.2.1 Preventing re-diffusion (soil loading)	In the case of removing fallen leaves on steep slopes, etc., soil loading will be done at the edge of the forest to prevent soil outflow.
			11.1.2.2 Preventing re-diffusion (board fence)	When removing fallen leaves on steep slopes, etc., use a large-sized puddle and a small pile (pile) or the like and install a plate fence at the edge of the forest.
		11.1.3 Trees	11.1.3.1 - (1) (2) (3) Conifer pruning, cutting branch collection	For evergreen coniferous trees (cedar, cypress, etc.) of III-age class or above, about 5 m from the edge of the forest (1 to 2 rows), cut branches up to about 4 m above the ground with saws or the like.
		11.1.4 Undergrowing	11.1.4.1 Undergrowth and shrub brush	Shuffle type grass cutters etc. perform cuttings of under growths, shrubs and the like, and when there are cuttings, falling branches and the like, collect them on the edge of the forest.
		11.1.5 Removal of sediment residue	11.1.5.1 Removal of sediment residue	Remove places where accumulated organic matter remains after removing sedimentary organic matter by scraping with rake etc. and remove to the extent that the mineral soil layer is not exposed.
	11.2 Deciduous trees	11.2.1 Sedimentary organic matter	11.2.1.1 (1) (2) (3) Removal of sedimentary organic matter	Same as 11.1.1.1- (1) - (3).
			11.2.1.2 Removal of sedimentary organic matter (unmanaged area)	Same as 11.1.1.1- (4).
		11.2.2 Soil	11.2.2.1 Preventing re-diffusion (soil loading)	Same as 11.1.2.1.
			11.2.2.2 Preventing re-diffusion (board fence)	Same as 11.1.2.2.
		11.2.3 Trees	11.2.3.1 Rough Loose Bundle	The falling branches etc. are bound within a length of 2 m with cords or the like so as to be coarse ribs having a diameter of about 30 cm.
		11.2.4 Undergrowing	11.2.4.1 Undergrowth / shrub brush	Same as 11.1.4.1.
		11.2.5 Removal of deposits of organic matter	11.2.5.1 Removal of deposits of organic matter	Same as 11.1.5.1.
	11.3 Woods		※ Same as 11.2 deciduous trees.	

Table 3-20 List of methods for decontamination work, etc. (Temporary Storage Sites)

Details			Decontamination method	Outline
13. Temporary Storage Sites	13.1 Temporary Storage Sites	13.1.1 Temporary Storage Sites etc.	13.1.1.1 Storage located groundwater survey	Establish groundwater monitoring hole. Sampling and analyzing groundwater.
			13.1.1.2 weeding	Depending on the condition of the land, do the same as in 1.4.1.2.
			13.1.1.3 Cutting of bush (dense)	Depending on the condition of the land, do the same as in 9.1.1.1.
			13.1.1.4 Cutting of shrub (coarse)	Depending on the situation of the land, do the same as in 9.2.1.1.
			13.1.1.5 - (1) Logging removal (logging operation)	Cut trees according to the condition of the land.
			13.1.1.5 - (2) Logging removal (root removal)	Depending on the situation of the land, use a rake dozer etc. to eliminate the root of the logging tree.
			13.1.1.5 - (3) Logging removal (collection operation)	Depending on the condition of the land, use a rake dozer etc. to accumulate the logging trees.
			13.1.1.8 Cover of gravel, crushed stone	Depending on the situation of installation road etc., do it in the same way as 2.4.3.3.
			13.1.1.9 - (1) Lower sheet (water impermeable sheet) installation	After finishing logging, removal and roughening, lay a waterproof sheet sandwiched from above and below with a protective mat
			13.1.1.9- (2) Installation of protective layer	For protection of the lower sheet, a protective layer of about 10 cm is installed on the upper part of the lower sheet with mountain sand or the like.
			13.1.1.9 - (3) Install upper sheet (breathable waterproof sheet, water impermeable sheet or light shielding sheet)	Use a combination of air permeable waterproof sheet and water impermeable sheet for installing combustibles, and cover the place where incombustibles are installed with a water impermeable sheet or a breathable waterproof sheet. Consider the landscape and use colors that are familiar to the surroundings.
			13.1.1.10 Invasion water collection drainage gutter, drainage pipe installation	Set up drainage water collection drainage grooves for collecting and draining water leaking from removed soil and the like. Install collection drain pipe and lead to leachate water collection facility.
			13.1.1.11 Establishment of invasion water collection equipment	Set for the purpose of temporary storage of leachate and confirming radioactive cesium in leachate
			13.1.1.12 Installation of surface water collecting equipment	① Installation of surface water collecting water grooves (grounding grooves): Prevent the inflow of surface water into the storage sites and install the surface water collecting drainage grooves around the temporary storage sites, etc. as the rainwater discharge in the temporary storage place . ② Drainage (corrugated flume) installation: Place the corrugated flume by human power around the temporary storage sites, etc. where plentiful spring water is difficult to machine construction. ③ Installation of drainage channel (U type groove): Place the U - shaped side groove

				around the temporary storage place etc. with plenty of spring water, install it using a truck with crane.
			13.1.1.14 Capture and setting of stored Contents	Transfer large container bags etc. with removed soil etc. transported by truck, etc. using a crane.
			13.1.1.15 Side shielding	Only place where shielding is necessary, place large container bags etc. containing uncontaminated soil (about 1.0 m^3/bag) on the surrounding side.
			13.1.1.16 Top shielding	Only place where shielding is necessary, place a large container bag etc. containing uncontaminated soil (about 0.5 m^3/bag) on the top side.
			13.1.1.17 End treatment	To prevent invasion of rainwater and leakage of leachate water, measures are taken such as welding the upper and lower sheets, and raising the end sheet.
			13.1.1.18 Establishment of incidental facilities	Provide a fence of 1.8 m in height at a distance of about 4 m from the stored content on the outer circumference of the temporary storage sites or the like. Install bulletin boards, fire extinguishers, etc.
			13.1.1.19 Heat radiation pipe (gas extraction pipe) · Gas venting port setting	In the case where the stack height is set to about 3 m at the place where the combustibles are installed, one heat radiation pipe (gas vent pipe) is provided at 200 m^2.
			13.1.1.20 Installation of thermometer	Install a temperature sensor with a data collection device at a location of 200 m^2 at the place where combustible materials is installed.
			13.1.1.21 Establishment of supporting soil	Place a soil bag (about 1.0 m^3/bag) containing uncontaminated soil in the inside of the side shaded soil, near the center of the bottom.
	13.2 Removal of Temporary Storage Sites (above ground type)	13.2.1 Removing the upper seat	13.2.1.1- (1) Removing upper sheet (waterproof sheet, composite sheet)	Remove the upper sheet, cut it, and bag it.
			13.2.1.1- (2) Removal of upper sheet (breathable waterproof sheet, light shielding sheet)	Same as 13.2.1.1.
		13.2.2 Removing the lower seat	13.2.2.1 Removing the lower seat (waterproof seat)	Remove the lower sheet, cut it, and bag it.
			13.2.2.2 Removing the lower seat (protective mat)	Same as 13.2.2.1.
		13.2.3 Packing and Refilling of Saved Contents	13.2.3.1 - (1) Packing and refilling of stored Contents (combustibles)	If there is a possibility of breakage, refill the large container bag. Storage contents whose volume reduction has progressed will be packed into 2 or 3 bags.
			13.2.3.1- (2) Saved Contents (incombustible)	If there is a possibility of breakage, refill the large container bag.

