環境省
Ministry of the Environment

Part V

Guidelines for Method of Measurement of Radioactive Concentration
(Tentative Translation)

March 2013, 2nd Edition

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Introduction

In the Guidelines, specific methods, etc., shall be explained for the measurement of the air dose rates and radioactive concentrations provided for in Ordinance for Enforcement of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011 (Ordinance of the Ministry of the Environment, No. 33 of 2011. (Hereinafter referred to as the "Ordinance."))

The Guidelines are prepared on presumption that the person required to make measurements under the Ordinance shall refer to these Guidelines together with each of the Guidelines from Part II through Part IV, which explain method of treatment, etc., of waste.

For the summary and purpose, etc., of the standards for various measurements in the Ordinance, please confirm in each of the Guidelines from Part II through Part IV.

Chapter 1 Measuring Instruments

Measurement of the air dose rates shall be made by an air dosimeter which can measure γ-rays of a scintillation survey meter and was calibrated within a year (**Figure 1-1**). Fixed monitoring post may be installed.

Measurement of radioactive concentration shall be made by a germanium semiconductor detector (**Reference Photo 1-1**), except for some parts of "Chapter 7" and "Chapter 8".

Various Types of Air Dosimeter (Examples)

- NaI(Tl) Scintillation Survey Meter
- CsI(Tl) Scintillation Survey Meter
- Other Types of Scintillation Survey Meter
- GM Survey Meter

Figure 1-1: Air Dosimeter

Reference Photo 1-1: Germanium Semiconductor Detector

Calibration of the air dosimeter shall be carried out in accordance with Japan Industrial Standards (JIS Z4511, JIS Z4333 for scintillation-type survey meters) *[1].

*1: Calibration can also be done at a registered operator based on the Measurement Law (http: //www.meti.go.jp/policy/economy/hyojun/techno_infra/sokuteikikousei.html)

If the above-mentioned calibration cannot be carried out easily, five measurements at the same location can be taken at the same time as a calibrated energy compensation scintillation survey meter serving as a separate standard to verify that the target device satisfies the required performance. After verifying and recording the ratio of the average standard value to the average of the measurements (average of the standard values / average of the measured values), the correct measured value can be calculated by multiplying the ratio by the actual measured value (however, when the ratio of the average measured value with the standard calibrated measurement device varies by more than 20%*[2] above or below 1, then that measurement device is then deemed not to be sufficiently reliable).

In addition, when calibrating in a location with the same level of radioactivity as the region used in reality, after verifying and recording the magnitude of the difference in the indicated value, the correct measured value can also be calculated by adjusting the average difference from the actual measured value (however, when the average of the difference in the measured value from the standard calibrated measurement device varies by more than 20%*[2], then that measurement device is then deemed not to be sufficiently reliable) .

*2: JIS Z 4333 The permissible range of the relative standard error is assumed to the ± (15＋U) % or 20% in “survey meters for measuring the dose equivalent ratio for X-ray and γ-ray” where U is considered to be less than 5% due to the uncertainty of the reference dose.

Chapter 2 Dose Rates in the Air

Measurement of radiation levels prescribed by the Minister of the Environment
(Ministry of the Environment Bulletin No. 110 dated Dec 28, 2011)

Under the method prescribed by the Minister of the Environment under Article 15 item (xi) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, measurements shall be taken using a gamma ray measurement device at a height of between 50 cm and 1 m from the ground surface.

2.1 Measurement during Storage

2.1.1. Measurement Method

Measurement shall be made in accordance with the following procedures.

(1) Measurement before Start of Storage

- Background measurement shall be made at the place which is to be the storage ground before the start of storage of waste.
- Measuring points shall be four points in the facilities where waste is stored. An example of measuring points is shown in Figure 2-1.
- If the storage site is already determined, measurements shall be taken at the planned points after the storage (**Figure 2-2**).
- Background measurement after start of storage shall be made at the points sufficiently distant from the stored waste.

(2) Measurement after Start of Storage

- Measuring points after start of storage shall be the boundary line of the fence of storage where the public enters and the boundary line of the premises of the facility where the public does not enter. Background measurement shall be made at the points sufficiently distant from the waste.
- The boundary line of the fence and the boundary line of the premises of the facility shall be the four points including the boundary line at the nearest point from the storage site of waste. An example of measuring points is shown in **Figure 2-2** and **Figure 2-3**.
- The point sufficiently distant from the stored waste (the background measuring point) can be the most distant boundary line of the premises of the facility from the place where waste is stored.
- Measuring points shall be the same place and same height every time.
- Only at the start of storage, it is desirable to measure and record the dose rates of the surface of waste (the air dose rate at the point 1cm from the waste).

(3) Matters of Note

- Since the air dose rates fluctuate depending on the ground surface conditions, it is desirable to record the ground surface conditions (sand, asphalt, etc.) of the measuring points.
- Measuring height shall be 1m above the ground (if removed soil, etc., is stored in a school yard, etc., it may be 50cm above ground, considering the living space of young children and younger students, etc., and in that case, the measuring points shall always be the same place and same height.)
- Measuring place shall be the place where there is no tree or building within 1m as practicable as possible.

- The detector shall be set parallel to the ground and be kept apart from the body as far as possible; provided, however, that for measurement of dose rates of the surface of waste, the detector shall be directed to the waste.
- The detector shall be covered by a plastic bag for pollution prevention.
- For daily checks of the measurement device, a check of the remaining amount of a battery, damage to cable connectors, movement of switches, etc., and measurement of background measurement values (measurement shall be made at the same place where the background does not fluctuate significantly and confirm that there is no significant change as compared with the previous values) shall be made for use as a rough standard for abnormalities and failures.
- Assume a sufficiently long time for the time constant when measuring the air dose rate (for example, set it as 30 seconds or more) , and wait for about three times the time constant until the measured value stabilizes.
- For measurement values, measurement values shall be read five times once in a stable condition and the average of five times shall be the measurement result.
- If the indicated value of measuring instrument swings past the maximum, measurement shall be made by switching the range and if it swings past the maximum in the maximum range, the value shall be read as above the maximum value of the range or measurement shall be made by another measuring instrument model.

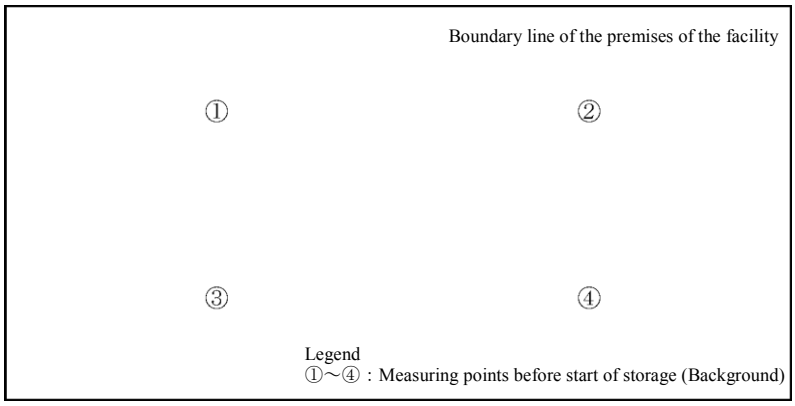


Figure 2-1 (1): Example of the measuring points before start of storage [1] (if the storage site is not determined)

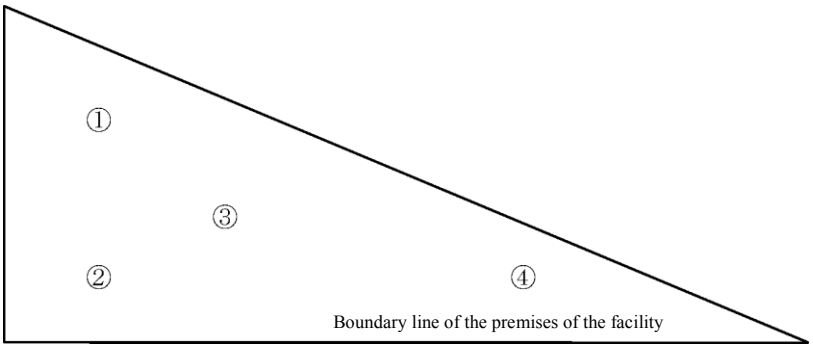


Figure 2-1 (2): Example of the measuring points before start of storage [2] (if the storage site is not determined)

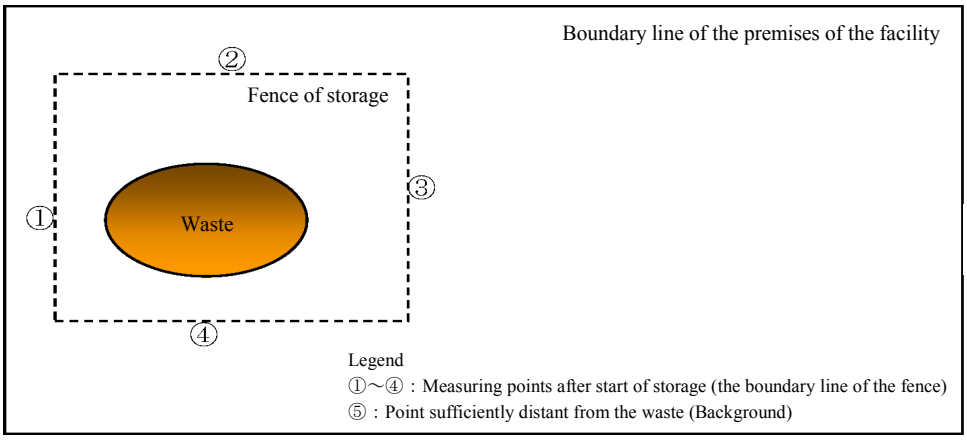


Figure 2-2 (1): Example of the measuring points where the public enters after start of storage [1]

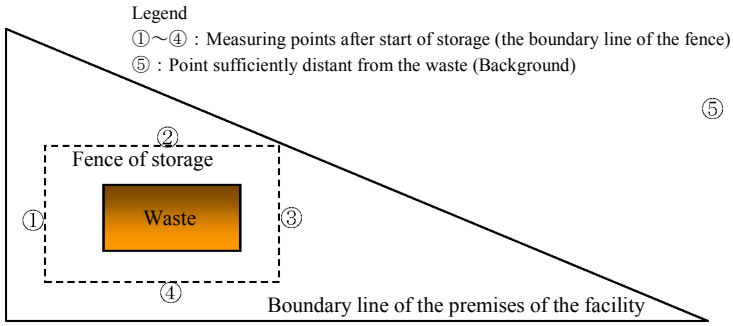


Figure 2-2 (2): Example of the measuring points where the public enters after start of storage [2]

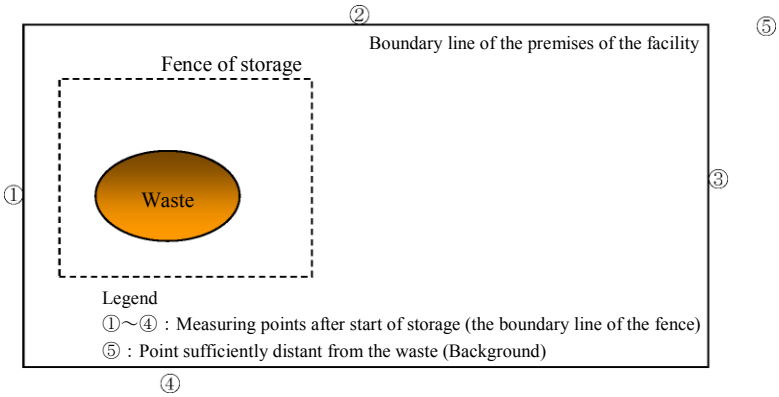


Figure 2-3 (1): Example of the measuring points where the public does not enter after start of storage [1]

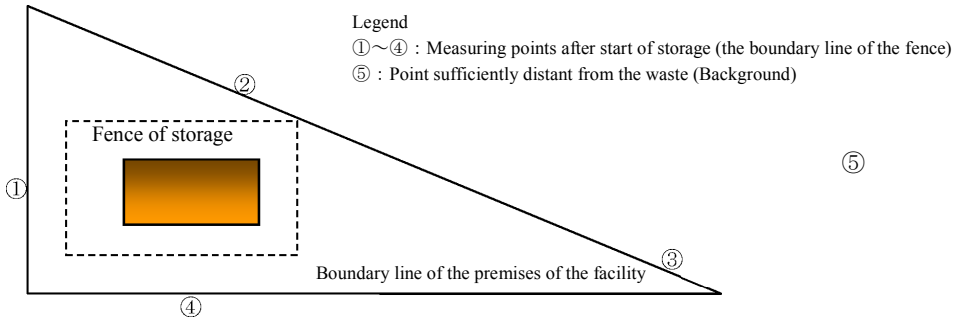


Figure 2-3 (2): Example of the measuring points where the public does not enter after start of storage [2]

2.1.2 Management of Measurement Results

(1) Record of Measurement Results

Measure the air dose rate of the storage site before carrying in and set it as the background. If the air dose rate cannot be measured before carrying in as storage has already started, etc., measure the air dose rate of the point sufficiently distant from the stored waste and set it as the background.

Retention period of the measurement results shall be until storage of the waste is terminated.

The measurement results shall be recorded and retained for the following items.

(1) Address of the storage site and name of the facility
(2) Date of measurement of the air dose rate
(3) Weather
(4) Date of start of storage
(5) Name of the manufacturer and model of the instrument used for measurement
(6) Name of measurer
(7) Measurement results
(8) Measuring position
(9) Surface dose, radioactive concentrations aerials (only limited to those which are known)
(10) Kind, shape and quantity of specified waste (only limited to new waste)

(2) Evaluation of the measurement results

During the transportation period, check that the measurement results at the fence or boundary line of the premises satisfy the following equation (must be less than the average background measurement + 3 times the background radiation standard deviation + 0.19μSv/h (additional 1mSv per year)*).

$$\text{Measurement results at the fence or boundary line of the premises} \leqq \bar{x} + 3\sigma + 0.19 \quad (\mu Sv/h)$$

$\bar{x}$: Average background radiation measurement $(\mu Sv/h)$

σ : Background radiation standard deviation $(\mu Sv/h)$

At the end of the transportation, check that the radiation level is “about the same” as the background radiation. “About the same” shall mean that the level is within the average background measurement + background standard deviation x 3*.

