Provisional Translation

Application No. FDEC-R4-143 November 14, 2022

Nuclear Regulatory Authority

1-1-3 Uchisaiwai-cho, Chiyoda-ku, Tokyo Tokyo Electric Power Company Holdings Inc. President Tomoaki Kobayakawa

Application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility

Pursuant to the provisions of Article 64-3, Paragraph (2) of "Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors", TEPCO submit the "Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility" as per the attached document.

Regard to the "Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility," the following sections shall be attached.

The amended part, the reason for the amendment, and the contents of the amendment shall be as follows;

OImplementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility

The following amendments are made to the changes in operation structure of the ALPS treated water dilution/discharge facility and selection of nuclides subject to measurement and assessment in order to confirm before discharging ALPS treated water into the sea.

III Security at the specified nuclear facility

Part 1 Security Measures on Unit 1 to 4

Chapter 3 Organizational Structure and Assessment

Article 5

• Reflection of the changes in operation structure of the ALPS treated water dilution/discharge facility

Supplementary Provisions

• Reflection of the changes in operation structure of the ALPS treated water dilution/discharge facility

Part 2 Security Measures on Unit 5 and 6

Chapter 3 Organizational Structure and Assessment

Article 5

 Reflection of the changes in operation structure of the ALPS treated water dilution/discharge facility

Supplementary Provisions

• Reflection of the changes in operation structure of the ALPS treated water dilution/discharge facility

Part 3 (Supplementary Explanation Regarding Safety)

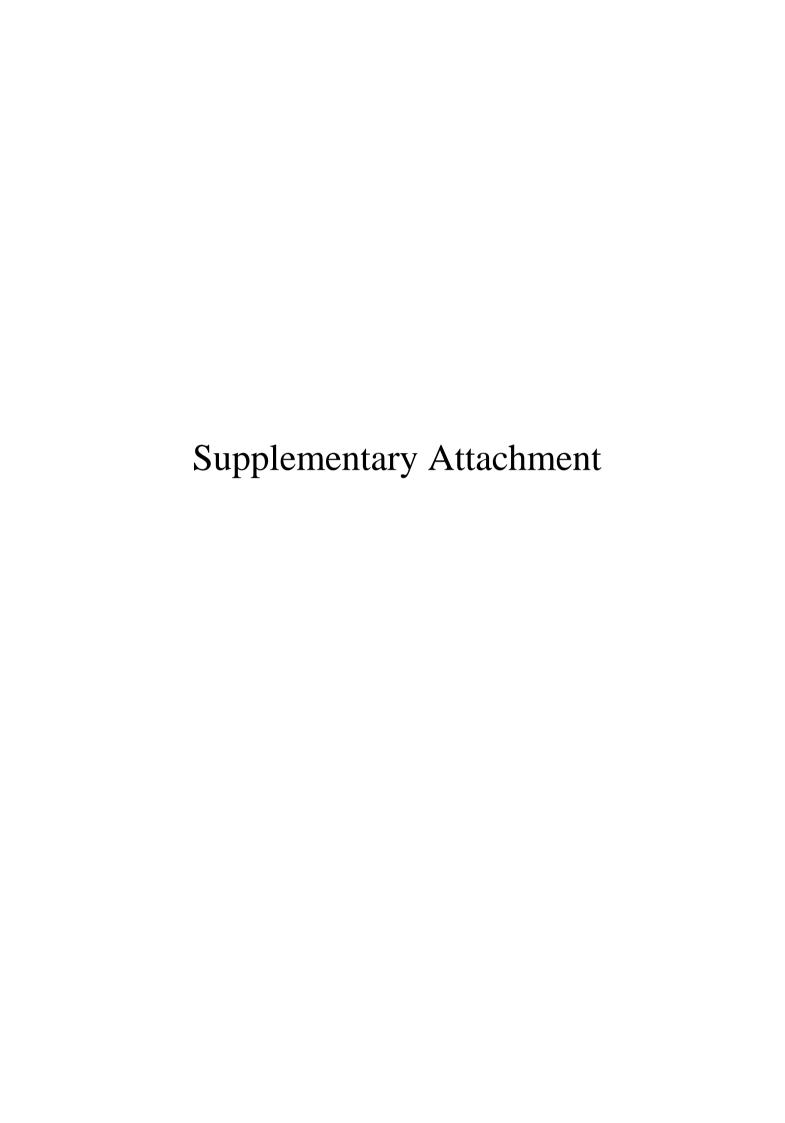
- 2 Supplementary explanation on the management of radioactive waste, etc.
 - 2.1 Management of radioactive waste, etc.
 - 2.1.2 Management of Radioactive Liquid Waste, etc.
 - Newly descriptions on the selection of nuclides subject to measurement and assessment in order to confirm before discharging ALPS treated water into the sea
 - 2.2 Dose assessment
 - 2.2.3 Dose assessment by radioactive liquid waste, etc.
 - · Optimization of description