Table 3-21 List of methods for decontamination work, etc. (Wastewater treatment)

Details			Decontamination method	Outline
15. Wastewater treatment	15.1.Wastewater treatment	15.1.1 Wastewater treatment	15.1.1.1 Wastewater treatment (precipitation treatment)	Drain the wastewater collected in the sedimentation facility such as a tank until it separates from the supernatant water and mud, and let it settle. Confirm that the supernatant water meets the control value and drain it.
			15.1.1.2 Packing of sedimentary soil	Dry mud generated by the precipitation sufficiently and pack it in a weather resistant large container bag or the like. Container shall be watertight for high water content soil.
			15.1.1.3 - (1) Installation of turbid water treatment equipment	Using a crane or the like, install a turbid water treatment device.
			15.1.1.3 - (2) Removal of turbid water treatment equipment	Use a crane or the like to remove the turbid water treatment equipment.

Source：”Common Specifications for Decontamination Works 10th edition”（April 2017 MOE）

2) Provisional Quantification Standards for Decontamination Work, Decontamination, and Guide for Quantitative Calculations in Decontamination Work

To estimate project costs for decontamination work contracted out by MOE in the Special Decontamination Areas, the ministry prepared Provisional Quantification Standards for Decontamination Work in Special Decontamination Areas.

These quantification standards listed the number of workers, the required equipment and materials for decontamination per unit of area, and the productivity or output for each method and target of decontamination. Costs were then estimated based on this information.

The standards were prepared by MOE based on the results of "Decontamination Model Projects" conducted by JAEA in FY2011 as commissioned by the Cabinet Office for demonstration tests of technologies necessary for effective implementation of decontamination in high-dose areas, as well as decontamination carried out by municipalities in Fukushima Prefecture.

The first edition was produced in May 2012 and it was subsequently modified as necessary to suit the actual situation at the decontamination sites, with additions of construction methods and revisions of productivity measures and so on, and the tenth edition was released in April 2017.

In addition, exceptions were permitted in cases where it was recognized that the estimation standards were particularly inappropriate or difficult to apply, because target sites varied widely in terms of siting conditions and environmental conditions and many locations were under special conditions,

In addition, in January 2015, a Guide for Quantitative Calculations in Decontamination Work was prepared to indicate methods to calculate quantities and methods of measurement when making estimates.

Table 3-22 Revisions of Provisional Quantification Standards for Decontamination Work

Edition number	Date of revision	Main revision contents
Original Ed.	May 2012	Initial release of standards
1st Ed.	October 2012	Added scraping of topsoil with suction work vehicle
2nd Ed.	January 2013	Revision by results of the labor productivity per unit etc., revision of common temporary expenses (maintenance expenses)
3rd Ed.	February 2013	Added blasting, scraping of topsoil Correction of coverage of land surface, preliminary measurements of radiation data correction work
4th Ed.	April 2013	Common temporary cost (safety expenses) revised. Revised farmland, wastewater treatment. Added tag attachment according to the results of labor productivity per unit, etc..
5th Ed.	June 2013	Revision of common temporary expenses (maintenance fee)
6th Ed.	September 2013	Partial revision of classification and totalization of common temporary expenses Revised the forest. Contents added to Temporary Storage Site construction work, drainage treatment, transportation of removed soil, etc., crushing of vegetation and the like, temporary installation, etc. added, partially revised Addition of summary of measurement of radiation dose at the time of measures for decontamination, etc., such as playground equipment

7th Ed.	April 2014	Review by the results of labor productivity per unit etc., revised the correction value for common temporary cost rate and on-site administrative expense ratio. Revised method of determining unit price of material. Addition of compensation extra factor in case of receiving time restriction Partial revision of protective equipment, etc., transportation, volume reduction, temporary construction, etc., of school, roads, forests, removed soil, etc. Newly added contents not covered by expenses
8th Ed.	March 2015	Revised rate and variable values related to calculation formula for on-site administrative expense ratio, general administrative expense ratio. Removal of outdoor equipment, removal of obstacles around housing, cemetery, spraying of greening base material, removal work such as Temporary Storage Sites, installation and removal of falling prevention equipment on the roof work, investigation of locally high dose areas, contaminated soil. Addition of expenses required for measurement of radioactivity concentration, etc., decontamination management information, etc. Wipe, brush wash, lawn cloth, washing with suction type high pressure water washer, extra high pressure water washing, play equipment, etc. Removal of bottom sediment, decomposed matter, ground recovery, ridge restoration, sedimentary organic matter, prevention of redeposition (soil loading), installation of lower sheet / upper sheet, shielding of side surface, shielding of upper surface, high pressure water cleaning of iron plates, self-screening at the return of the iron plate, revision of safety training cost related to Ionizing Radiation Ordinance for Decontamination
9th Ed.	March 2016	Added scope to each step. Partial revision of work procedures. Wiping off, harvesting tree root, belt conveyor built-in type scraper · scrape off topsoil using towing scraper bag filling in small sacks small conveying, waste cutting down - removing root, withdrawing willow, bamboo., Processing of hindrance trees, expenses required for persons assisting original safety and health managers are added. Covering the land surface, deep cultivation, restoring the ground (soil improvement materials spraying), twice tillage, storage location groundwater survey, installation of incidental facilities, partial revision of armor. Deleted the leveling, cut and embankment. Storage sites. Add a step by step walk to underground water survey. Add reference formula to expenses required for creation of decontamination management information.
9th Ed. (Revised)	June 2016	Revised rate, variable value on calculation formula for common temporary work cost rate and field office expenses rate. Partial revision of composition of direct work costs, classification of common temporary expenses and contents of quantification. Revised thermometer installation. High location work (rain gutter), expenses required for persons assisting safety and health managers, measurement of radioactivity concentrations of precipitated water, expenses required for preparation of decontamination management information.
10th Ed.	April 2017	Revised amendment to common temporary cost and field administration cost rate.