*According to the Nuclear Power Safety Committee's "Environmental Radiation Monitoring Guidelines" (partially revised in Apr. 2010), "when significant multiple measurements are obtained under well-controlled conditions such as the measurements obtained chronologically from a single monitoring post, these measurements shall be managed statistically and a normal fluctuation band of the previous average measurement plus/minus three times the standard deviation shall be assumed.

Records of Measurement of Air Dose Rates during Storage (Form Example)

Address of storage site and name of the facility	Address: Name of the Facility:						
Date of measurement of the air dose rates	Date:			Weather			
Date of start of storage	Date:						
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: Model:						
Name of Measurer							
Measurement Results							Unit: μSv/h
Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]							
Measuring Point [2]							
Measuring Point [3]							
Measuring Point [4]							
Measuring Point [5]							
Measuring Position (attach drawings or photos)							
Surface dose rate (Reference)							(μSv/h)
Radioactive Concentration (only limited to those which are known)							(Bq/kg)
Kind, form and quantity of specified waste (only limited to new waste)							

Remarks: ground conditions mean soil, asphalt or grass, etc.

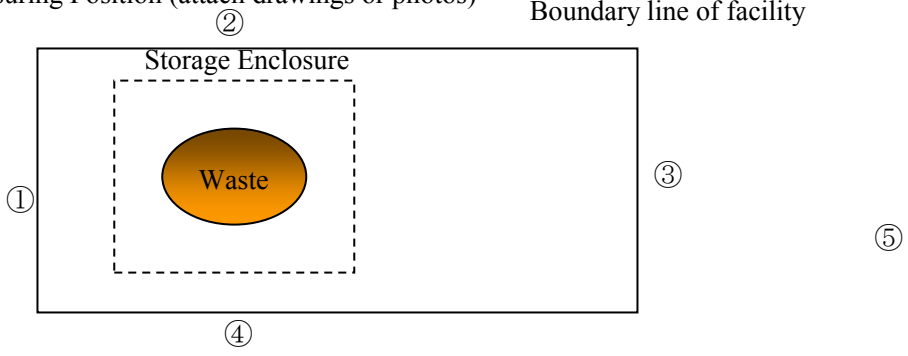
Records of Measurement of Air Dose Rates during Storage (Description Example)

Address of storage site and name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxxxxx Co., Ltd.		
Date of measurement of the air dose rates	Date: Feb 27, 2012	Weather	Clear
Date of start of storage	Date: Feb 27, 2014		
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: xxxxxx Model: xxxx		
Name of Measurer	xxxx, xxxxxx Co., Ltd.		

Measurement Results Unit: μSv/h

Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]	Asphalt	0.12	0.11	0.12	0.11	0.11	0.11
Measuring Point [2]	Asphalt	0.13	0.14	0.15	0.13	0.14	0.14
Measuring Point [3]	Soil	0.16	0.16	0.15	0.16	0.16	0.16
Measuring Point [4]	Grass	0.17	0.19	0.17	0.18	0.18	0.18
Measuring Point [5] (Background)	Asphalt	0.13	0.13	0.14	0.12	0.13	0.13

Measuring Position (attach drawings or photos)



Surface dose rate (Reference)	0.58 (μSv/h)
Radioactive Concentration (only limited to those which are known)	8500 (Bq/kg)
Kind, form and quantity of specified waste (only limited to new waste)	Solidified fly ash, packed in flexible containers, 10m^3

Remarks: ground conditions mean soil, asphalt or grass, etc.

[Example on the evaluation of measurement results during transportation]

The measurement results are as follows.

Measurement Points ①-④ are measurement results at the fence or boundary line of the premises

Measurement Point ⑤ is the background measurement value

Measurement Point	1st time	2nd time	3rd time	4th time	5th time	Average
Measurement Point ①	0.12	0.11	0.12	0.11	0.11	0.11
Measurement Point ②	0.13	0.14	0.15	0.13	0.14	0.14
Measurement Point ③	0.16	0.16	0.15	0.16	0.16	0.16
Measurement Point ④	0.17	0.19	0.17	0.18	0.18	0.18
Measurement Point ⑤ (Background)	0.13	0.17	0.16	0.14	0.15	0.15

An example on the calculation of the standard deviation of the background measurement value (Measurement point ⑤) is shown below.

The formula for the standard deviation is as follows.

$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}$$

$$\sigma = \sqrt{\frac{1}{5-1}\{(0.13-0.15)^2 + (0.17-0.15)^2 + (0.16-0.15)^2 + (0.14-0.15)^2 + (0.15-0.15)^2} = 0.016$$

Therefore, check that all the measurement results of measurement points ①-④ during the transportation period are

≦0.15 (average background value) + 3 × 0.016 (background standard deviation) + 0.19 (additional 1mSv per year)

≦0.39μSv/h

And that all the measurement results of measurement points ①-④ at the end of the transportation are

≦0.15 (average background value) + 3 x 0.016 (background standard deviation)

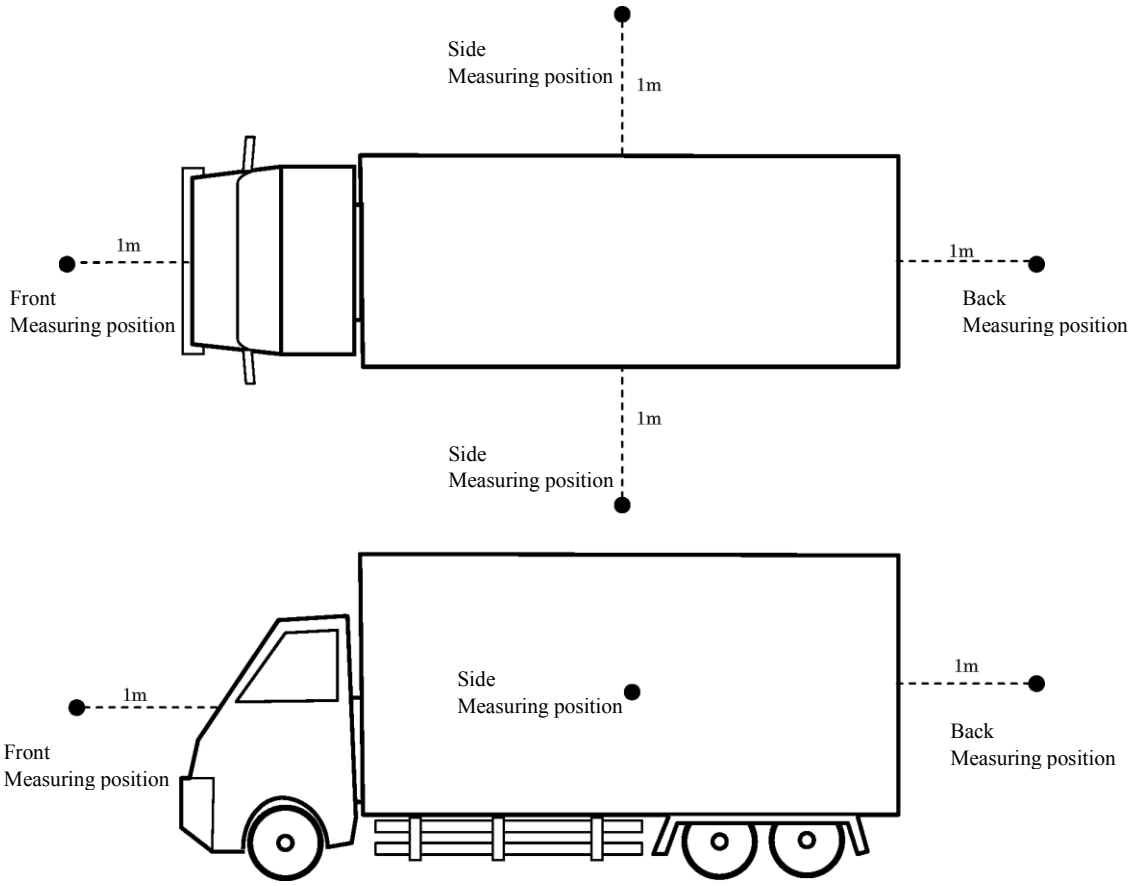
≦0.198μSv/h

2.2 Measurement during Transportation

2.2.1 Measurement Method

If measurement of a vehicle loading waste is made, the air dose rates shall be measured at a distance of 1m from the vehicle.

- Measuring points are front, back and both sides of the vehicle (if the vehicle is open type, the vertical surface contacting the contour). An example of the measuring points is shown in **Figure 2-4**.
- Measurement shall be made at the position 1m away from the surface of the vehicle.
- The detector shall be set parallel to the ground and kept apart as far as possible from the body.
- After screening at each surface, measurement shall be made at the point which indicated the highest air dose rate. If the point with the highest air dose rate is unknown, measurement shall be made at the center of each side.
- The detector shall be covered by a plastic bag, etc. for pollution prevention.
- For daily checks of the measurement device, a check of the remaining amount of a battery, damage to cable connectors, movement of switches, etc., and measurement of background measurement values (measurement shall be made at the same place where the background does not fluctuate significantly and confirm that there is no significant change as compared with the previous values) shall be made for use as a rough standard for abnormalities and failures.
- Assume a sufficiently long time for the time constant when measuring the air dose rate (for example, set it as 30 seconds or more) , and wait for about three times the time constant until the measured value stabilizes.
- For measurement values, measurement values shall be read five times after in a stable condition and the average of the five times shall be the measurement result.
- If the indicated value of measuring instrument swings past the maximum, measurement shall be made by switching the range and if it swings past the maximum in the maximum range, the value shall be read as above the maximum value of the range or measurement shall be made by another measuring instrument model.



* After screening at each surface, measurement shall be made at the point which indicated the highest air dose rate. If the point with the highest air dose rate is unknown, measurement shall be made at the center of each side.

Figure 2-4: Example of Measuring Points [1]

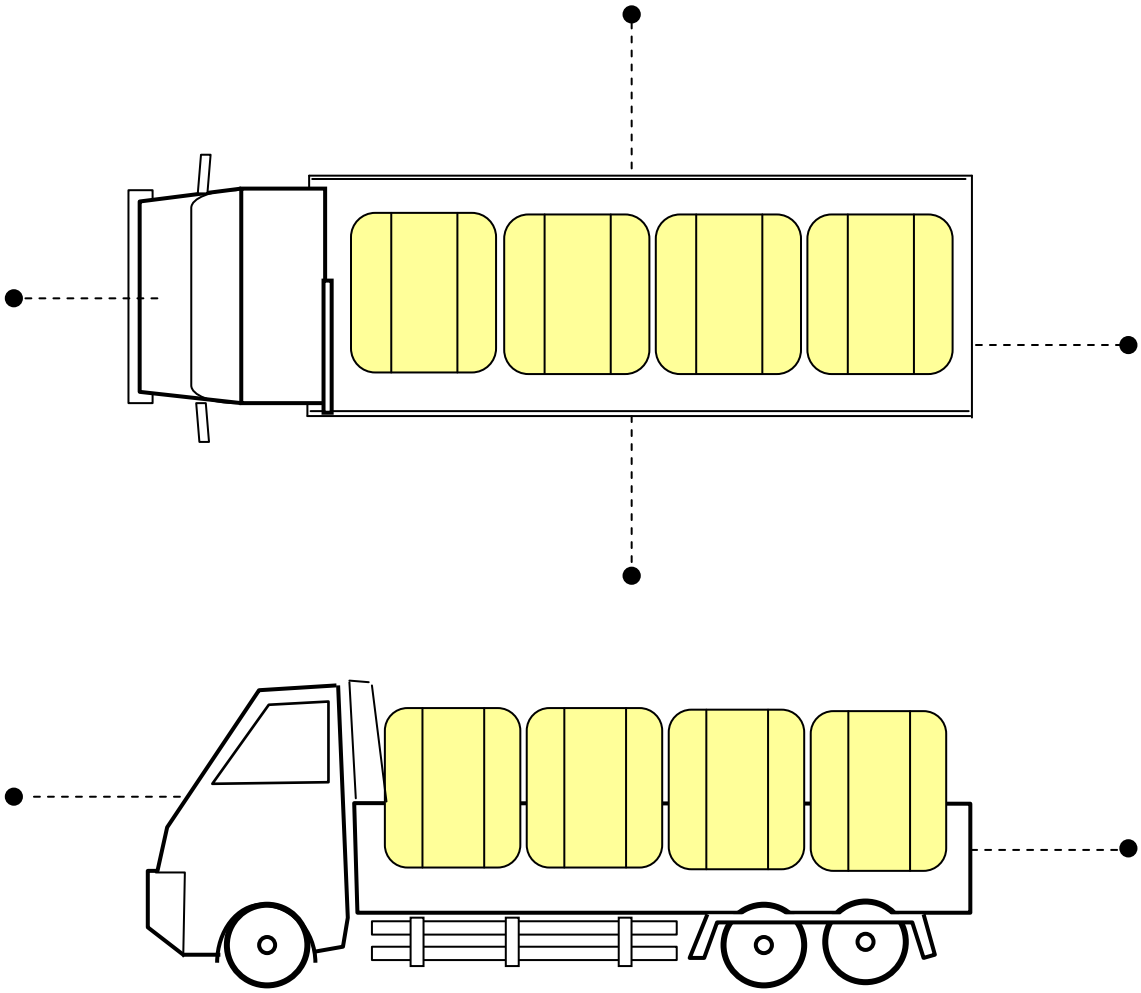


Figure 2-5: Example of measurement point [2]

2.2.2 Management of Measurement Results

(1) Record of Measurement Results

Measurement results shall be retained for a year from the date of completion of collection or transportation.

Measurement results shall be recorded and retained for the following items.

(1) Address of transportation place and name of the facility
(2) Date of measurement of the air dose rates
(3) Type and number of the vehicle
(4) Name of the manufacturer and model of the instrument used for measurement
(5) Name of measurer
(6) Measurement results

(2) Evaluation of Measurement Results

The air dose rate must be below 100μSv/h on all sides 1 m away from the vehicle. If this is exceeded, the type and loaded quantity of the waste shall be adjusted.