OReference Material

Action in response to "Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station"

- Optimization of description due to the selection of nuclides to be measured and assessed in order to confirm before discharging ALPS treated water into the sea
- Newly description of uncertainty in the analysis of ALPS treated water
- · Optimization and of enhancement of description

End



Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Chapter III, Part 1)				
Current	Revised	Reason for Revision		
 (Duties for Security) Article 5 The Head Quaters organization performs the following duties for security. (1) As a top management, the President leads the Chief Management, supervises safety preservation activities for the quality management system establishment, implementation, maintenance and improvement as well as activities to establish an awareness of compliance with applicable laws, regulations and Technical Specifications and those to foster and mantain the safety culture. Moreover, the President requires reporting from safety-related organizations (including Senior Reactor Engineer) as appropriate, places top priority on nuclear safety and gives necessary instructions based on the "Nuclear Risk Management Basic Manual" and the "Trouble Reporting Manual." 	the quality management system establishment, implementation, maintenance and improvement as well as activities to establish an awareness of compliance with applicable laws, regulations and Technical Specifications and those to foster and mantain the safety culture. Moreover, the President requires reporting from safety-related organizations (including Senior Reactor Engineer) as appropriate, places top priority on			
(Omission)	(Omission)			
2. The power station organization performs the following duties for security.(1) Superintendent assists the Chief Decommissioning Officer and supervises safety-related duties at the power station while paying respect to Senior Engineer's opinions.	2. The power station organization performs the following duties for security.(1) Superintendent assists the Chief Decommissioning Officer and supervises safety-related duties at the power station while paying respect to Senior Engineer's opinions.			
(Omission)	(Omission)			
 (11)The Site General Management and Response Program Department performs duties on the planning and management of the reactor facilities related to Units 5/ 6 and outdoor area projects (excluding the duties performed by the general managers of the other program departments.) (12)The ALPS treated water Program Department performs duties on the planning and management of , and study for the operation method of facilities related to the discharge of the water which have been purified by Advance Liquid Processing System, etc., and whose sum of ratios to regulatory concentration limit of radioactive materials other than tritium is less than 1 (hereinafter, referred to as ALPS treated water), and the duties on the design and construction/ installation of the mechanical and civil engineering SSCs related to those, among the safety assurance facilities of the Units 1 to 4. In addition, the Depertment performs duties on on planning ALPS treated water analyses. (13)The Mechanical Engineering Group performs duties on the design of mechanical SSCs (excluding the duties performed by the general manager of each program department and group manager of each group other than the Mechanical Engineering Group Manager.) 	management of the reactor facilities related to Units 5/ 6 and outdoor area projects (excluding the duties performed by the general managers of the other program departments.) (12) The ALPS treated water Program Department performs duties on the planning and management of, and study for the operation method of facilities related to the discharge of the water which have been purified by Advance Liquid Processing System, etc., and whose sum of ratios to regulatory concentration limit of radioactive materials other than tritium is less than 1 (hereinafter, referred to as ALPS treated water), the planning of operation for ALPS treated water dilution/discharge facility, and the duties on the design and construction/installation of the mechanical and civil engineering SSCs related to those, among the safety assurance facilities of the Units 1 to 4. In addition, the Depertment performs duties on on planning ALPS treated water analyses. (13) The Mechanical Engineering Group performs duties on the design of mechanical SSCs (excluding the duties	Changes in operation structure of the ALPS treated water dilution/discharge facility		
(Omission)	(Omission)			
 (25)The Operation Shift Team (Unit 5-6) performs duties on the operation management of the radioactive solid waste storing facility and related facility among the safety assurance facilities of the Units 5/6 and the others (excluding the duties performed by the gereral manager of each Program Department and Group Manager of each Group other than the Operation Shift Supervisor (Unit 5-6).) (26)The Operation Shift Team (Water treatment System) performs duties on the operation management of contaminated water treatment facilities, buildings that store accumulated water, Advance Liquid Processing Systems and sub-drain etc. treatment facility (excluding groundwater drain collection facility) among the safety assurance facilities of the Units 1 to 4 (excluding the duties performed by the Operation Support Group Manager, the Work Management Group Manager and the Water Treatment