		Partial revision of classification and quantification of common temporary expenses. Addition of accumulation method at small-scale work which completes in common contents in less than one day.

Source: "Provisional Quantification Standards for Decontamination Work in Special Decontamination Areas" (10th edition) (MOE, April 2017)

(5) Specifications for Decontamination in the Intensive Contamination Survey Areas (ICSA)

As common specifications and quantification standards by MOE are prepared for decontamination work in Special Decontamination Areas, they cannot be applied as directly to Intensive Contamination Survey Areas (ICSA). Thus, in order to compensate for this, in July 2012 Fukushima Prefecture prepared "Fukushima Prefecture decontamination work common specifications," and in August 2012, "Fukushima Prefecture decontamination provisional quantification standards" and presented these to municipalities. Each municipality generally followed the Prefecture's common specifications and quantification standards when ordering work, and for matters not specified therein, they responded by using the common specifications and quantification standards issued by MOE.

These materials have been appropriately revised according to the implementation status of decontamination and the social situation, etc., and as of May, 2017, the common specifications were revised four times after the initial release, and provisional quantification standards were revised 11 times after the initial release.

(6) Unit Cost of Labor, Special Work Allowance

For decontamination work, etc., in Special Decontamination Areas, for estimating labor unit prices, estimated unit labor prices are prescribed for roles such as supervisors, special decontamination workers, and regular decontamination workers, etc., and these are reviewed each year. Accommodation and other expenses are also prescribed, and contracts are modified depending on work achievements.

Also, due to the specialized nature of their work, decontamination workers engaged in Special Decontamination Areas are paid a special work allowance in accordance with the rules of the National Personnel Authority (Regulation 9-30, Special Work Allowance), in addition to the unit labor price.

3.4.4. Radiation Protection for Workers

(1) Ionizing Radiation Ordinance for Decontamination

The Ministry of Health, Labor and Welfare, on December 22, 2011, as a means of reducing radiation exposure to workers engaged in decontamination and related work (defined as decontamination workers), promulgated the Ordinance on Prevention of Ionizing Radiation Hazards at Works to Decontaminate Soil and Wastes Contaminated by Radioactive Materials Resulting from the Great East Japan Earthquake and Related Works (hereinafter referred to as the "Ionizing Radiation Ordinance for Decontamination"), and it was enacted on January 1, 2012, the same day as the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials was enacted.

Thereafter, on July 1, 2012, amendments were being made to expand the scope of applicable work to prevent radiation hazards of workers who conduct restoration and reconstruction work.

The Ionizing Radiation Ordinance for Decontamination stipulates: (1) basic principles on radiation hazards prevention, (2) dose limit and measurement, (3) measures concerning implementation of decontamination works, (4) prevention of pollution, (5) special education and medical examinations, etc. The target of application is decontamination work (work for decontamination of soil, waste collection, handling of specific contaminated soil) or contractors working below a specific dose rate (other than the decontamination work where there is an average air dose rate exceeding 2.5 μSv/h), and workers employed by those contractors.

(2) Guidelines on Prevention of Radiation Hazards

The Ministry of Health, Labor and Welfare issued "Guidelines on Prevention of Radiation Hazards for Workers Engaged in Decontamination Works, etc." on December 22, 2011 in order for workers to perform according to the Ionizing Radiation Ordinance for Decontamination, and on June 15, 2012, "Guidelines on Prevention of Radiation Hazards for Workers Engaged in Works under a Designated Dose Rate" were formulated and announced.

The guidelines cover topics such as specific protective measures and health examinations.

(3) Comprehensive Radiation Management Systems

The radiation dose of the workers engaged in decontamination works are managed by each decontamination contractor based on laws and regulations, but since these workers often move between multiple contractors, it is necessary to centrally manage the radiation dose recorded by each contractor.

For this reason, it is to implement a system equivalent to the "Individual Dose Record Book System" and "Nuclear Radiation Worker Exposure Dose Registration Management System" for nuclear power station workers in the decontamination work and on November 15, 2013, "Radiation dose registration and control system for decontamination, etc., workers, etc." was established for centralized management of radiation dose of workers for decontamination, etc.

The system is operated by Radiation Workers Registration Center of the Radiation Effects Association (hereinafter referred to as "Registration Center") and the Registration Center registers radiation dose records and specific medical examinations of the workers recorded by contractors based on the Act.

3.4.5. Expert Committee

(1) Investigative Committee on Remediation

In response to the establishment of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, 19 meetings of the "Investigative Committee on Remediation," aimed at considering matters related to measures for decontamination, etc. of radioactive substances released by the TEPCO Fukushima Daiichi Nuclear Power Station accident, were held since between September 14, 2011 and March 2018.

Table 3-23 Members of the Investigative Committee on Remediation (titles omitted)

	Name	Affiliation	Note
1	Takeshi Iimoto	Associate professor, Division for Environment, Health and Safety, The University of Tokyo	17th～19th
2	Takashi Inagaki	President, Gifu Pharmaceutical University	1st～19th
3	Masahiro Osako	Director, Center for Material Cycles and Waste Management Research, National Institute for Environmental Studies, Japan	1st～19th
4	Takehiko Ota	Professor Emeritus, The University of Tokyo	5th～19th
5	Tadashi Otsuka	Professor, School of Law, Waseda University	1st～19th
6	Michiaki Kai	Professor, Faculty of Nursing, Oita University of Nursing and Health Sciences	17th、19th
7	Yuko Sakita	Journalist, Environmental Counselor	1st～19th
8	Motoyuki Suzuki (Chair)	Professor Emeritus, The University of Tokyo	1st～19th
9	Minoru Takeishi	Adviser for Analytical Technique Development, Fukushima Environmental Safety Center, Sector of Fukushima Research and Development, Japan Atomic Energy Agency	15th～19th
10	Shunichi Tanaka	Vice Chief Director, NPO Radiation Safety Forum NPO	1st～6th
11	Toru Nakashizuka	Professor, Graduate School of Life Sciences, Tohoku University	4th～19th
12	Osami Nakasugi	Former Professor of Sophia University	1st～19th
13	Ikufumi Niimi	Professor, Institute of Law and Social Sciences, Meiji University Graduate School of Law	1st～19th
14	Seiji Hayashi	Research Group Manager, Fukushima Branch, National Institute for Environmental Studies, Japan	4th～19th
15	Sadaaki Furuta	Director, Department of Radiation Control, Nuclear Fuel Cycle Engineering Laboratories, Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development, Japan Atomic Energy Agency	1st～14th
16	Hiroaki Furumai	Professor, School of Engineering, The Unversity of Tokyo.	4th～19th
17	Masaaki Hosomi	Professor, Institute of Engineering, Tokyo University of Agriculture and Technology	1st～19th
18	Hisaoki Mori	Technical Adviser, Interim Storage Department, Japan Environmental Storage & Safety Corporation (JESCO)	1st～19th
19	Yuichi Moriguchi	Professor, School of Engineering, The University of Tokyo.	1st～19th