Records of Measurement of Air Dose Rates during Transportation (Form Example)

Address of transportation place, name of the facility	Address: Name of the Facility:
Date of measurement of air dose rates	Date:
Type of vehicle	
Number of vehicle	
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: Model:
Name of Measurer	

Measurement Results Unit: μSv/h

Measuring Side	1st time	2nd time	3rd time	4th time	5th time	Average
Front						
Left side						
Right side						
Back						

Records of Measurement of Air Dose Rates during Transportation (Description Example)

Address of transportation place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxx Co., Ltd.
Date of measurement of air dose rates	Date: Feb 27, 2012
Type of vehicle	10-t truck with canopy
Number of vehicle	Chiba 100 A 12-34
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: xxxxxx Model: xxxx
Name of Measurer	Company Name: xxx Co., Ltd. Name of Measurer: xxxxxx

Measurement Results Unit: μSv/h

Measuring Side	1st time	2nd time	3rd time	4th time	5th time	Average
Front	0.25	0.23	0.26	0.22	0.25	0.24
Left side	1.56	1.62	1.58	1.55	1.64	1.59
Right side	1.85	1.76	1.80	1.77	1.82	1.80
Back	0.89	0.85	0.84	0.86	0.88	0.86

2.3 Measurement at Incineration Facilities, Sludge Dehydration Facilities, etc.

2.3.1 Measurement Method

Measurement shall be made in accordance with the following procedures.

(1) Measurement before start of acceptance of waste

- Before start of acceptance of waste, at the boundary line of the premises, background measurement shall be made. An example of measuring points is shown in **Figure 2-6**.
- Background measurement shall be made at the point sufficiently distant from the incineration facility when waste has already been accepted and the incineration facility started operation.

(2) Measurement after acceptance of waste

- Measuring points after acceptance of waste shall be four points including the boundary line of the premises nearest to the facilities of incineration, etc. Background measurement shall be made at the point sufficiently distant from the incineration facility. An example of measuring points is shown in **Figure 2-7**.
- The point sufficiently distant from the facilities of incineration, etc. (background measuring points) may be the boundary line of the premises farthest from the facilities of incineration, etc., of waste.
- Measuring points shall be the same every time.

(3) Matters of Note

- Since the air dose rates fluctuate depending on the ground surface conditions, it is desirable to record the ground surface conditions (sand, asphalt, etc.) of the measuring points.
- Measuring height shall be 1m above the ground.
- Measuring place shall be the place where there is no tree or building within 1m as practicable as possible.
- The detector shall be set parallel to the ground and be kept apart from the body as far as possible.
- The detector shall be covered by a plastic bag, etc. for pollution prevention.
- For daily checks of the measurement device, a check of the remaining amount of a battery, damage to cable connectors, movement of switches, etc., and measurement of background measurement values (measurement shall be made at the same place where the background does not fluctuate significantly and confirm that there is no significant change as compared with the previous values) shall be made for use as a rough standard for abnormalities and failures.
- Assume a sufficiently long time for the time constant when measuring the air dose rate (for example, set it as 30 seconds or more) , and wait for about three times the time constant until the measured value stabilizes.
- For measurement values, measurement values shall be read five times once in a stable condition and the average of five times shall be the measurement result.
- If the indicated value of measuring instrument swings past the maximum, measurement shall be made by switching the range and if it swings past the maximum in the maximum range, the value shall be read as above the maximum value of the range or measurement shall be made by another measuring instrument model.

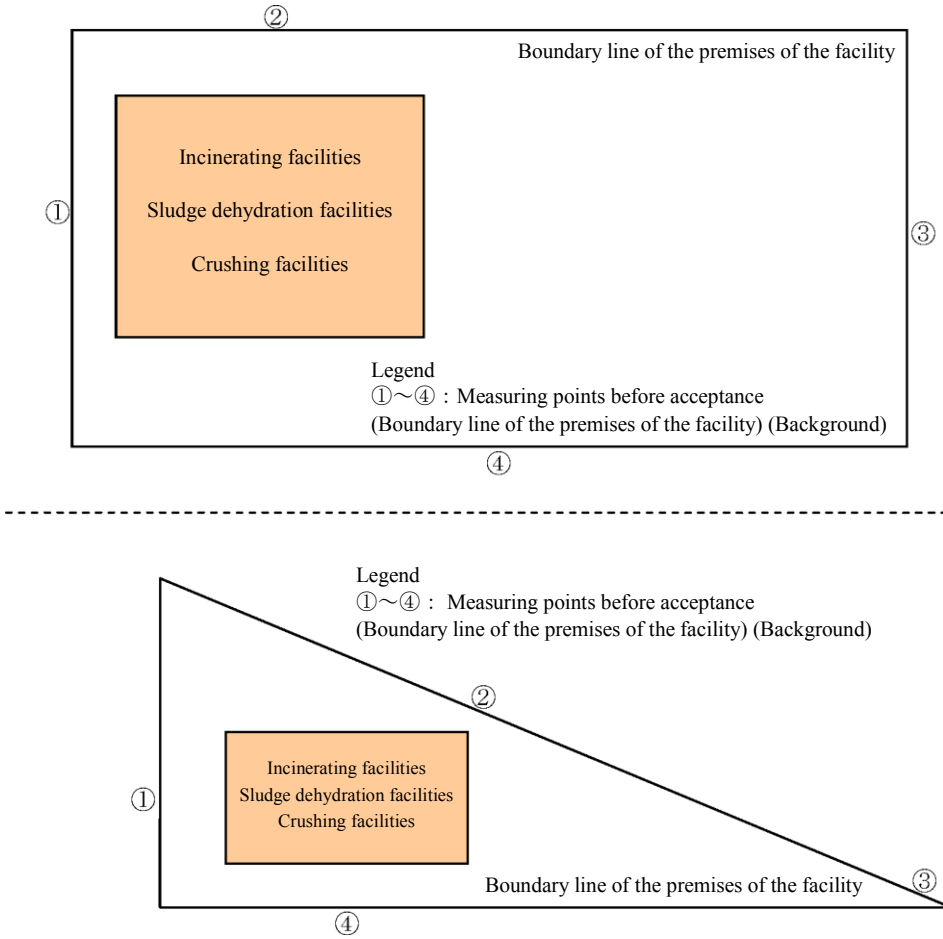


Figure 2-6: Example of Measuring Points before Start of Acceptance of Waste

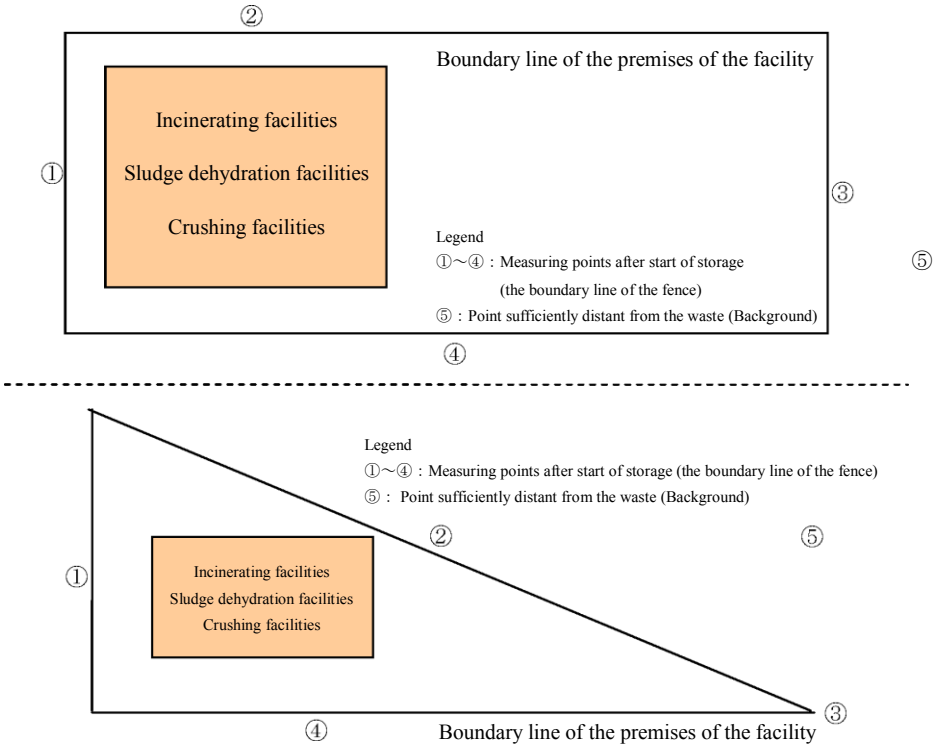


Figure 2-7: Example of Measuring Points after Acceptance of Waste

2.3.2 Management of Measurement Results

(1) Record of Measurement Results

Measure the air dose rate at the boundary line of the premises prior to receiving the waste and take this as the background radiation. When waste has already been taken in and the air dose rate cannot be measured prior to the waste being received, measure the air dose rate at a point that is sufficiently isolated from the incineration facility and take this as the background radiation.

Measurement results shall be recorded and retained for the following items until the facility is abolished.

(1) Address of the facility and name of the facility
(2) Date of measurement of the air dose rates
(3) Weather
(4) Name of the manufacturer and model of the instrument used for measurement
(5) Name of measurer
(6) Measurement results
(7) Measuring position

(2) Evaluation of Measurement Results

During the period when waste is taken in, check that the measurement results satisfy the following equation (must be less than the average background measurement + 3 times the background standard deviation + 0.19μSv/h (additional 1mSv per year)).

$$\text{Measurement results} \leqq \bar{x} + 3\sigma + 0.19 \quad (\mu Sv/h)$$

$\bar{x}$: Average background radiation measurement $(\mu Sv/h)$

σ : Background radiation standard deviation $(\mu Sv/h)$

After taking in the waste, check that the measurement results are “about the same” as the background radiation level. “About the same” shall mean that the level is within the average background measurement + 3 x background standard deviation.

Records of Measurement of Air Dose Rates at Incineration Facilities, Sludge Generation Facilities, etc. (Form Example)

Address and name of the facility	Address: Name of the Facility:		
Date of measurement of air dose rates	Date:	Weather:	
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: Model:		
Name of Measurer			

Measurement Results Unit: μSv/h

Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]							
Measuring Point [2]							
Measuring Point [3]							
Measuring Point [4]							
Measuring Point [5]							

Measuring Position (attach drawings or photos)

Remarks: ground conditions mean soil, asphalt or grass, etc.

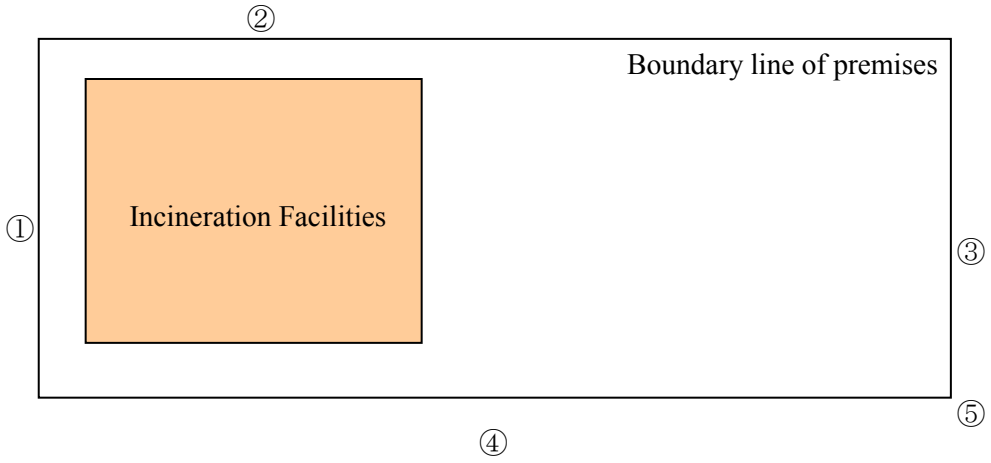
Records of Measurement of Air Dose Rates at Incineration Facilities, Sludge Generation Facilities, etc. (Description Example)

Address and name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxx Co., Ltd.		
Date of measurement of air dose rates	Date: Feb 27, 2012	Weather:	Clear
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: xxxxxx Model: xxxx		
Name of Measurer	Company Name: xxx Co., Ltd.	Name of Measurer: xxxxxx	

Measurement Results Unit: μSv/h

Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]	Asphalt	0.12	0.11	0.12	0.11	0.11	0.11
Measuring Point [2]	Asphalt	0.13	0.14	0.15	0.13	0.14	0.14
Measuring Point [3]	Soil	0.16	0.16	0.15	0.16	0.16	0.16
Measuring Point [4]	Grass	0.17	0.19	0.17	0.18	0.18	0.18
Measuring Point [5]	Grass	0.17	0.19	0.17	0.18	0.18	0.18

Measuring Position (attach drawings or photos)



Remarks: ground conditions mean soil, asphalt or grass, etc.

2.4 Measurement at Landfill Site

2.4.1 Measurement Method

Measurement shall be made in accordance with the following procedures.

(1) Measurement before the start of landfill

- Before the start of landfill, at the boundary line of the premises, background measurement shall be made. An example of measuring points is shown in **Figure 2-8**.
- Background measurement after the start of landfill shall be made at the point sufficiently distant from the landfill site.

(2) Measurement after start of landfill

- Measuring points after the start of landfill shall be four points at the boundary line of the premises. Background measurement shall be made at the point sufficiently distant from the landfill site.
  An example of measuring points is shown in **Figure 2-9**.
- The point sufficiently distant from the landfill site (background measurement) may be the boundary line of the premises with the longest distance from the landfill site to the premises.
- Measuring points at the boundary line of premises shall be the same every time.