Planning Group Manager.) (27)The Operation Support Group performs duties on the part of the operation management, such as making manual and procedure and the facility management, of the common spent fuel pool facility and the radioactive solid management facility and related facility (excluding miscellaneous solid waste incineration facility) among the safety assurance facilities of the Units 1 to 4, the Units 5/6 and the others. In addition, the Group performs duties on the operation of water injection facility for RPV/PCV (filtrate tanks, pure water tanks and raw water underground tanks) among the safety assurance facilities of the Units 1 to 4, and the radioactive solid management facility and related facility (miscellaneous solid waste incineration facility), large equipment decontamination facility and volume reduction facility among the safety assurance facilities of the others. 	waste storing facility and related facility among the safety assurance facilities of the Units 5/6 and the others (excluding the duties performed by the gereral manager of each Program Department and Group Manager of each Group other than the Operation Shift Supervisor (Unit 5-6).) (26)The Operation Shift Team (Water treatment System) performs duties on the operation management of contaminated water treatment facilities, buildings that store accumulated water, Advance Liquid Processing Systems, sub-drain etc. treatment facility (excluding groundwater drain collection facility,) and the ALPS treated water dilution/ discharge facility among the safety assurance facilities of the Units 1 to 4 (excluding the duties performed by the Operation Support Group Manager, the Work Management Group Manager and the Water Treatment Planning Group Manager.) (27)The Operation Support Group performs duties on the part of the operation management, such as making manual and procedure and the facility management, of the common spent fuel pool facility and the radioactive solid management facility and related facility (excluding miscellaneous solid waste incineration facility) among the safety assurance facilities of the Units 1 to 4, the Units 5/6 and the others. In addition, the Group performs duties on the operation of water injection facility for RPV/ PCV (filtrate tanks, pure water tanks and raw water underground tanks) among the safety assurance facilities of the Units 1 to 4, and the radioactive solid management facility and related facility (miscellaneous solid waste incineration facility) and additional miscellaneous solid waste incineration facility),			
(Omission)	(Omission)			
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Current	Revised	Revised reason
Supplementary Provisions	Supplementary Provisions Supplementary Provisions ((Effective Date) Article 1 This provision shall come into force not later than ten days after the date of approval by Nuclear Regulation Autority. 2. Article 5 shall be applied from the time ALPS treated water dilution/ discharge facility started operation, and the provisions then in force shall remain applicable until that time.	
Supplementary Provisions (Notification No. 2210277, October 27, 2022) (Effective Date) Article 1 This provision shall come into effect on Novemver 4, 2022. 2. Article 42 shall be applied from the time when the operation of the Unit 1 large cover ventilation system is started, and the previous then in force shall remain applicable until that time. Supplementary Provisions (Notification No. 2205093, May 9, 2022) (Effective Date) Article 1 2. Articles 4, 5, 52, 56, and 57 shall be enforced within 30 days from the date of approval of this application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility or the date of approval of the application for approval or the date of approval of the application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (IV Protection of Special Nuclear Fuel Material) submitted on January 14, 2022, whichever is later. The provisions then in force shall remain applicable until that date. (Omitted below)	provisions then in force shall remain applicable until that time. Supplementary Provisions (Notification No. 2210277, October 27, 2022) (Effective Date) Article 1 2.Article 42 shall be applied from the time when the operation of the Unit 1 large cover ventilation system is started, and the previous then in force shall remain applicable until that time. Supplementary Provisions (Notification No. 2205093, May 9, 2022) (Effective Date) Article 1 2.Articles 4, 5, 52, 56, and 57 shall be enforced within 30 days from the date of approval of this application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility or the date of approval of the application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility or the date of approval of the Application for approval of the Application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (IV Protection of Special Nuclear Fuel Material) submitted on January 14, 2022, whichever is later. The provisions then in force shall remain applicable until that date. (Omitted below)	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Chapter III, Part 2)				
Current	Revised	Reason for Revision		