Table 3-24 Details of meetings of Investigative Committee on Remediation

No	Date	Main Agenda Contents
1st	September 14, 2011	1. Approaches to decontamination
2nd	September 27, 2011	1. Approaches to decontamination
Joint Meeting※	October 10, 2011	About the Basic Policy for the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials * Disaster Waste Safety Assessment Committee / Joint Review with Committee on Environmental Remediation (1st)
3rd	11th December 2011	1. Basic Policy Based on the Act on Special Measures 2. Road Map for Construction of Interim Storage Facility 3. About the enforcement regulation (draft) of the Act on Special Measures 4. Guidelines on decontamination (draft) 5. Regarding national government direct work in Fukushima
4th	July 9, 2012	1. Approaches to forest decontamination 2. On the progress of decontamination (report)
5th	June 31, 2012	1. Approaches to forest decontamination
6th	August 29, 2012	1. About hearing from stakeholders 2. Study on the approaches to forest decontamination
7th	September 19, 2012	1. Study on the approaches to forest decontamination
8th	April 22, 2013	1. About Decontamination Guidelines 2. Recent decontamination efforts
9th	August 27, 2013	1. Progress of decontamination 2. Response etc. after decontamination 3. Regarding the consolidation of knowledge on forest decontamination
10th	December 26, 2013	1. Interim report (preliminary report) of the decontamination model projects in Areas where Returning is Difficult 2. Current supplemental decontamination 3. About the evaluation etc. concerning the goals of the basic policy 4. Recent decontamination efforts
11th	20th March 2014	1. Supplemental decontamination for the time being 2. On the results of forest model project 3. Study on the behavior of radioactive cesium in landfill of the removed soil 4. Recent Decontamination Initiatives
12th	August 22, 2014	1. Response to rivers, lakes, etc. 2. About recent decontamination efforts
13th	January 30, 2015	1. Report and issues on decontamination progress 2. Storage condition of removed soil etc. in Intensive Contamination Survey Areas (ICSA) 3. Estimation of radiation dose in recreational activities at waterside
14th	March 19, 2015	1. Progress of decontamination 2. Storage condition in Temporary Storage Sites 3. About knowledge on radioactive materials in forest
15th	15th June 2015	1. Management of Temporary Storage Sites 2. Demonstration Project of Forest (Interim Report) 3. Estimation of radiation dose in recreational activities in forest
16th	December 21, 2015	1. Concept on supplemental decontamination 2. Measures to deal with radioactive materials in forests 3. Response to the case of discharge of removed soil by Kanto / Tohoku torrential rain in September 2015
17th	December 20,2016	1. Removal soil storage in ICSA outside of Fukushima Prefecture 2. About management of Temporary Storage Sites 3. Progress status of measures to deal with radioactive materials in forests
18th	December 27, 2017	1. About restoration of Temporary Storage Sites 2. Study on disposal method of removed soil outside Fukushima Prefecture 3. Measures to deal with radioactive materials in forests
19th	March 13, 2018	1. Deliberation on guidelines (draft) on specific methods for land restoration of Temporary Storage Sites 2. Report on the progress of demonstration projects etc. on decontamination and treatment of removed soil

(2) Other Committees of the Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries established the "Examination Committee on Decontamination Countermeasures for Farmland" consisting of experts. It held a field study meeting in January 2012, review conferences four times to August 2012, and working group meetings four times, and prepared the aforementioned "Technical Document for Decontamination of Farmland."[43]

Also, to consider measures to deal with radioactive materials in reservoirs, the "Study meeting on measures to deal with radioactive materials in reservoirs" was held starting in December 2015 and it prepared the "Manual for measures to deal with radioactive materials in irrigation ponds."

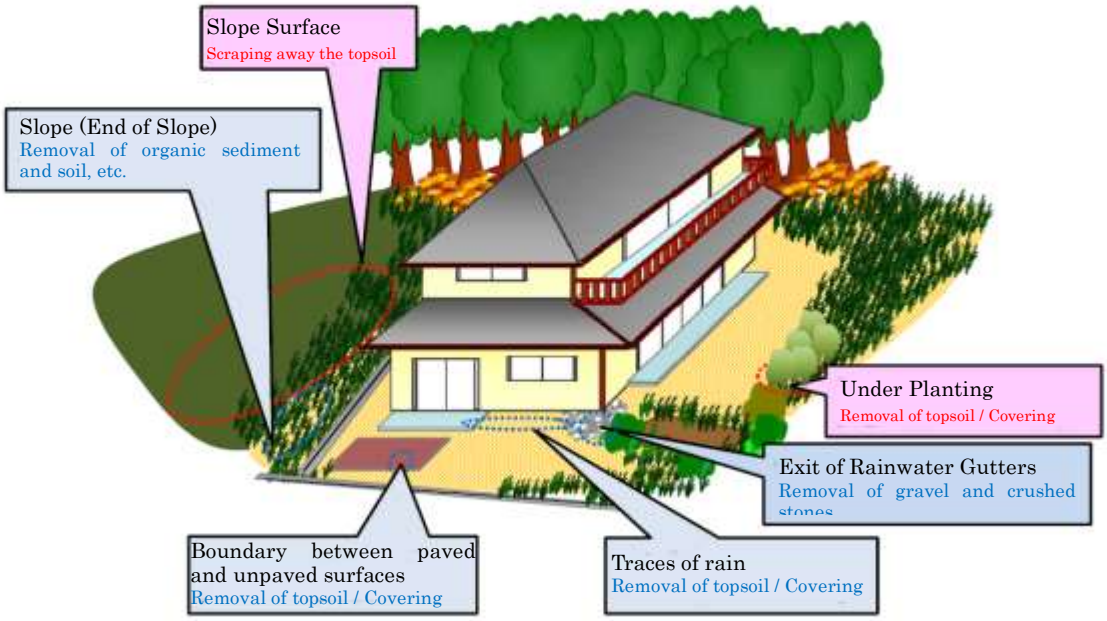
[43] MAFF "Technical Document for Decontamination of Farmland (Part I, Volume for survey and design"(February 2013)