(3) Matters of Note

- Since the air dose rate fluctuates according to the condition of the ground, it is desirable to record down the condition of the ground (soil, asphalt, etc.) at the measurement point.
- Measuring height shall be 1m above the ground.
- Measuring place shall be the place where there is no tree or building within 1m as practicable as possible.
- The detector shall be set parallel to the ground and be kept apart from the body as far as possible.
- The detector shall be covered by a plastic bag, etc. for pollution prevention.
- For daily checks of the measurement device, a check of the remaining amount of a battery, damage to cable connectors, movement of switches, etc., and measurement of background measurement values (measurement shall be made at the same place where the background does not fluctuate significantly and confirm that there is no significant change as compared with the previous values) shall be made for use as a rough standard for abnormalities and failures.
- Assume a sufficiently long time for the time constant when measuring the air dose rate (for example, set it as 30 seconds or more) , and wait for about three times the time constant until the measured value stabilizes.
- For measurement values, measurement values shall be read five times once in a stable condition and the average of five times shall be the measurement result.
- If the indicated value of measuring instrument swings past the maximum, measurement shall be made by switching the range and if it swings past the maximum in the maximum range, the value shall be read as above the maximum value of the range or measurement shall be made by another measuring instrument model.

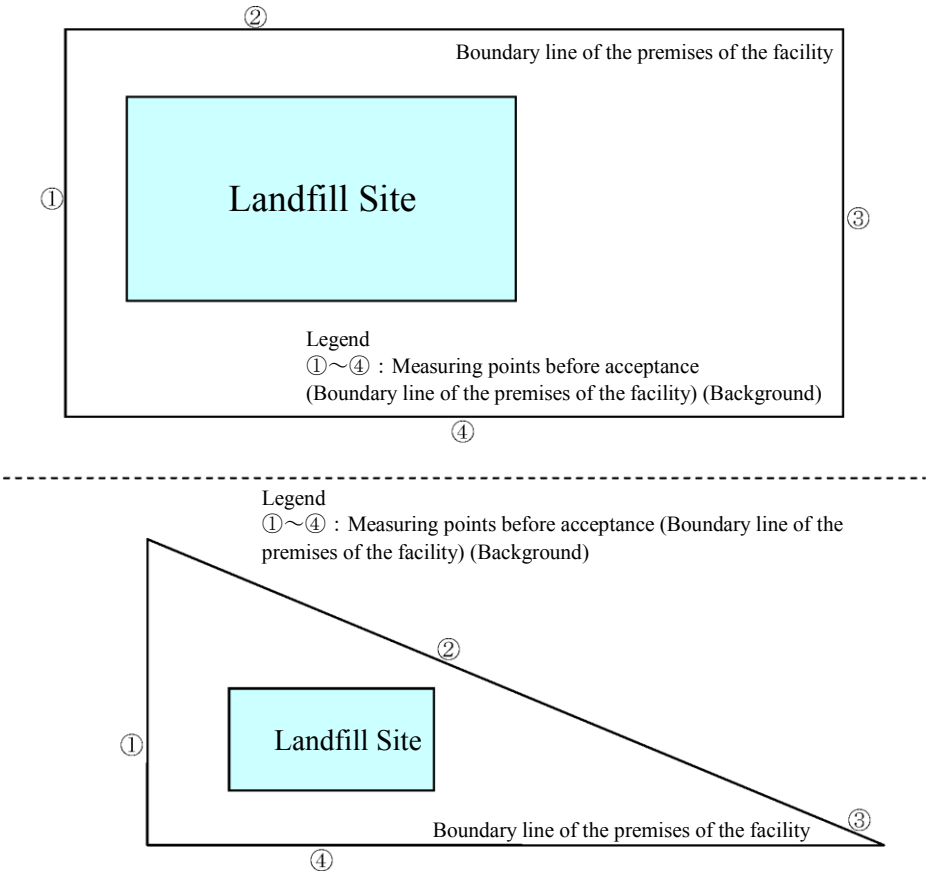


Figure 2-8: Example of Measuring Points before the Start of Landfill

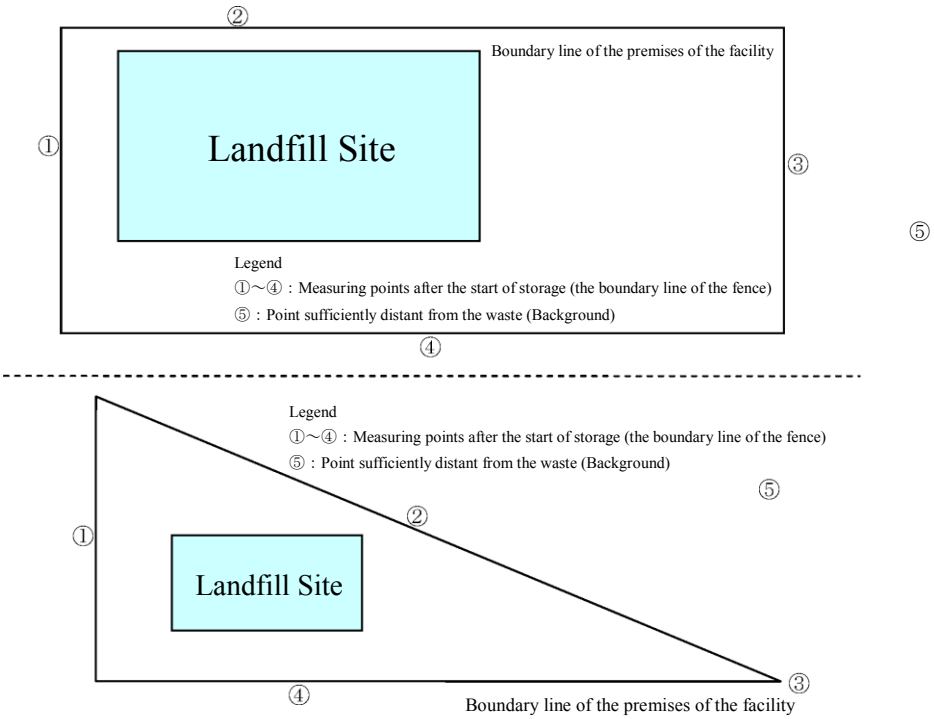


Figure 2-9: Example of Measuring Points after the Start of Landfill

2.4.2 Management of Measurement Results

(1) Record of Measurement Results

Measure the air dose rates of the boundary line of the premises before acceptance of waste and set it as the background. If the air dose rates cannot be measured as storage has already started, etc., measure the air dose rates of the point sufficiently distant from the landfill site and set it as the background.

Measurement results shall be recorded and retained for the following items until the facility is abolished.

(1) Address of the facility and name of the facility
(2) Date of measurement of the air dose rates
(3) Weather
(4) Name of the manufacturer and model of the instrument used for measurement
(5) Name of measurer
(6) Measurement results
(7) Measuring position

(2) Evaluation of Measurement Results

During the period when waste is taken in, check that the measurement results at the boundary line of the premises satisfy the following equation (must be less than the average background measurement + 3 times the background standard deviation + 0.19μSv/h (additional 1mSv per year).

$$\text{Measurement results} \leqq \bar{x} + 3\sigma + 0.19 \quad (\mu Sv/h)$$

$\bar{x}$: Average background radiation measurement $(\mu Sv/h)$

σ : Background radiation standard deviation $(\mu Sv/h)$

After taking in the waste, check that the measurement results are “about the same” as the background radiation level. “About the same” shall mean that the level is within the average background measurement + 3 x background standard deviation.

Records of Measurement of Air Dose Rates at Landfill Site, etc. (Form Example)

Address and name of the facility	Address: Name of the Facility:		
Date of measurement of air dose rates	Date:	Weather:	
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: Model:		
Name of Measurer			

Measurement Results Unit: μSv/h

Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]							
Measuring Point [2]							
Measuring Point [3]							
Measuring Point [4]							
Measuring Point [5]							

Measuring Position (attach drawings or photos)

Remarks: ground conditions mean soil, asphalt or grass, etc.

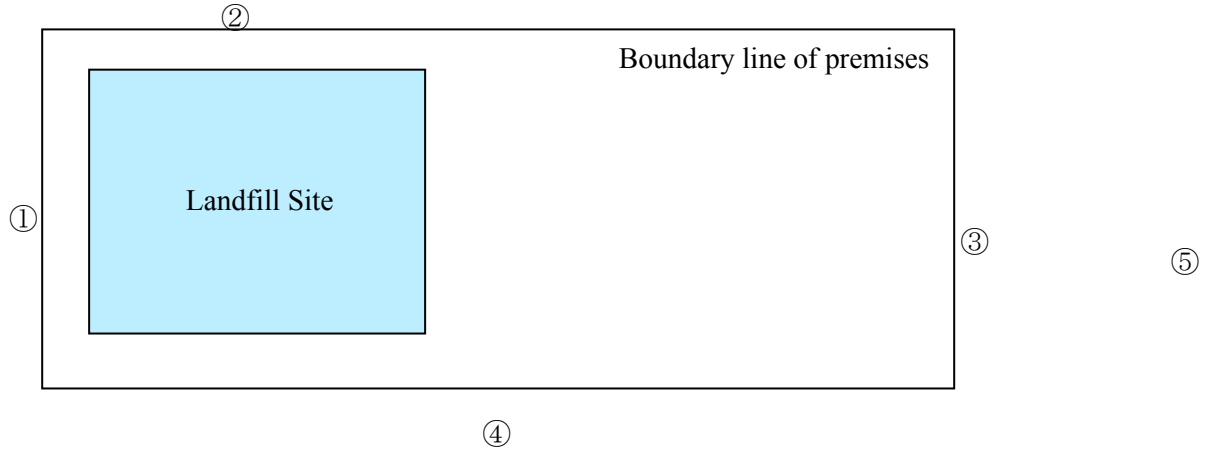
Records of Measurement of Air Dose Rates at Landfill Site, etc. (Description Example)

Address and name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxx Co., Ltd.		
Date of measurement of air dose rates	Date: Feb 27, 2012	Weather:	Clear
Name of the manufacturer and model of the instrument used for measurement	Name of the Manufacturer: xxxxxx Model: xxxx		
Name of Measurer	Company Name: xxx Co., Ltd.	Name of Measurer: xxxxxx	

Measurement Results Unit: μSv/h

Measuring Place	Ground Conditions	1st time	2nd time	3rd time	4th time	5th time	Average
Measuring Point [1]	Asphalt	0.12	0.11	0.12	0.11	0.11	0.11
Measuring Point [2]	Asphalt	0.13	0.14	0.15	0.13	0.14	0.14
Measuring Point [3]	Soil	0.16	0.16	0.15	0.16	0.16	0.16
Measuring Point [4]	Grass	0.17	0.19	0.17	0.18	0.18	0.18
Measuring Point [5]	Grass	0.17	0.19	0.17	0.18	0.18	0.18

Measuring Position (attach plans and photos)



Remarks: ground conditions mean soil, asphalt or grass, etc.

Chapter 3 Discharged Gas

Measurement of the concentration of radioactive substances discharged by the accident in the exhaust gas when exhaust gas generated during disposal is discharged (Ministry of the Environment Bulletin No. 111 dated Dec 28, 2011)

Under the method prescribed by the Minister of the Environment under Article 25 paragraph (1) item (v) (b) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, samples shall be taken in accordance with the method set forth in JIS Z 8808 and measurements shall be taken using a germanium semiconductor detector.

3.1 Specimen Sampling

Position of specimen sampling shall be the collection opening of discharged gas from which the same gas as the gas composition of the final discharge outlet can be sampled. Measurements shall be taken at each individual discharge outlet.

Specimen sampling of discharged gas shall be in compliance with JIS Z 8808, "Measuring Method of Dust Concentration in Discharged Gas" and sampling shall be made by constant speed suction. Composition of specimen sampling instrument is shown in **Figure 3-1**.

If the temperature of the discharged gas is high or the measurement hole is small, take the samples based on the Method 2 prescribed in JIS Z 8808 but maintain the temperature at a level where water will not condense along the line from the probe to the collection area of the paper filter (or from the temperature where water condensation will not occur to the temperature of 120℃) in order to prevent damage to the paper filter. When taking samples based on the Method 2, take samples from the materials attached to the sampling tube at the front end of the collection area of the paper filter and include them in the measurement sample taken from the collection area of the paper filter.

Sampling gas amount shall be approximately 3000L as a rough standard. If the lower limit of detection shown in **Table 3-2** is fully satisfied, sampling gas amount may be reduced.

When sampling is made with round paper filter, if the soot and dust amount is large, the paper filter shall be changed from time to time. There is no limit as to the number of paper filters, sampling shall be made with the number of paper filters as small as possible.

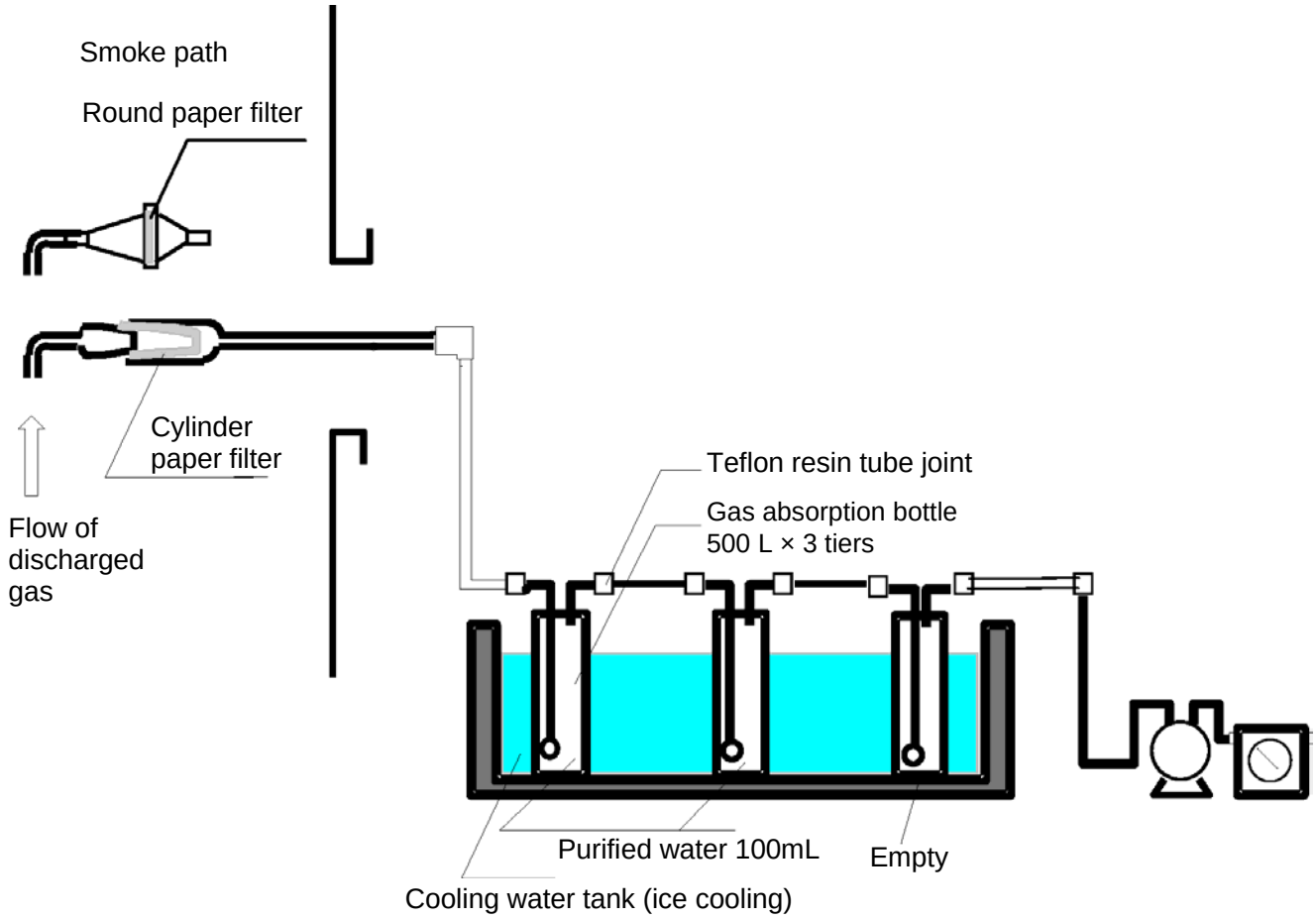
If the water content in the exhaust gas is high, take samples from the drains of all the impingers together with the washing solution. If the total volume is less than 2L, dilute it in a measuring flask to make it 2L. If the total volume exceeds 2L, heat up or isolate and remove the water content in the sample. If the sampled gas volume cannot satisfy the lower limit of detection, extend the analysis time until the lower limit of detection is satisfied.