 (Duties for Security) Article 5 The Head Quaters organization performs the following duties for security. (1) As a top management, the President leads the Chief Management, supervises safety preservation activities for the quality management system establishment, implementation, maintenance and improvement as well as activities to establish an awareness of compliance with applicable laws, regulations and Technical Specifications and those to foster and mantain the safety culture. Moreover, the President requires reporting from safety-related organizations (including Senior Reactor Engineer) as appropriate, places top priority on nuclear safety and gives necessary instructions based on the "Nuclear Risk Management Basic Manual" and the "Trouble Reporting Manual." 	the quality management system establishment, implementation, maintenance and improvement as well as activities to establish an awareness of compliance with applicable laws, regulations and Technical Specifications and those to foster and mantain the safety culture. Moreover, the President requires reporting from safety-related organizations (including Senior Reactor Engineer) as appropriate, places top priority on			
(Omission)	(Omission)			
2. The power station organization performs the following duties for security.(1) Superintendent assists the Chief Decommissioning Officer and supervises safety-related duties at the power station while paying respect to Senior Engineer's opinions.	2. The power station organization performs the following duties for security.(1) Superintendent assists the Chief Decommissioning Officer and supervises safety-related duties at the power station while paying respect to Senior Engineer's opinions.			
(Omission)	(Omission)			
 (11)The Site General Management and Response Program Department performs duties on the planning and management of the reactor facilities related to Units 5/ 6 and outdoor area projects (excluding the duties performed by the general managers of the other program departments.) (12)The ALPS treated water Program Department performs duties on the planning and management of , and study for the operation method of facilities related to the discharge of the water which have been purified by Advance Liquid Processing System, etc., and whose sum of ratios to regulatory concentration limit of radioactive materials other than tritium is less than 1 (hereinafter, referred to as ALPS treated water), and the duties on the design and construction/ installation of the mechanical and civil engineering SSCs related to those, among the safety assurance facilities of the Units 1 to 4. In addition, the Depertment performs duties on on planning ALPS treated water analyses. (13)The Mechanical Engineering Group performs duties on the design of mechanical SSCs (excluding the duties performed by the general manager of each program department and group manager of each group other than the Mechanical Engineering Group Manager.) 	management of the reactor facilities related to Units 5/ 6 and outdoor area projects (excluding the duties performed by the general managers of the other program departments.) (12) The ALPS treated water Program Department performs duties on the planning and management of, and study for the operation method of facilities related to the discharge of the water which have been purified by Advance Liquid Processing System, etc., and whose sum of ratios to regulatory concentration limit of radioactive materials other than tritium is less than 1 (hereinafter, referred to as ALPS treated water), the planning of operation for ALPS treated water dilution/ discharge facility, and the duties on the design and construction/ installation of the mechanical and civil engineering SSCs related to those, among the safety assurance facilities of the Units 1 to 4. In addition, the Depertment performs duties on on planning ALPS treated water analyses. (13) The Mechanical Engineering Group performs duties on the design of mechanical SSCs (excluding the duties	Changes in operation structure of the ALPS treated water dilution/discharge facility		
(Omission)	(Omission)			
 (25)The Operation Shift Team (Unit 5-6) performs duties on the operation management of the radioactive solid waste storing facility and related facility among the safety assurance facilities of the Units 5/6 and the others (excluding the duties performed by the gereral manager of each Program Department and Group Manager of each Group other than the Operation Shift Supervisor (Unit 5-6).) (26)The Operation Shift Team (Water treatment System) performs duties on the operation management of contaminated water treatment facilities, buildings that store accumulated water, Advance Liquid Processing Systems and sub-drain etc. treatment facility (excluding groundwater drain collection facility) among the safety assurance facilities of the Units 1 to 4 (excluding the duties performed by the Operation Support Group Manager, the Work Management Group Manager and the Water Treatment Planning Group Manager.) (27)The Operation Support Group performs duties on the part of the operation management, such as making manual and procedure and the facility management, of the common spent fuel pool facility and the radioactive solid management facility and related facility (excluding miscellaneous solid waste incineration facility) and additional miscellaneous solid waste incineration facility and management facilities of the Units 1 to 4, the Units 5/6 and the others. In addition, the Group performs duties on the operation of water injection facility for RPV/PCV (filtrate tanks, pure water tanks and raw water underground tanks) among the safety assurance facilities of the Units 1 to 4, and the radioactive solid management facility and related facility (miscellaneous solid waste incineration facility), large equipment decontamination facility and volume reduction facility among the safety assurance facilities of the others. 	