3.5. Policies Formulated After the Start of Decontamination

(1) Supplemental Decontamination

After performing whole area decontamination, there were some areas confirmed where the decontamination effect was not maintained. As a response, MOE issued a document on "Approaches to supplemental decontamination" (draft) at the 16th meeting of the Committee on Environmental Remediation, held on December 21, 2015, stating the following: ① Whole area decontamination is not implemented twice in principle, however, if it is confirmed there is an area where decontamination effect is not maintained, ascertain the cause according to the situation of each site as far as possible, and judging rationality and feasibility, supplemental decontamination is to be carried out. ② If it is confirmed that additional annual radiation dose of 1 mSv/y or less will be predicted as the government's long-term goal, supplemental decontamination will not be carried out. ③ In the Habitation Restricted Areas, if even after properly performing the decontamination based on the decontamination implementation plan it cannot be said that it surely fulfills the annual accumulated dose of 20 mSv/y or less, which is the requirement for lifting evacuation orders within the residential land, the source location is to be defined, and without waiting for supplemental monitoring immediately after whole area decontamination, supplemental decontamination is to be implemented depending on the situation at each site.

Further, the judgment of the implementation for ③, radiation dose survey will be intensively conducted if the air dose rate average of residential land exceeds 1 μSv/h, and if it is confirmed that it may exceed 3.8 μSv/h within a certain range in the land, the supplemental decontamination method would be considered for the relevant locations.



Note: Blue part, blue text: Standard supplemental decontamination technique
Red part, red text: Supplemental decontamination method in old habitation restricted area

Figure 3-18 Image of supplemental decontamination method

Source: Documents from MOE "The 16th Investigative Committee on Remediation" (December 21, 2015)

(2) Decontamination of Forests and Rivers

1) Forests

Regarding decontamination of forests, it was indicated in the "Decontamination Guidelines" that sedimentary organic matter such as fallen leaves shall be removed within an effective range of 20 m from the edge of the forest in order to reduce the radiation dose in the living environment of residents who own forests in the surroundings.

After that, MOE announced "Current arrangements on forest decontamination methods" on September 25, 2012 in light of discussions at the Investigative Committee on Remediation, stipulating that forest decontamination is to be prioritized for the forests neighboring residential houses; that for forests that have daily access by workers and so on decontamination methods should be considered based upon how the forests are used; and that for other cases of forests, methods shall be decided after investigation and study in future.

In addition, MOE announced "Future directions for forests" on August 27, 2013 based on the findings clarified so far, and showed the direction of future forest decontamination for each area shown in the "Current arrangements on forest decontamination methods."

Thereafter, opinions were expressed that decontamination based only on initiatives under the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials would be insufficient to regenerate Fukushima forests and forestry. Thus, starting in February 2016, led by the Reconstruction Agency, a "Project Team of Related Ministries and Agencies for Fukushima Forests and Forestry Restoration" was launched and compiled a report on "Comprehensive Efforts towards the Restoration of Fukushima Forests and Forestry." A project based on this comprehensive approach, the "Satoyama restoration model project" has been implemented, promoting efforts for decontamination and forest improvement in 14 model districts.

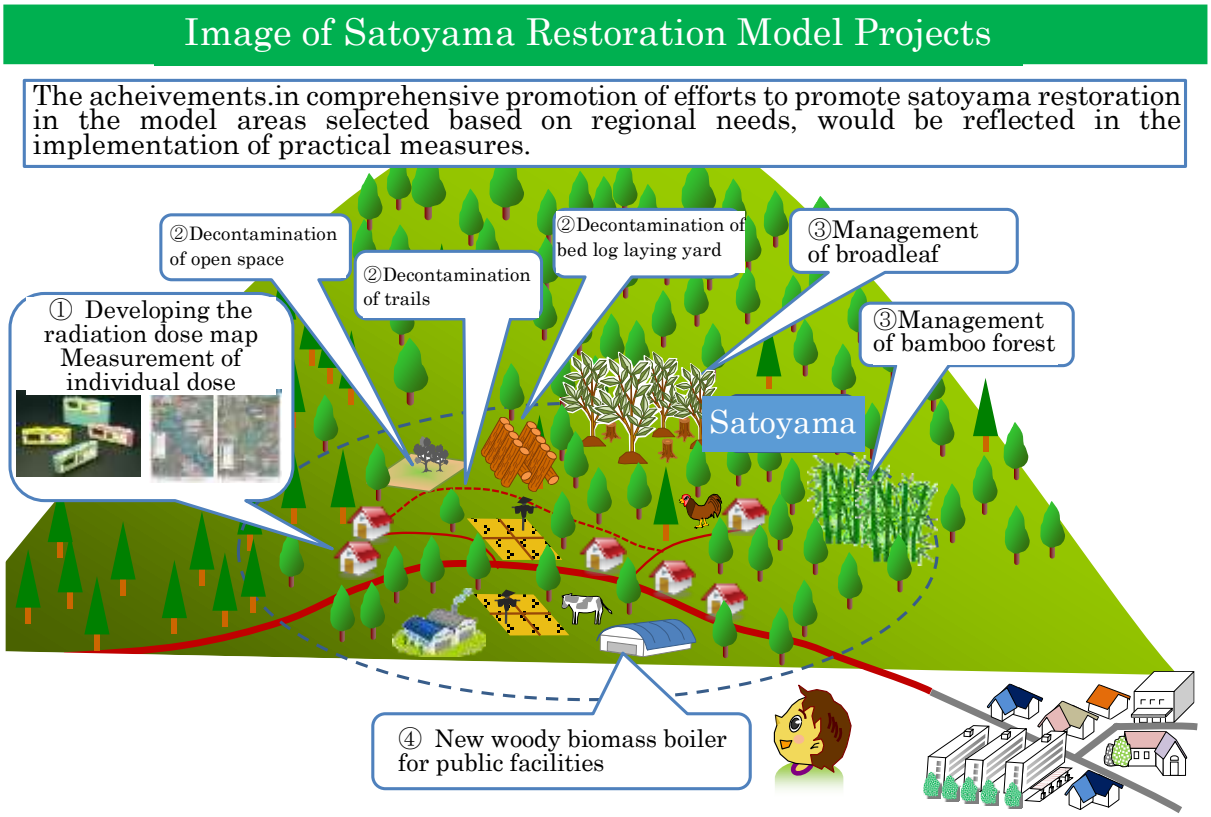


Figure 3-19 Satoyama Restoration Model Projects

Source: Reconstruction Agency, MAFF, MOE, "Comprehensive Efforts towards the Restoration of Fukushima's Forests and Forestry" (March 9, 2016)