If the temperature of the sampling gas is low, an organic paper filter can also be used. However, take note

that the paper filter may be damaged by the effect of corrosive gases depending on the quality of the paper filter.

(Reference)

If measurement is made at the entrance of the dust collector where there is a lot of soot and dust in order to confirm the capacity of the discharged gas treatment facilities, a cylinder paper filter, which can measure by a germanium semiconductor detector shall be used and the paper filter shall be replaced from time to time up to five paper filters. Sampling gas amount shall be the amount sampled by five cylinder paper filters.



Sampling Conditions (Example)

1. Suction flow amount : less than 15L/min. × 240 min. (4 hours), total approximately 3000L
2. Cylinder, round filter paper : silica filter paper or organic filter paper

Figure 3-1: Composition of Specimen Sampling Instrument

3.2 Management of Measurement Results

For the radioactive concentration in the discharged gas, measurement is generally made only at the discharge outlet. If the measurement value exceeded the limit of concentration in the air around (**Table 3-1**, the value provided for in the "Ordinance for Enforcement of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011"), the impact on the surrounding environment shall be determined by comparing the assumed value and measurement value of concentrations in [1] -[3] below with the concentration limit.

[1] Concentrations at the maximum ground level concentration point presumed by the analysis of movement of discharged gas.

[2] Concentrations of radioactive materials in the air measured at the maximum ground level concentration point presumed in [1]

[3] Concentrations of radioactive materials in the air measured in four directions of the boundary of premises around the facility

Measurement results shall be recorded and retained for the following items until the facility is abolished.

(1) Address of measuring place and name of the facility
(2) Date of specimen sampling
(3) Name of person sampling specimen
(4) Specimen sampling position
(5) Method of analysis of radioactive concentration
(6) Analysis Results
(7) Name of Analyzer

Table 3-1: Concentration Limit in the Air

Kind of radioactive materials	Concentration limit in the air (Bq/m^3)
Cesium-134	20
Cesium-137	30

Remarks 1: Concentration limit means that for the average concentration for three months, the value calculated in accordance with the following formula (in case of cesium-134 and cesium-137, the total of ratio to each concentration limit) shall not exceed 1.

Remarks 2: The idea of the average concentration for three months shall be as follows.

(1) Measurement shall be made at least once a month. The measurement values of cesium-134 and cesium-137 shall be divided by 20 and 30 respectively and by totaling them, the ratio of 1 shall be sought (effective to 2 significant digits).
(2) If measurement is made more than once a month, the average of the ratio sought in (1) above (effective to 2 significant digits) shall be adopted and it shall be the measurement value of the month.
(3) The average value for consecutive three months as to the calculation result in (2) above shall be adopted and it shall be the "average concentration for three months,"

the concentration limit (effective to 2 significant digits).

(4) For example, if measurement is made from January through April, the average of January, February and March and the average of February, March and April shall respectively be the average value for three (3) consecutive months.

Concentration of cesium-134 (Bq/m^3) /20 (Bq/m^3) + concentration of cesium-137 (Bq/m^3) /30 (Bq/m^3) ≤1

3.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology)". Analysis shall be made for two specimens of paper filter part and drain part*.

Analysis conditions for nuclide analysis by a germanium semiconductor detector are shown in **Table 3-2**.

*For drain part, sample solution shall be prepared so that the total of drain and wash liquid in an impinger shall be less than 2L.

Table 3-2: Analysis Conditions

Measuring Specimen		Pre treatment	Specimen container	Measuring time (Reference)	Lower limit of detection	Remarks
Discharged Gas	Paper filter part	None or cut	None or U-8 container	1000 - 2000 sec.	$2Bq/m^3(N)$	In case of cylinder paper filter, as one cylinder cannot obtain a sufficient specimen amount, a blank paper filter shall be cut and put into the container after mixing with a sampling paper filter. If there are multiple pieces of round paper filter, analysis shall be made by overlapping paper filter.
	Drain part	None	Marinelli (2L)	1000-2000 sec.	$2Bq/m^3(N)$	Use the entire drain amount and if it is not sufficient for 2L, make it 2L using pure water.

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result shall be reported as it is if it is above the lower limit of detection, and reported as "ND" if it is less than the lower limit of detection.

Remark 3: The volumetric unit used shall be dry gas in the standard state (0℃, 101.3kPa).

Remark 4: If the height of the sample can be corrected in the analysis condition of the germanium semiconductor detector, height correction can also be carried out in the analysis without adding a

blank paper filter.

Remark 5: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 “Rounding of Figures”. In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 6: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

Records of Measurement of Radioactive Concentration in Discharged Gas (Form Example)

Address of measurement place, name of the facility	Address: Name of the Facility:
Date of specimen sampling	
Name of the person sampling specimen	
Position of specimen sampling	
Method of analysis of radioactive concentration	

Analysis Results				
Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
(Paper Filter Part)	Cesium-134	Bq/m^3 (N)		Bq/m^3 (N)
	Cesium-137	Bq/m^3 (N)		Bq/m^3 (N)
(Drain Part)	Cesium-134	Bq/m^3 (N)		Bq/m^3 (N)
	Cesium-137	Bq/m^3 (N)		Bq/m^3 (N)
(Total of Paper Filter Part and Drain Part)	Cesium-134	Bq/m^3 (N)	/20=	
	Cesium-137	Bq/m^3 (N)	/30=	
	Total			

Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remark 2: In the ratio to the concentration limit and calculation of total paper filter and drain, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remark 3: If the sum of the ratios to the concentration limit exceeds 1, assess the impact on the surrounding environment from the discharge outlet by comparing it with the concentration etc. at the maximum concentration point on land in accordance with the method set forth in Chapter 3 Paragraph 3.2.

Name of Analyzing Person	

Records of Measurement of Radioactive Concentration in Discharged Gas (Description Example)

Address of measurement place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Municipal Clean Center
Date of specimen sampling	Feb 27, 2012
Name of the person sampling specimen	xxxxxx Co., Ltd.
Position of specimen sampling	No. 1 Furnace Smokestack
Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
(Paper Filter Part)	Cesium-134	2.5 Bq/m^3 (N)		1.5 Bq/m^3 (N)
	Cesium-137	3.2 Bq/m^3 (N)		1.5 Bq/m^3 (N)
(Drain Part)	Cesium-134	ND Bq/m^3 (N)		1.8 Bq/m^3 (N)
	Cesium-137	ND Bq/m^3 (N)		1.9 Bq/m^3 (N)
(Total of Paper Filter Part and Drain Part)	Cesium-134	4.3 Bq/m^3 (N)	4.3/20=0.22	
	Cesium-137	5.1 Bq/m^3 (N)	5.1/30=0.17	
	Total		0.39	

Remarks 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remarks 2: In the ratio to the concentration limit and calculation of total paper filter and drain, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remarks 3: If the sum of the ratios to the concentration limit exceeds 1, assess the impact on the surrounding environment from the discharge outlet by comparing it with the concentration etc. at the maximum concentration point on land in accordance with the method set forth in Chapter 3 Paragraph 3.2.

Name of Analyzing Person	Company Name: xxxxxx Co., Ltd. Name of Analyzing Person:

Chapter 4 Particulates

4.1 Specimen Sampling

(1) Open-type Crushing Facilities

Points of specimen sampling shall be the two points of the boundary of the premises on the windward side and the boundary of the premises on the leeward side of the crushing facilities.

Wind direction shall be measured by a simple wind direction and wind speed meter (**Reference Photo 4-1**) before sampling particulates.

A high-volume air sampler (**Reference Photo 4-2**) shall be used for specimen sampling and suctioning shall be made for 30 minutes at 500L/min. If particulate amount is large, the paper filter shall be replaced in the process of sampling.

Reference Photo 4-1: Wind direction and wind speed meter

Reference Photo 4-2: High-volume air sampler

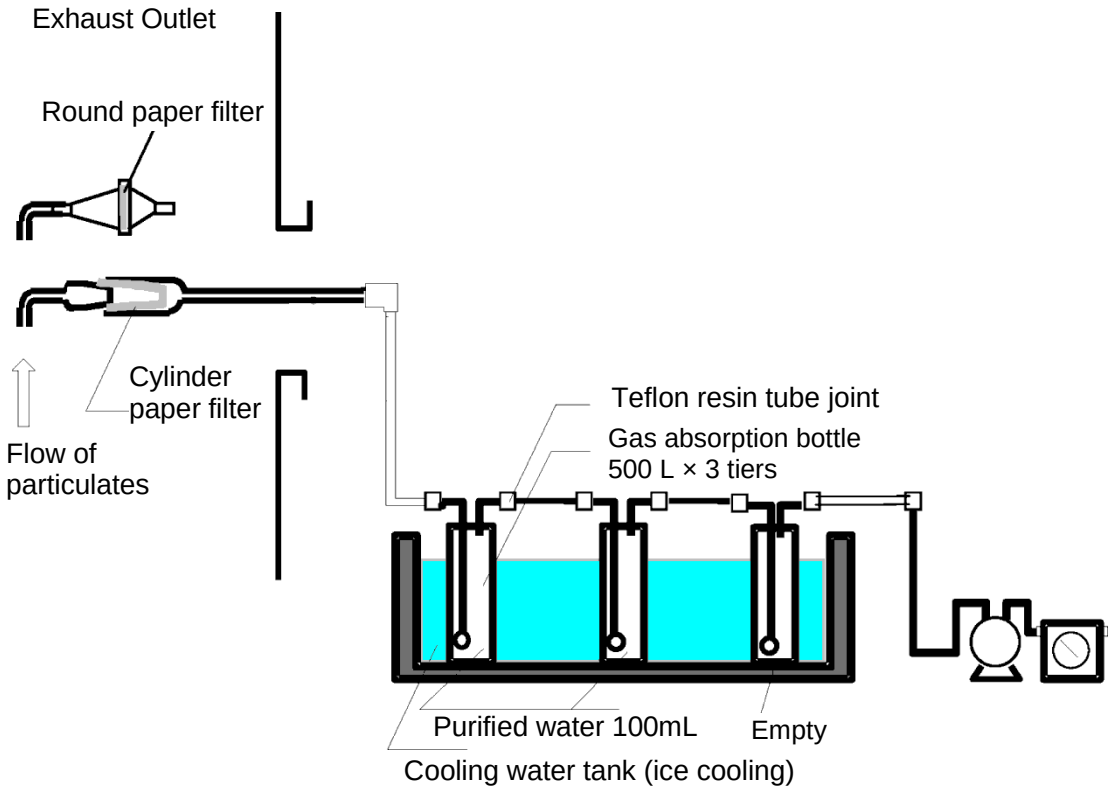
(2) Closed-type Crushing Facilities

Specimen sampling shall comply with JIS Z 8808, "Measurement Method of Dust Concentration in Discharged Gas" and sampling shall be made by constant speed suction. In Figure 4-1, composition of specimen sampling instrument is shown.

Sampling gas amount shall be approximately 3000L at the outlet. If there is a large amount of particulates, the cylinder paper filter, which can measure by a germanium semiconductor detector, shall be used and the paper filter shall be replaced from time to time up to five paper filters. Sampling gas amount shall be the amount to be sampled by five cylinder paper filters.

When sampling is made with a round paper filter, if the particulates amount is large, the paper filter shall be changed from time to time. There is no limit as to the number of paper filters, but sampling shall be made with the number of paper filters as small as possible.

When the temperature of the collected gas is low, organic filter paper can also be used. However, take note that the filter paper may be damaged due to the influence of corrosive gases etc. depending on the quality of the filter.



Sampling Conditions (Example)

1. Suction flow amount : Approximately 15L/min. × 240 minutes (4 hours), total approximately 3000L
2. Cylinder/Round Paper Filter : silica paper filter or organic paper filter

Figure 4-1: Composition of Specimen Sampling Instrument

4.2 Management of Measurement Results

The measurement results shall be compared with the concentration limit in the air applied to facilities discharging gas (**Table 4-1**).

Measurement results shall be recorded and retained for the following items.