waste storing facility and related facility among the safety assurance facilities of the Units 5/6 and the others (excluding the duties performed by the gereral manager of each Program Department and Group Manager of each Group other than the Operation Shift Supervisor (Unit 5-6).) (26)The Operation Shift Team (Water treatment System) performs duties on the operation management of contaminated water treatment facilities, buildings that store accumulated water, Advance Liquid Processing Systems, sub-drain etc. treatment facility (excluding groundwater drain collection facility,) and the ALPS treated water dilution/ discharge facility among the safety assurance facilities of the Units 1 to 4 (excluding the duties performed by the Operation Support Group Manager, the Work Management Group Manager and the Water Treatment Planning Group Manager.) (27)The Operation Support Group performs duties on the part of the operation management, such as making manual and procedure and the facility management, of the common spent fuel pool facility and the radioactive solid management facility and related facility (excluding miscellaneous solid waste incineration facility) among the safety assurance facilities of the Units 1 to 4, the Units 5/6 and the others. In addition, the Group performs duties on the operation of water injection facility for RPV/ PCV (filtrate tanks, pure water tanks and raw water underground tanks) among the safety assurance facilities of the Units 1 to 4, and the radioactive solid management facility and related facility (miscellaneous solid waste incineration facility) and additional miscellaneous solid waste incineration facility),			
(Omission)	(Omission)			
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Current	Revised	Revised reason
Supplementary Provisions	Supplementary Provisions Supplementary Provisions ((Effective Date) Article 1 This provision shall come into force not later than ten days after the date of approval by Nuclear Regulation Autority. 2. Article 5 shall be applied from the time ALPS treated water dilution/ discharge facility started operation, and the	
Supplementary Provisions (Notification No. 22007222, July 22, 2022) (Effective Date) Article 1 This provision shall come into effect on August 1, 2022. Supplementary Provisions (Notification No. 2205093, May 9, 2022)	provisions then in force shall remain applicable until that time. Supplementary Provisions (Notification No. 2205093, May 9, 2022)	
 (Effective Date) Article 1 This provision shall come into effect on May 16, 2022. 2. Articles 4, 5, 95, 97, and 98 shall be enforced within 30 days from the date of approval of this application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility or the date of approval of the application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (IV Protection of Special Nuclear Fuel Material) submitted on January 14, 2022, whichever is later. The provisions then in force shall remain applicable until that date. 	 (Effective Date) Article 1 2. Articles 4, 5, 95, 97, and 98 shall be enforced within 30 days from the date of approval of this application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility or the date of approval of the application for approval to amend the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (IV Protection of Special Nuclear Fuel Material) submitted on January 14, 2022, whichever is later. The provisions then in force shall remain applicable until that date. 	
Supplementary Provisions (Notification No. 2111112, Novemver 11, 2021) (Effective Date) Article 1 2. Surrounding monitored area designated in figure 98 in article 98, figure 101 in article 101, the whole map in attachment-1 (radiation control area), and the whole map in attachment-2 (radiation control taraget area) shall be applied from the time fences for radioative material analysis/ research center laboratory-1 installed, and the provisions then in force shall remain applicable until that time. 3. Revision on map of radioative material analysis/ research center laboratory-1 and radiation control area for radioative material analysis/ research center laboratory-1 designated in the whole map in attachment-1 (radiation control area), and the whole map in attachment-2 (radiation control taraget area) shall be applied from the time each area changed, and the provisions then in force shall remain applicable until that time. 4. Revision on radiation control area for additional miscellaneous solid waste incineration facility (1st and 2nd floors) designated in the whole map in attachment-1 (radiation control area) and radiation control target area for additional miscellaneous solid waste incineration facility (1st and 2nd floors) designated in the whole map in attachment-2 (radiation control target area) shall be applied from the time each area changed, and the provisions then in force shall remain applicable until that time.	radioative material analysis/ research center laboratory-1 designated in the whole map in attachment-1 (radiation control area), and the whole map in attachment-2 (radiation control taraget area) shall be applied from the time each area changed, and the provisions then in force shall remain applicable until that time.	
(Omitted below)	(Omitted below)	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Chapter III, Part 3 Supplementary explanation on security) 2.1 Management of Radioactive Waste, etc.)