2) Rivers, Lakes and Reservoirs

Regarding rivers and lakes, as water provides a shielding effect and sediment flows in from the land area and is transported within a watershed, the general approach was to have regular monitoring, and to respond based on knowledge accumulated through studies and research. However, on August 22, 2014 MOE announced a "Summary of future approaches on measures for rivers and lakes, etc." to articulate its basic approaches. For example, it states: "Decontamination will be implemented as needed, in cases where the water dries up and the water shielding effect cannot be expected, where the air dose rate is high due to the accumulation of radioactive cesium and the location is believed to correspond to the living area where there are many activities of the general public."

Regarding reservoirs, "Measures to deal with radioactive materials in reservoirs" were announced on the same date, stating that MOE is to conduct decontamination measures for reducing the air dose in living areas, based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials, while measures to restart farming and restore agriculture are to be implemented by Fukushima Prefecture and municipalities, etc., using Fukushima Revitalization Acceleration Grants.

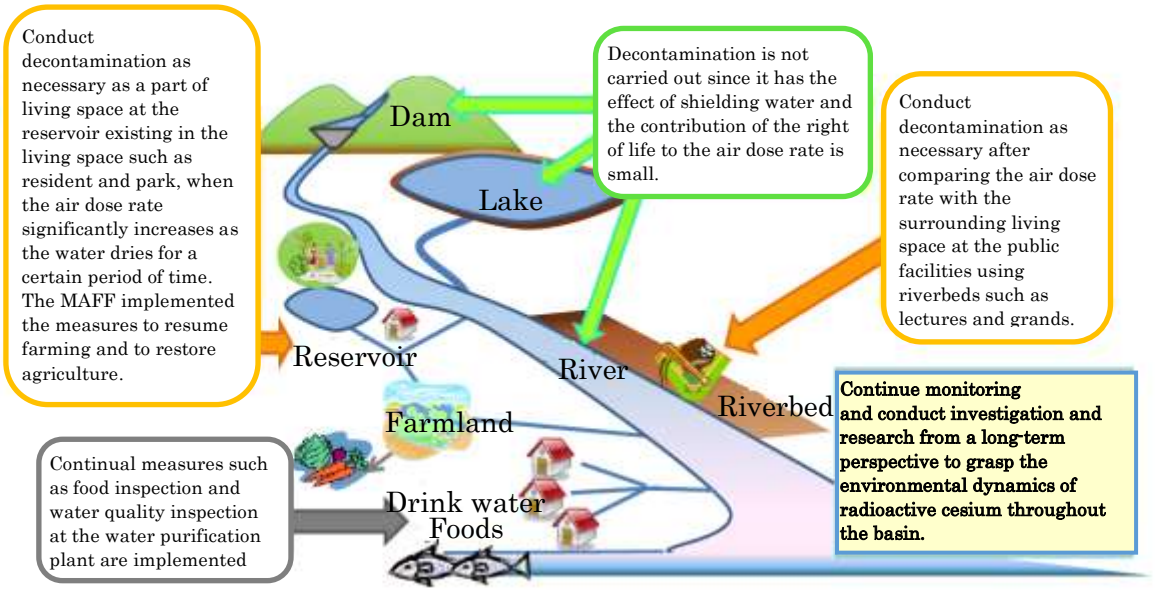
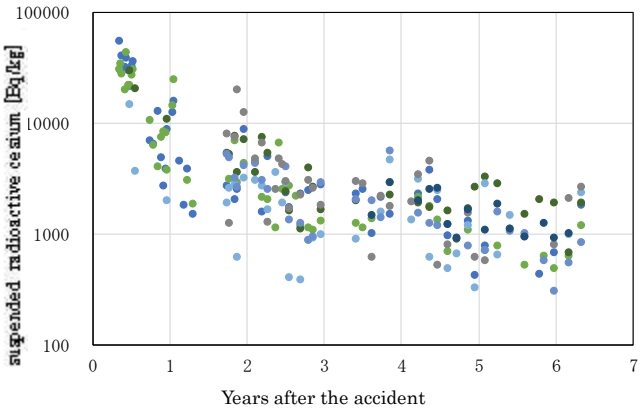


Figure 3-20 Future directions in rivers, lakes, etc.

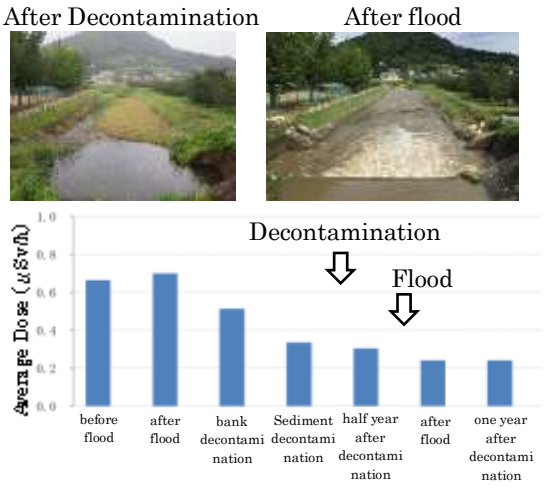
Source: Ministry of Agriculture, Forestry and Fisheries," On the countermeasures for the radioactive materials in the reservoirs, etc. "Investigative Committee on Remediation" (August 22, 2014)

Commentary	Research on the behavior of radioactive substances in rivers

As the result of surveys on rivers flowing in Fukushima Prefecture, it was revealed that radioactive cesium concentrations in rivers continued to decrease after the disaster (left figure below). Also, as a result of investigating changes after completion of decontamination on riverbank areas where the general public is active, it was confirmed that there is no significant change in air dose rates when areas are flooded by heavy rains (right figure below)



Changes in radioactive cesium concentrations in suspended state in Abukuma River



Changes in air dose rates after decontamination of riverbank

Source：Fukushima Prefectural Centre for Environmental Creation

(3) Decontamination of Areas where Returning is Difficult

The "Basic Policy for Emergency Response on Decontamination Work" (August 26, 2011 Nuclear Emergency Response Headquarters) states that in areas where the additional annual radiation dose significantly exceeds 20 mSv/y, the national government conducts decontamination model projects and establishes policies to ensure the safety of decontamination technologies and workers.