(1) Address of measuring place and name of the facility
(2) Date of specimen sampling
(3) Name of person sampling specimen
(4) Wind direction and wind speed of open-type facilities
(5) Position of specimen sampling
(6) Method of analysis of radioactive concentration
(7) Analysis results
(8) Name of analyzing person

Table 4-1: Concentration Limit in the Air

Kind of radioactive materials	Concentration limit in the air (Bq/m^3)
Cesium-134	20
Cesium-137	30

Remark: The concentration limit applied to facilities discharging gas means that for the average concentration for three months, the value calculated in accordance with the following formula (in case of cesium-134 and cesium-137, the total of the ratio to each concentration limit) shall not exceed 1.

Concentration of cesium-134 (Bq/m^3) /20 (Bq/m^3) + concentration of cesium-137 (Bq/m^3) /30 (Bq/m^3) ≤1

4.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology)".

The conditions for nuclide analysis by a germanium semiconductor detector are shown in **Table 4-2**.

Table 4-2: Analysis Conditions

Measurement Specimen		Pre-treatment	Specimen Container	Measuring Time (Reference)	Lower limit of detection	Remarks
Particulates	Paper filter part (open-type crushing facilities)	None	None	1000-2000sec.	$2Bq/m^3$	If there are multiple pieces of paper filter, paper filter shall be analyzed by overlapping.
	Paper filter part (closed-type crushing facilities)	None	None or U-8 Container	1000-2000sec.	$2Bq/m^3$	In case of cylinder paper filter, as one cylinder cannot obtain a sufficient specimen amount, a blank paper filter shall be cut and put into the container after mixing with a sampling paper filter. If there are multiple pieces of round paper filter, analysis shall be made by overlapping paper filter.
	Drain part	None	Marinelli (2L)	1000-2000sec.	(Open-type) $2Bq/m^3$ (Closed-type) $2Bq/m^3$ (N)	Use the entire drain amount and if it is not sufficient for 2L, make it 2L using pure water.

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result shall be reported as it is if it is above the lower limit of detection, and reported as "ND" if it is less than the lower limit of detection.

Remark 3: The volumetric unit used shall be wet gas at 20℃, 101.3kPa for the open-type (Source: Hazardous Atmospheric Contaminants Measurement Manual (revised in Mar 2011)), and dry gas at 0℃, 101.3kPa for the closed-type.

Remark 4: If the height of the sample can be corrected in the analysis condition of the germanium semiconductor detector, height correction can also be carried out in the analysis without adding a blank paper filter.

Remark 5: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 "Rounding of Figures". In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 6: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

Records of Measurement of Radioactive Concentration in Particulates (Open-type) (Form Example)

Address of measurement place, name of the facility	Address: Name of the Facility:		
Date of specimen sampling	Date:	Weather	
Name of the person sampling specimen			
Wind direction and wind speed			
Position of sampling specimen (attach drawings or photos)			
Method of analysis of radioactive concentration			

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
(Windward)	Cesium-134	Bq/m^3	/20 =	Bq/m^3
	Cesium-137	Bq/m^3	/30 =	Bq/m^3
	Total			
(Leeward)	Cesium-134	Bq/m^3	/20=	Bq/m^3
	Cesium-137	Bq/m^3	/30=	Bq/m^3
	Total			

Remarks 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

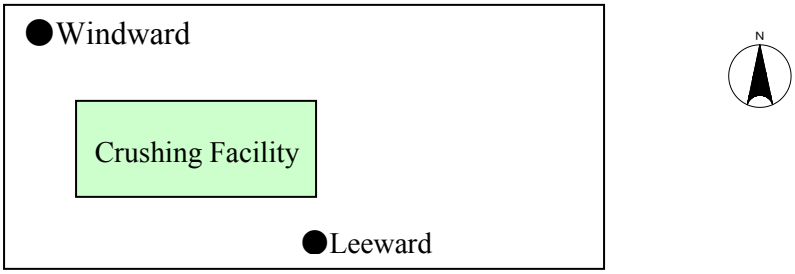
Remarks 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Name of Analyzing Person	

Records of Measurement of Radioactive Concentration in Particulates (Open-type) (Description Example)

Address of measurement place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Municipal Clean Center		
Date of specimen sampling	Date: Feb 27, 2012	Weather	Clear
Name of the person sampling specimen	xxxxxx Co., Ltd.		
Wind direction and wind speed	Northwest 2.5 m/s		

Position of sampling specimen (attach drawings or photos)



Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
Crushing Facility (Windward)	Cesium-134	ND Bq/m^3	1.4/20 =0.07	1.4 Bq/m^3
	Cesium-137	ND Bq/m^3	1.5/30 =0.05	1.5 Bq/m^3
	Total		0.12	
Crushing Facility (Leeward)	Cesium-134	2.4 Bq/m^3	2.4/20= 0.12	1.4 Bq/m^3
	Cesium-137	2.8 Bq/m^3	2.8/30=0.09	1.5 Bq/m^3
	Total		0.21	

Remarks 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

Remarks 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Name of Analyzing Person	Company Name: xxxxxx Co., Ltd. Name of Analyzing Person:

Records of Measurement of Radioactive Concentration in Particulates (Closed-type) (Form Example)

Address of measurement place, name of the facility	Address: Name of the Facility:
Date of specimen sampling	Date:
Name of the person sampling specimen	
Sampling Position	
Method of analysis of radioactive concentration	

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
(Paper Filter)	Cesium-134	Bq/m^3 (N)		Bq/m^3 (N)
	Cesium-137	Bq/m^3 (N)		Bq/m^3 (N)
(Drain)	Cesium-134	Bq/m^3 (N)		Bq/m^3 (N)
	Cesium-137	Bq/m^3 (N)		Bq/m^3 (N)
(Total of Paper Filter and Drain)	Cesium-134	Bq/m^3 (N)	/20=	
	Cesium-137	Bq/m^3 (N)	/30=	
	Total			

Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remark 3: If the sum of the ratios of the concentration to the concentration limit exceeds one, assess the impact on the surrounding environment from the crushing facility etc. by taking measurements on four sides of the boundary around the facility in accordance with the method set forth in Chapter 3 Paragraph 3.2.

Name of Analyzing Person	

Records of Measurement of Radioactive Concentration in Particulates (Closed-type) (Description Example)

Address of measurement place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Municipal Clean Center
Date of specimen sampling	Feb 27, 2012
Name of the person sampling specimen	xxxxxx Co., Ltd.
Sampling Position	Discharge Outlet
Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
(Paper Filter)	Cesium-134	2.5 Bq/m^3 (N)		1.5 Bq/m^3 (N)
	Cesium-137	3.2 Bq/m^3 (N)		1.5 Bq/m^3 (N)
(Drain)	Cesium-13	ND Bq/m^3 (N)		1.5 Bq/m^3 (N)
	Cesium-137	ND Bq/m^3 (N)		1.5 Bq/m^3 (N)
(Total of Paper Filter and Drain)	Cesium-134	4.0 Bq/m^3 (N)	4.0/20=0.20	
	Cesium-137	4.7 Bq/m^3 (N)	4.7/30=0.16	
	Total		0.36	

Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remark 3: If the sum of the ratios of the concentration to the concentration limit exceeds one, assess the impact on the surrounding environment from the crushing facility etc. by taking measurements on four sides of the boundary around the facility in accordance with the method set forth in Chapter 3 Paragraph 3.2.

Name of Analyzing Person	Company Name: xxxxxx Co., Ltd. Name of Analyzing Person:

Chapter 5 Effluent and Water in Public Water Area

Measurement of the concentration of radioactive substances discharged by the accident in the final affluent when wastewater generated during disposal is discharged (Ministry of the Environment Bulletin No. 112 dated Dec 28, 2011)

Under the method prescribed by the Minister of the Environment under Article 25 paragraph (1) item (vi) (b) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, measurements shall be taken using a germanium semiconductor detector.

Water quality inspection method pertaining to the landfill disposal of specified waste (Ministry of the Environment Bulletin No. 130 dated Aug 28, 2012)

Under the method prescribed by the Minister of the Environment under Article 26 paragraph (1) item (iii) (a) (1) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, the respective items listed below shall be defined as follows.

3 Radioactive substances discharged by the accident : Measurements shall be taken using a germanium semiconductor detector.

Article 2 – Article 5 Omitted

5.1 Specimen Sampling

Use such sampling instruments as a ladle or a bucket.

Specimen containers (polypropylene bottle, glass bottle, etc.) shall be washed by sampling water three times.

Sampling amount shall be 2L.

Specimen sampling in the public water area shall be conducted if the concentration exceeded the limit in **Table 5-1**.

5.2 Management of Measurement Results

Effluent shall generally be measured only at the outlet (**Figure 5-1 [2]**). If the measurement values exceeded the concentration limit of public water area (**Table 5-1** the "Ordinance for Enforcement of the Act on Special Measures concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011," the impact of outlet on the surrounding environment shall be determined by comparing the measurement results in 1) and the

concentration limit.

1) The point nearest to the outlet, where the concentrations of radioactive materials in the effluent, which is located upstream of the water intake gate or interflowing side streams or the outlet of other facilities (**Figure 5-1 [1]**) and interflowing with public water basin, can be stably measured.

· Sampling point where water can stably be measured means the point where there is no variation in values after measurements two to three times almost simultaneously.

· Where stocking is made to the closed conduit in a public water area, if sampling is impossible around the effluent outlet, measurement shall be made at the point nearest to the effluent outlet, where the concentrations of radioactive materials in the effluent can be stably measured (point of interflowing with rivers and open conduits). If there is a manhole, from which sampling of a specimen is possible, at the nearer point to the effluent outlet than the interflowing point, however, the specimen shall be sampled at that point.

Measurement results shall be recorded and retained for the following items until the facility is abolished.

(1) Address of the facility, name of the facility
(2) Date of specimen sampling
(3) Weather
(4) Name of the person sampling specimen
(5) Position of specimen sampling
(6) Method of specimen sampling (sampling instrument)
(7) Amount of specimen sampling
(8) Specimen container
(9) Method of analysis of radioactive concentration
(10) Analysis Results
(11) Name of the analyzing person

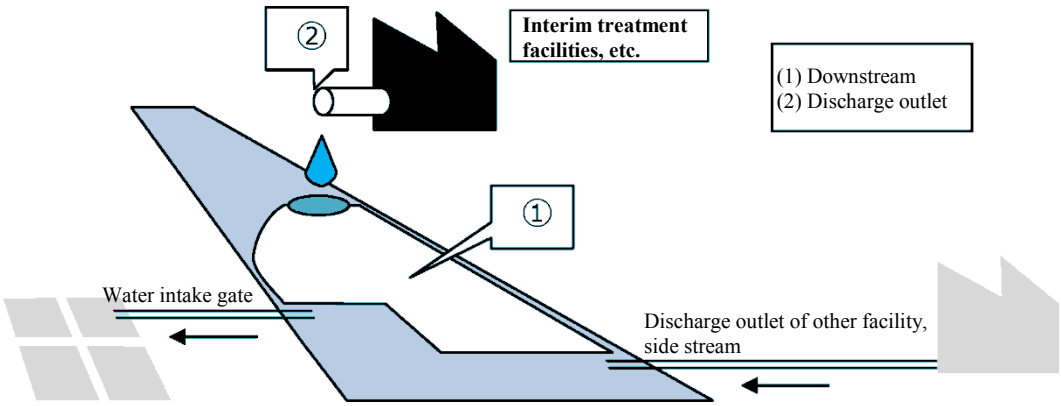


Figure 5-1: Example of Sampling Points

Table 5-1: Concentration limit in the public water area

Kind of radioactive materials	Concentration limit in the public water area (Bq/L)
Cesium-134	60
Cesium-137	90

Remark 1: Concentration limit means that for the average concentration for three months, the value calculated in accordance with the following formula (in case of cesium-134 and cesium-137, the total of ratio to each concentration limit) shall not exceed 1.

Remark 2: The idea of the average concentration for three months shall be as follows.

(1) Measurement shall be made at least once a month. The measurement values of cesium-134 and cesium-137 shall be divided by 60 and 90 respectively and by totaling them, the ratio to 1 shall be sought (rounded to 2 significant digits).

(2) If measurement is made more than once a month, the average of the ratios sought in (1) above (rounded to 2 significant digits) shall be adopted and it shall be the measurement value of the month.

(3) The average value for consecutive three months as to the calculation result in (2) above shall be adopted and it shall be the "average concentration for three months," or the concentration limit (rounded to 2 significant digits).

(4) For example, if measurement is made from January through April, the average of January, February and March and the average of February, March and April shall respectively be the average value for three (3) consecutive months.

$$\text{Concentration of cesium-134 (Bq/L)} / 60 \text{ (Bq/L)} + \text{concentration of cesium-137 (Bq/L)} / 90 \text{ (Bq/L)} \leq 1$$

5.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology).

Conditions for nuclide analysis by a germanium semiconductor detector are shown in **Table 5-2**.

Table 5-2: Analysis Conditions

Measurement specimen	Pre-treatment	Specimen container	Measuring time (Reference)	Lower limit of detection
Effluent	None	U-8 Container	1000~2000sec.	10~20 Bq/L
Public water area	None	Marinelli (2L)	1000~2000sec.	1~2 Bq/L

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result is reported as it is if it is above the lower limit of detection, and reported as "ND" if it is less than the lower limit of detection.

Remark 3: When checking for minute radiation concentration in water effluent in a specimen container, the analysis can also be done using a Marinelli (2L) container.

Remark 4: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 "Rounding of Figures". In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 5: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

Records of Measurement of Radioactive Concentration in Effluent (Form Example)

Address of measurement place, name of the facility	Address: Name of the Facility:		
Date of specimen sampling	Date:	Weather	
Name of the person sampling specimen			
Position of sampling specimen			
Method of specimen sampling (sampling instrument)			
Amount of sampling specimen			
Specimen container			
Method of analysis of radioactive concentration			

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
	Cesium-134	Bq/m^3	/60=	Bq/m^3
	Cesium-137	Bq/m^3	/90=	Bq/m^3
	Total			

Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remark 3: If the sum of the ratios of the concentration to the concentration limit exceeds one, assess the impact on the surrounding environment from the discharge outlet by taking measurements of the concentration in public water areas.

Name of Analyzing Person	

Records of Measurement of Radioactive Concentration in Effluent (Description Example)

Address of measurement place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxxxxx Co., Ltd.		
Date of specimen sampling	Date: Feb 27, 2012	Weather	Clear
Name of the person sampling specimen	Company Name: xxxxxx Co., Ltd. Sampler Name:		
Position of sampling specimen	Discharge container		
Method of specimen sampling (sampling instrument)	Stainless steel bucket		
Amount of sampling specimen	2L		
Specimen container	2L polyvinyl bottle		
Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))		

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
Final Effluent	Cesium-134	ND Bq/L	12/60=0.20	12 Bq/L
	Cesium-137	25 Bq/L	25/90=0.28	11 Bq/L
	Total		0.48	

Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.

Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Remark 3: If the sum of the ratios of the concentration to the concentration limit exceeds one, assess the impact on the surrounding environment from the discharge outlet by taking measurements of the concentration in public water areas.

Name of Analyzing Person	Company Name: xxxxxx Co., Ltd. Name of Person-in-Charge:

Records of Measurement of Radioactive Concentration in Public Water Area (Form Example)

Address of measurement place, name of the facility	Address: Name of the Facility:		
Date of specimen sampling	Date:	Weather	
Name of the person sampling specimen			
Method of specimen sampling (sampling instrument)			
Amount of sampling specimen			
Specimen container			
Position of sampling specimen (attach drawings or photos)			
Method of analysis of radioactive concentration			

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
	Cesium-134	Bq/L	/60=	Bq/L
	Cesium-137	Bq/L	/90=	Bq/L
	Total			

Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

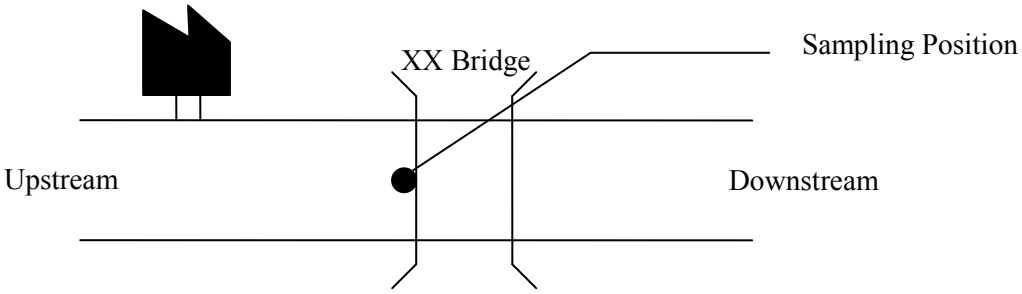
Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Name of Analyzing Person	

Records of Measurement of Radioactive Concentration in Public Water Area (Description Example)

Address of measurement place, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxxxxx Co., Ltd.		
Date of specimen sampling	Date: Feb 27, 2012	Weather	Clear
Name of the person sampling specimen	Company Name: xxxxxx Co., Ltd. Sampler Name:		
Position of sampling specimen	Stainless steel bucket		
Amount of sampling specimen	2L		
Specimen container	2L polyvinyl bottle		

Position of sampling specimen (attach drawings or photos)



Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Ratio to concentration limit	Lower limit of detection
Near XX Bridge	Cesium-134	ND Bq/L	1/60=0.02	1 Bq/L
	Cesium-137	ND Bq/L	2/90=0.02	2 Bq/L
	Total		0.04	

Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

Remark 2: In the ratio to the concentration limit, if the analysis results were below the lower limit of detection, calculation shall be made by using the lower limit of detection.

Name of Analyzing Person	Company Name: xxxxxx Co., Ltd. Name of Person-in-Charge:

Chapter 6 Surrounding Groundwater

Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of groundwater as prescribed under Article 26 paragraph (1) item (iii) (a) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 113 dated Dec 28, 2011)

Among the methods prescribed by the Minister of the Environment under Article 26 paragraph (1) item (iii) (a) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, those pertaining to radioactive substances discharged by the accident (as prescribed under Article 1 of the Special Measures Act (2011 Act No. 110) on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011) shall be measured using a germanium semiconductor detector.

Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of groundwater as prescribed under Article 26 paragraph (4) item (ii) (a) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 115 dated Dec 28, 2011)

Among the methods prescribed by the Minister of the Environment under Article 26 paragraph (4) item (ii) (a) (1) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, those pertaining to radioactive substances discharged by the accident (as prescribed under Article 1 of the Special Measures Act (2011 Act No. 110) on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011) shall be measured using a germanium semiconductor detector.

6.1 Specimen Sampling

Sampling of specimen shall be made at the observation well or well at the storage site, etc., if the flowing direction of groundwater is known and the flowing direction can be assumed. If the flowing direction is unknown, sampling shall be made at the observation well or well nearest to the storage site, etc. The flowing direction of groundwater may be assumed by land shape (slope of ground surface and related position with nearby rivers, etc.) If assumption is difficult, it is desirable to sample at more than two wells located at the position surrounding the site. Even if the observation well or well is near, it is necessary to avoid measurement of the upstream groundwater.

Measurements for final disposal sites are taken at the upstream and downstream observation wells.

Sampling instrument shall be bailer (**Reference Photo 6-1**) and water pump, etc.

Specimen containers (polyethylene bottle, glass bottle) shall be washed by sampling water three times.

Sampling amount shall be 2L.

Reference Photo 6-1: Groundwater sampling instrument (Bailer)

6.2 Management of Measurement Results

It shall be confirmed by measurement of the surrounding groundwater that the value of radioactive cesium is not abnormal (must be lower than the lower limit of detection etc. (refer to 6.3)).

Measurement results shall be recorded and retained for the following items. Retention period of measurement results shall be by the end of storage of the waste.

(1) Address of the storage site, name of the facility
(2) Date of start of storage
(3) Date of sampling specimen
(4) Weather
(5) Name of the person sampling specimen
(6) Method of specimen sampling (sampling instrument)
(7) Amount of specimen sampling
(8) Specimen container
(9) Position of specimen sampling
(10) Method of analysis of radioactive concentration
(11) Analysis results
(12) Name of the analyzing person
(13) Surface dose, radioactive concentration (only limited to those which are known)
(14) Kind and form of specified waste (only limited to new (changed) waste)

6.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology).

Analysis conditions for nuclide analysis by a germanium semiconductor detector are shown in **Table 6-1**.

Table 6-1: Analysis Conditions

Measurement specimen	Pre-treatment	Specimen container	Measuring time (Reference)	Lower limit of detection
Surrounding groundwater	None	Marinelli (2L)	1000~2000sec.	1~2Bq/L

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result is reported as it is if it is above the lower limit of detection, and reported as “ND” if it is less than the lower limit of detection.

Remark 3: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 “Rounding of Figures”. In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 4: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

Measurement Records of Radioactive Concentration in the Surrounding Groundwater (Form Example)

Location of facility, name of the facility	Location: Name of the Facility:		
Date of start of storage	Date:		
Date of specimen sampling	Date:	Weather	
Name of the person sampling specimen			
Method of specimen sampling (sampling instrument)			
Amount of specimen sampling			
Specimen Container			
Position of specimen sampling (attach drawings or photos)			

Method of analysis of radioactive concentration	

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
	Cesium-134	Bq/L	Bq/L
	Cesium-137	Bq/L	Bq/L
	Cesium-134	Bq/L	Bq/L
	Cesium-137	Bq/L	Bq/L

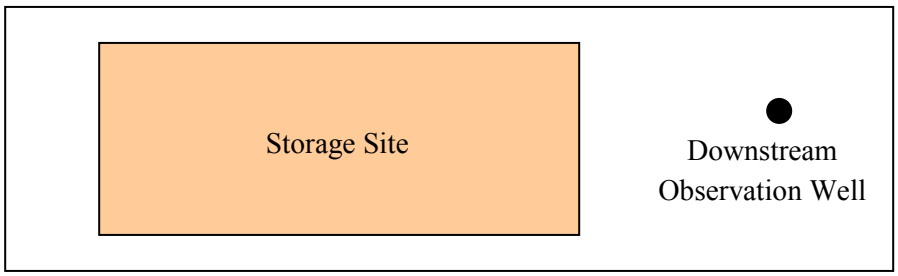
Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

Name of the analyzing person	
Surface dose rate (Reference)	(μSV/h)
Radioactive concentration (only limited to those which are known)	(Bq/kg)
Kind, form and amount of specified waste (only limited to new waste)	

Measurement Records of Radioactive Concentration in the Surrounding Groundwater (Description Example)

Location of facility, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Storage Site		
Date of start of storage	Date: Feb 26, 2012		
Date of specimen sampling	Date: Feb 27, 2012	Weather	Clear
Name of the person sampling specimen	Company Name: xxxxxx Co., Ltd. Sampler Name:		
Method of specimen sampling (sampling instrument)	Bailer		
Amount of specimen sampling	2L		
Specimen Container	2L polyvinyl bottle		

Position of specimen sampling (attach drawings or photos)



Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
Downstream observation well	Cesium-134	ND Bq/L	2 Bq/L
	Cesium-137	3 Bq/L	1 Bq/L
Upstream observation well	Cesium-134	ND Bq/L	1 Bq/L
	Cesium-137	ND Bq/L	1 Bq/L

Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

Name of the analyzing person	Company Name: xxxxxx Co., Ltd. Name of Person-in-Charge:
Surface dose rate (Reference)	1.55 (μSV/h)
Radioactive concentration (only limited to those which are known)	8,500 (Bq/kg)
Kind, form and amount of specified waste (only limited to new waste)	Solidified fly ash, packaged in flexible containers, 200m^3

Chapter 7 Burnt Residue, Soot and Dust, Discharged Sludge, Slag from Ash Melting Furnace, Fly Ash from Ash Melting Furnace

Method to measure radiation concentration of radioactive substances discharged by the accident in waste (Ministry of the Environment Bulletin No. 107 dated Dec 28, 2011)

The methods prescribed by the Minister of the Environment under Article 5 item (iv) and Article 20 item (iv) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011, shall use the equipment listed in the attachment for measurement purposes.

Attachment

1. Germanium semiconductor detector
2. NaI (Tl) scintillation spectrometer
3. $LaBr_3$ (Ce) scintillation spectrometer

7.1 Specimen Sampling

Specimen sampling shall be conducted, considering the objective and site and conditions for representativeness of specimen.

Examples of specimen sampling will be shown below.

- Increment scoop, etc. (**Figure 7-1**) shall be used for specimen sampling
- In case of piled specimens, sample from at least four isolated points to secure representativeness. Examples of sampling from piled specimens are shown in **Figure 7-2**.
- If specimens are flowing on the conveyor, sampling shall be conducted at least four times by certain intervals during moving of a lot.
- The sampling volume per location shall be based on JIS K 0060 “Sampling Method for Industrial Waste”. For samples in powder or bulk form, use the volume defined in the table below as a guide based on the particle size. For sludge, a sample taken with a container that is 100 mL or more in volume shall be considered a single sample in general.
- Place all four or more samples into one container (a plastic bag with a fastener is acceptable) and mixed well, dividing into smaller portions where necessary.
- Final sampling amount shall be approximately 500g - 1kg as a guide.

* Under JIS K 0060, it is provided that “3-5 increments will be sufficient for sampling purposes if the waste formation or treatment process is sufficiently controlled.”

Table 7-1: Maximum Particle Size and Size of Increment Sample (Average Volume)
(Source: JIS K 0060 "Sampling Method for Industrial Waste")

Maximum Particle Size(mm)	1	5	10	16	22.4	31.5	40	50	71	100	125	150
Average Volume of Increment(ml)	Approx. 16	Approx. 70	Approx. 120	Approx. 180	Approx. 270	Approx. 380	Approx. 730	Approx. 1,600	Approx. 3,700	Approx. 11,000	Approx. 21,000	Approx. 35,000

Reference: When a lot with a maximum particle size of 40mm is sieved with a screen mesh of 40 mm, about 5% of the lot will remain in the sieve. For example, an increment size of approximately 730 mL on average will be adequate.

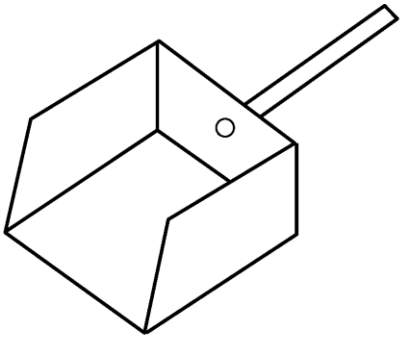
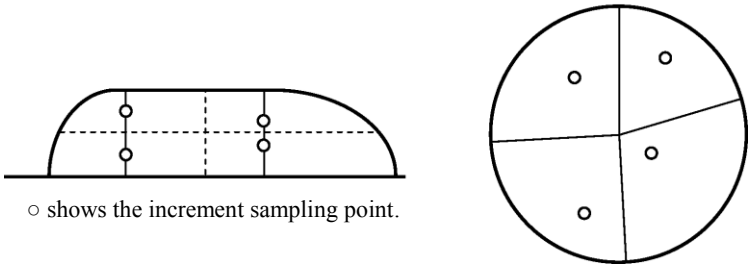


Figure 7-1: Increment Scoop



○ shows the increment sampling point.

Figure 7-2: Examples of Sampling Points of Piled Specimens

7.2 Management of Measurement Results

Burnt residue, soot and dust, discharged sludge, slag from ash melting furnace, fly ash from ash melting furnace shall be managed in accordance with the standards depending on the radioactive concentration. Measurement results shall be retained.

Measurement results shall be recorded and retained for the following items

(1) Address of the facility, name of the facility
(2) Date of specimen sampling
(3) Name of the person sampling specimen
(4) Position of specimen sampling
(5) Method of specimen sampling (sampling instrument)
(6) Amount of specimen sampling
(7) Specimen container
(8) Method of analysis of radioactive concentration
(9) Analysis results
(10) Name of the analyzing person

7.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "Part I: Guidelines for Survey on Pollution Status."

In addition to analysis of radioactive concentration, measurement of water content rate shall be made.

Conditions for nuclide analysis by a germanium semiconductor detector (measurement by NaI (Tl) scintillation spectrometer or $LaBr_3$ (Ce) scintillation spectrometer is possible) are shown in **Table 7-2**.