The MOE carried out Decontamination Model Projects in Areas where Returning is Difficult starting in October 2013 and announced the results on June 10, 2014.[44]

In addition, early decontamination was carried out around JR station areas, roads, and areas in contact with Habitation Restricted Areas, and for wide area infrastructure, decontamination was carried out under the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials.

The document "For Accelerating the Reconstruction of Fukushima From the Nuclear Disaster" (Nuclear Emergency Response Headquarters on December 20, 2013), states that MOE is to consider projections for radiation doses and reconstruction scenarios based on the result of decontamination model projects, etc.

[44] MOE, "Report on the Results of Model Demonstration Projects in Areas where Returning is Difficult" (June 10, 2014).

Later, on August 31, 2016, “Approach on the handling of Areas where Returning is Difficult” was announced from the Nuclear Emergency Response Headquarters. It presented the following policies, and for Areas where Returning is Difficult, it was the policy to set up reconstruction centers and to integrate decontamination along with infrastructure development.

- In Areas Where Returning is Difficult, depending on the achievements of each municipality, establish and develop reconstruction centers that will aim to have the evacuation orders lifted based on a reduction in dose, and make residence possible within about five years.
- In addition, decontamination and other measures are conducted so that people can safely travel or use the main roads constituting the wide area network, starting with National Highway No. 6 (including connecting roads and additional interchanges on Joban Expressway).
- Municipalities formulate plans to develop Specified Reconstruction and Revitalization Bases, etc., in consultation with the prefectural government, and the national government approves them.
- As for maintenance, decontamination and infrastructure development are integrated in an efficient manner.

Based on the above policy, the Cabinet decided “Basic Guidelines for Accelerating Fukushima Reconstruction from Nuclear Disaster” on December 10, 2016, and on May 19, 2017 the “Act on Partial Revision of the Act on Special Measures for the Reconstruction and Revitalization of Fukushima” (Act No. 25 of 2012) was promulgated and entered into force, and a planning system was established to promote the reconstruction and revitalization of Specified Reconstruction and Revitalization Bases.

<Planning system to promote Specified Reconstruction and Revitalization Bases>

Heads of municipalities established plans to promote construction of the “Specified Reconstruction and Revitalization Bases” aiming to lift evacuation orders and allow returnees, etc., to live in Areas where Returning is Difficult. When the plan is accredited by the Prime Minister, the following systems etc. shall be made available in the area.

- The national government implements decontamination and waste disposal treatment based on the qualification plan (cost burdened by the government).
- Business agency takes over infrastructure project by the government, such as construction of new roads.
- Special provision for taxation related to capital investment, etc., necessary for restarting business by the disaster victims and promotion of local establishment of new business operators
- The “Specified Reconstruction and Revitalization Base development system of one housing complex” is applied to construct a new urban area by outright acquisition method.

(4) Interim Storage Facility (ISF)

1) Outline of Interim Storage Facility

ISF is to be developed based on the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials in order to safely and intensively manage and store soil containing radioactive materials generated by decontamination work in Fukushima as well as designated waste with radioactivity concentration of more than 100,000 Bq/kg stored in the Prefecture until its final disposal. The amount of removed soil within Fukushima Prefecture (as of July 2013) was estimated to be 16 million to 22 million m^3 even after volume reduction (incineration of combustibles), with a volume about 13 to 18 times that of the Tokyo Dome (Figure 3-21) (Figure 3-21).

The MOE is proceeding with the construction of ISF as well as the ongoing transporting of the removed soil. The "Five Year Ad-hoc Policy" concerning ISF publicly announced in March 2016 states that 5 million to 12.5 million m^3 of removed soil would be transported to the ISF by the year 2020, the last year of the "Reconstruction and Revitalization Period." According to this policy, the aim is to transport to ISF at least an amount equivalent to the removed soil currently stored on-site at schools and residential houses (estimated to be 1.8 million m^3 as of the time announced), and to make every effort for land acquisition, aiming to transport to ISF an amount equivalent to the removed soil that is along main roads (3 million to 5 million m^3).

2) Status of land acquisition for Interim Storage Facility

The area of planned sites for Interim Storage Facility is about 1,600 ha, and 2,360 persons are registered in land registries within that area. As of February 2017, steady progress had been made, as the contact information of landowners was known for about 1,220 ha, the area surveyed was about 1,170 ha, the area with contracts in place was about 844 ha (about 52.8% of the total), and contracts had been signed with 1,380 persons (about 58.5% of the total). Regarding land acquisition, MOE believes that it is important to have public understanding of the Interim Storage Facility project, as well as a relationship of mutual trust with landowners, and will continue to work while providing sufficient explanations to the landowners.

3) Status of transport to Interim Storage Facility

710,000 m^3 of removed soil had been transported to ISF by the end of February 2017. For the future transport, the Transportation Implementation Plan will be updated and traffic measures such as improvement of pavement thickness was implemented for necessary spots on transport routes to ISF. MOE will continue to carry out transportation considering safety and securement.

4) Publication of 2018 project policy

In November 2017, the "Policy of the Interim Storage Facility Project in FY2018" described policies including (1) the amount transported in FY2018 shall be about 1.8 million m^3, which is the maximum value of the "Five Year Ad-hoc Policy" and (2) in FY2019, to the extent possible aim at the maximum possible (4 million m^3). In addition, the current outlook for the development of Interim Storage Facility was released (Figure 3-22).

5) Efforts toward volume reduction and recycling

With regard to removed soil within Fukushima Prefecture, the necessary measures are to be taken to complete the final disposal outside of Fukushima Prefecture within 30 years after the start of the Interim Storage Facility. For the realization of final disposal of removed soil, etc., outside of Fukushima Prefecture, it is important to treat the removed soil with volume reduction technologies in order to increase to the extent possible the amount of soil recycled, and attempt to reduce the final disposal amount. To do so, in April 2016, the "Volume reduction and recycling utilization technology development strategy" and "road map" were formulated, as a medium to long-term policy concerning the development of volume reduction technologies for the time being for final disposal outside the prefecture and the recycling of removed soil, etc. In addition, the "Basic concept concerning the safe use of recycled removed soil" was formulated in June that same year as a guideline for step-by-step progress with the recycling of removed soil.