Table 7-2: Analysis Conditions

Measurement Specimen	Pre-treatment	Specimen Container	Measuring time (Reference)	Lower limit of detection	Remarks
Burnt residue, soot and dust, discharged sludge, slag from ash melting furnace, fly ash from ash melting furnace	None or crushing	U-8 Container	1000~2000sec.	10~30 Bq/kg	The lower limit of detection fluctuates according to the specimen density. The lower limit of detection of specimen containing radiation will be higher due to the impact of Compton dispersion.

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result is reported as it is if it is above the lower limit of detection, and reported as "ND" if it is less than the lower limit of detection.

Remark 3: When checking for minute radiation concentration in water effluent in a specimen container, the analysis can also be done using a Marinelli (2L) container.

Remark 4: The analyzed result shall assume the concentration to be in a hydrated state.

Remark 5: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 “Rounding of Figures”. In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 6: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

(Reference)

As a routine management method to determine before measurement whether the designated standards are satisfied, by measuring the surface dose rate, using a survey meter, a more simplified assumption can be made if the quantity and properties, etc., of the survey subjects are the same. In such an event, it is necessary that the results of the radioactive concentration and the surface dose rate shall be accumulated and the coefficient for assumption shall be determined in advance.

However, please note a simplified assumption cannot replace the actual measurement.

Measurement Records of Radioactive Concentration in Burnt Residue, Soot and Dust, Discharged Sludge, Slag from Ash Melting Furnace, Fly Ash from Ash Melting Furnace(Form Example)

Address of storage site, name of the facility		Address: Name of the Facility:	
Date of specimen sampling		Date:	
Name of the person sampling specimen			
Position of specimen sampling			
Method of specimen sampling (sampling instrument)			
Amount of specimen sampling			
Specimen Container			
Method of analysis of radioactive concentration			
Analysis Results			
Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
	Cesium-134	(Bq/kg)	(Bq/kg)
	Cesium-137	(Bq/kg)	(Bq/kg)
	Total	(Bq/kg)	-
	(Reference) Water content rare	%	-
Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.			
Name of the analyzing person			

Measurement Records of Radioactive Concentration in Burnt Residue, Soot and Dust, Discharged Sludge, Slag from Ash Melting Furnace, Fly Ash from Ash Melting Furnace (Description Example)

Address of storage site, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxxxxx Co., Ltd.
Date of specimen sampling	Date: Feb 27, 2012
Name of the person sampling specimen	Company Name: xxxxxx Co., Ltd. Sampler Name:
Position of specimen sampling	Ash bunker
Method of specimen sampling (sampling instrument)	Increment scoop
Amount of specimen sampling	1,000 g
Specimen Container	Plastic bag with fastener
Method of analysis of radioactive concentration	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))

Analysis Results

Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
Solidified fly ash	Cesium-134	3,900 (Bq/kg)	20 (Bq/kg)
	Cesium-137	4,800 (Bq/kg)	19 (Bq/kg)
	Total	8,700 (Bq/kg)	
	(Reference) Water content rare	23.5%	

Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.

Name of the analyzing person	Company Name: xxxxxx Co., Ltd. Name of Person-in-Charge:

Chapter 8 Elution Amount

Requirements of specified waste eluting low quantities of radioactive substances discharged by the accident when there is infiltration of rainwater and other water (Ministry of the Environment Bulletin No. 3 dated Jan 13, 2012)

Article 1

For test solutions pertaining to the specified waste concerned that have been prepared in accordance with the method set forth in JIS K 0058-1, the radiation concentration for cesium-137 as measured by the equipment given separately in the attachment must be 150 Bq/L or less as prescribed by the Minister of the Environment under Article 26 paragraph (2) item (ii) (e) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011.

Article 2 Omitted

Attachment

1 Germanium semiconductor detector

2 NaI (Tl) scintillation spectrometer

3 LaBr3 (Ce) scintillation spectrometer

Requirements of waste that poses no risk of contaminating public water areas and groundwater with radioactive substances discharged by the accident (Ministry of the Environment Bulletin No. 6 dated Jan 27, 2012)

For test solutions pertaining to the waste concerned that have been prepared in accordance with the method set forth in JIS K 0058-1, no cesium-134 and cesium-137 must be detected when measured using a germanium semiconductor detector as prescribed by the Minister of the Environment under Article 29 item (iii) (d) (1) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011.

Requirements of specified waste complying with the standards that poses no risk of contaminating public water areas and groundwater (Ministry of the Environment Bulletin No. 169 dated Dec 25, 2012)

Article1 - Article 2 Omitted

Article 3

For test solutions pertaining to the waste concerned that have been prepared in accordance with the method set forth in JIS K 0058-1, no cesium-134 and cesium-137 must be detected when measured using a germanium semiconductor detector.

Requirements of specified industrial waste that poses no risk of contaminating public water areas and groundwater with radioactive substances discharged by the accident

(Ministry of the Environment Bulletin No. 170 dated Dec 25, 2012)

For test solutions pertaining to the waste concerned that have been prepared in accordance with the method set forth in JIS K 0058-1, no cesium-134 and cesium-137 must be detected when measured using a germanium semiconductor detector.

8.1 Elution Amount Test Method

Preparation of sample solution shall be made in compliance with JIS K 0058-1, "Test Method of Chemical Substances of Slag, etc. – Part 1: Elution Amount Test Method" In Figure 8-1, summary chart of elution amount test device is shown.

In elution amount test, specimen in "as is for use" shall be sampled by certain amount and the solvent (water) shall be added by ten times of the specimen and the specimen shall be stirred for six hours at 200 rotations per minute and sample solution shall be obtained by making radioactive materials elute after still standing for 10~30 minutes.

Extracted solution shall be separated by centrifugalization for 20 minutes at 3000 rotations per minute as appropriate and the supernatant solution shall be filtered by membrane filter of diameter of 0.45 μm.

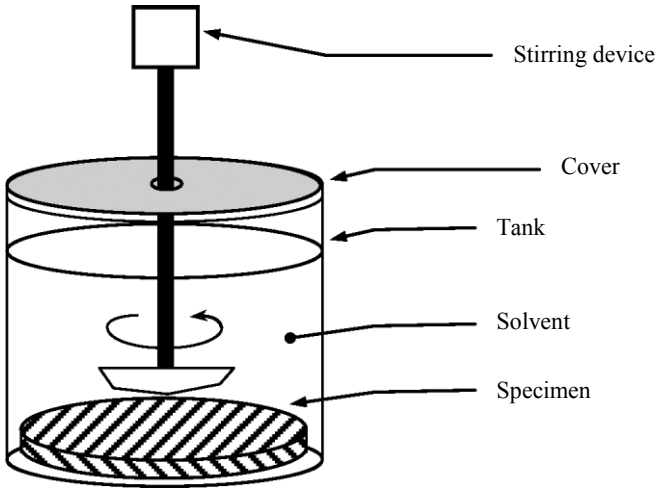


Figure 8-1: Summary chart of elution amount test device

8.2 Management of Measurement Results

Records of elution amount test result shall be retained.

Measurement results shall be recorded and retained for the following items.

(1) Address of the facility, name of the facility
(2) Date of specimen sampling
(3) Name of the person sampling specimen
(4) Position of specimen sampling
(5) Method of specimen sampling (sampling instrument)
(6) Amount of specimen sampling

(7) Specimen Container
(8) Method of elution amount test
(9) Method of analysis of radioactive concentration
(10) Analysis results
(11) Name of the analyzing person

8.3 Analysis Conditions and Lower Limit of Detection

Analysis of radioactive concentration shall be made in compliance with "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology)

Analysis conditions for nuclide analysis by a germanium semiconductor detector (measurement by NaI (Tl) scintillation spectrometer or $LaBr_3$ (Ce) scintillation spectrometer is also possible: Limited to the case in which the Ministry of the Environment Bulletin No. 3 dated Jan 13, 2012, applies) are shown in **Table 8-1**.

Table 8-1: Analysis Conditions

Measurement Specimen	Pre-treatment	Specimen Container	Measuring time (Reference)	Lower limit of detection
Elution Liquid	None	U-8 Container	1000~2000sec.	10~20Bq/L

Remark 1: The lower limit of detection shown in the table is a target value. If this is exceeded, change the analysis conditions and repeat the analysis. However, if a value higher than the lower limit of detection is obtained, then this lower limit of detection shall not apply.

Remark 2: The analyzed result is reported as it is if it is above the lower limit of detection, and reported as "ND" if it is less than the lower limit of detection.

Remark 3: When checking for minute radiation concentration in water effluent in a specimen container, the analysis can also be done using a Marinelli (2L) container.

Remark 4: The analyzed result shall be rounded to 2 significant figures in accordance with Rule B under JIS Z 8401 "Rounding of Figures". In addition, the minimum number of digits displayed shall be up to the number of digits of the lower limit of detection.

Remark 5: The lower limit of detection shall be shown for cesium-134 and cesium-137 respectively.

Measurement Records of Radioactive Concentration in Elution Liquid (Form Example)

Address of the facility, name of the facility	Address: Name of the Facility:		
Date of specimen sampling	Date:		
Name of the person sampling specimen			
Position of specimen sampling			
Method of sampling specimen (sampling instrument)			
Amount of sampling specimen			
Specimen Container			
Method of elution amount test			
Method of analysis of radioactive concentration			
Analysis Results			
Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
	Cesium-134	Bq/L	Bq/L
	Cesium-137	Bq/L	Bq/L
Remark 1: If the analysis results were below the lower limit of detection, “ND” shall be indicated.			
Name of the analyzing person			

Measurement Records of Radioactive Concentration in Elution Liquid (Description Example)

Address of the facility, name of the facility	Address: x-x-x, xxx City, xxx Prefecture Name of the Facility: xxx Factory, xxxxxx Co., Ltd.		
Date of specimen sampling	Date: Feb 27, 2012		
Name of the person sampling specimen	Company Name: xxxxxx Co., Ltd. Sampler Name:		
Position of specimen sampling	Transportation conveyor		
Method of sampling specimen (sampling instrument)	Increment scoop		
Amount of sampling specimen	1,000g		
Specimen Container	9-liter square can		
Method of elution amount test	JIS K 0058-1"Test Method of Chemical Substances of Slag, etc. – Part 1: Elution Amount Test Method"		
Method of analysis of radioactive materials	Germanium semiconductor detector (gamma ray spectrometry using germanium semiconductor detector (1992 Ministry of Education, Culture, Sport, Science & Technology))		
Analysis Results			
Name of Specimen	Radioactive nuclide	Analysis Results	Lower limit of detection
Bottom ash	Cesium-134	ND Bq/L	15 Bq/L
	Cesium-137	20 Bq/L	12 Bq/L
Remark 1: If the analysis results were below the lower limit of detection, "ND" shall be indicated.			
Name of the analyzing person	Company Name: xxxxxx Co., Ltd. Name of Person-in-Charge:		

Chapter 9 Cited Standards, etc.

- Measurement Method of Spectrum of γ-rays in the Air (1990, Ministry of Education, Culture, Sports, Science and Technology)
- Guidelines for Monitoring Environmental Radiation in Case of Emergency (June 1984, Nuclear Safety Commission)
- Provisional Manual of Radiation Survey and Measurement Method of Waste, etc. (November 11, 2011, Study Group of Survey and Measurement Method of Waste, etc.)
- "γ-rays Spectrometry by Germanium Semiconductor Detector (1992, Ministry of Education, Culture, Sports, Science and Technology)
- JIS Z 4511(2005) Calibration method for exposure meters, air kerma meters, air absorbed dose meters and dose equivalent meters
- JIS Z 4333(2006) Dose equivalent rate survey meter for X-ray and gamma ray
- JIS Z 8808 (1995)
- JIS K 0060 (1992) Sampling Method of Industrial Waste
- JIS K 0058-1 "Test Method of Chemical Substances of Slag, etc. – Part 1: Elution Amount Test Method"
- Technical Matters concerning Sampling, etc., of Sludge containing Radioactive Cesium (23 Sho'an No. 1939, June 27, 2011)
- On Treatment of Waste which might have been contaminated with Radioactive Materials in Municipal Solid Waste Treatment Facilities (August 29, 2011, Ministry of the Environment)
- Method to measure the radiation level as prescribed by the Minister of the Environment (Ministry of the Environment Bulletin No. 110 dated Dec 28, 2011)
- Method to measure radiation concentration of radioactive substances discharged by the accident in waste (Ministry of the Environment Bulletin No. 107 dated Dec 28, 2011)
- Method to measure concentration of radioactive substances discharged by the accident in the exhaust gas when exhaust gas generated during disposal is discharged (Ministry of the Environment Bulletin No. 111 dated Dec 28, 2011)
- Method to measure concentration of radioactive substances discharged by the accident in the final effluent when wastewater generated during disposal is discharged (Ministry of the Environment Bulletin No. 112 dated Dec 28, 2011)
- Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of groundwater as prescribed under Article 26 paragraph (1) item (iii) (a) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 113 dated Dec 28, 2011)
- Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of final effluent as prescribed under Article 26 paragraph (2) item (iv) (c) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific

Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 114 dated Dec 28, 2011)

- Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of groundwater as prescribed under Article 26 paragraph (4) item (ii) (a) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 115 dated Dec 28, 2011)
- Method to measure concentration of radioactive substances discharged by the accident pertaining to water quality inspection of permeating water as prescribed under Article 26 paragraph (4) item (ii) (c) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 116 dated Dec 28, 2011)
- Requirements of specified waste eluding low quantities of radioactive substances discharged by the accident when there is infiltration of rainwater and other water as prescribed under Article 26 paragraph (2) item (ii) (e) of the Special Measures Act Enforcement Ordinance on the treatment of environmental contamination caused by radioactive substances discharged by the nuclear plant accident as a result of the Pacific Ocean earthquake which occurred in the Tohoku region on Mar 11, 2011 (Ministry of the Environment Bulletin No. 3 dated Jan 13, 2012)
- Requirements of waste that poses no risk of contaminating public water areas and groundwater with radioactive substances discharged by the accident (Ministry of the Environment Bulletin No. 6 dated Jan 27, 2012)
- Compliance requirements of specified waste that poses no risk of contaminating public water areas and groundwater (Ministry of the Environment Bulletin No. 169 dated Dec 25, 2012)
- Requirements of specified industrial waste that poses no risk of contaminating public water areas and groundwater with radioactive substances discharged by the accident (Ministry of the Environment Bulletin No. 170 dated Dec 25, 2012)