In line with these, a test embankment was constructed using removed soil at a Temporary Storage Site in Minamisoma City in December 2016, and a monitoring survey of the air dose rate, etc., was carried out. It found that no large fluctuation of the air dose rate was observed, and no radioactivity concentration of the seepage water of the embankment was detected, which confirmed a certain degree of safety for recycling.

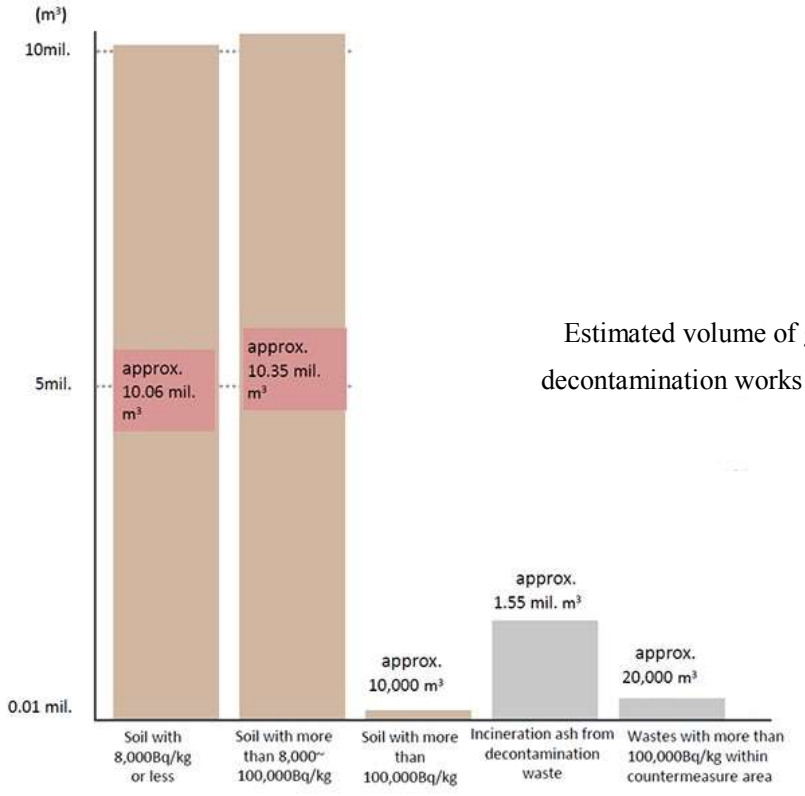


Figure 3-21 Forecast of total quantity contaminated soil and waste generated

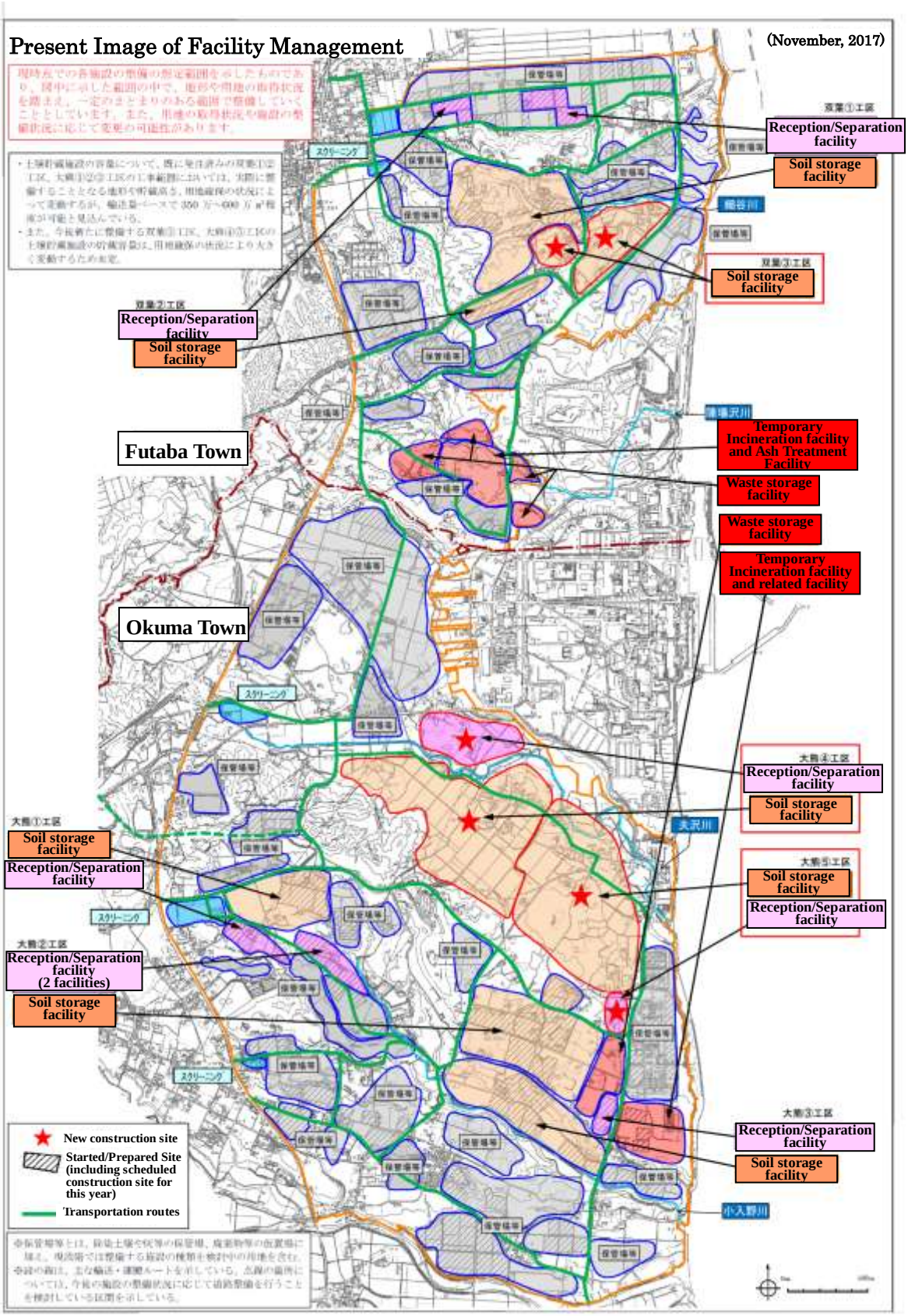


Figure 3-22 Current outlook for development of Interim Storage Facility

Source: MOE "Policy of the Interim Storage Facility Project in 2018" (November 2017)