Current	Revised	Reason for Revision
2 Supplementary Explanation regarding Management of Radioactive Waste, etc.	2 Supplementary Explanation regarding Management of Radioactive Waste, etc.	
2.1 Management of Radioactive Waste, etc.	2.1 Management of Radioactive Waste, etc.	
(Omission)	(Omission)	
2.1.2 Management of Radioactive Liquid Waste, etc.	2.1.2 Management of Radioactive Liquid Waste, etc.	
(Omission)	(Omission)	
(5) Liquid waste management methods	(5) Liquid waste management methods	
(Omission)	(Omission)	
 The concepts of identification of radionuclides other than tritium in ALPS treated water and subsequent selection of radionuclides to be measured and assessed are as follows. • The sum of the total of radioactivity concentration obtained by adding carbon 14 and technetium 99 to the seven major nuclides of ALPS treated water and gross β measured values is not allowed to indicate the presence of radionuclides other than the current 64 nuclides. In addition, some nuclides subject to removal by ALPS will exist small amount for decay at the time of discharging ALPS treated water into the sea, so that it is considered that the sum of ratio to reglulatory concentration limits of radionuclides other than tritium is less than 1. • In order to ensure that the sum of ratios to regulatory concentration limit is less than 1, a radionuclide to be measured and evaluated will be selected after thorough verification of the presence of radionuclides in contaminated water is conducted based on domestic knowledge and findings of decommissioning and buried facilities. 	subsequent selection of radionuclides to be measured and assessed are <u>referred to attachment-5</u> .	Change and delete description about the selection of nuclides to be measured and assessed for ALPS treated water due to the replacement to attachment.
(Omission)	(Omission)	
2.1.2.4 Attachment Attachment-1 Operation of drainage control for subdrain and other water treatment facilities Attachment-2 Target nuclides to be evaluated related to subdrain and other water treatment facilities Attachment-3 Nuclides to be verified for selection of nuclides for drain control for subdrain and other water treatment facilities Attachment-4 Reselection of target nuclides (Review after five years of the accident taking account of decay) (Omission)	2.1.2.4 Attachment Attachment-1 Operation of drainage control for subdrain and other water treatment facilities Attachment-2 Target nuclides to be evaluated related to subdrain and other water treatment facilities Attachment-3 Nuclides to be verified for selection of nuclides for drain control for subdrain and other water treatment facilities Attachment-4 Reselection of target nuclides (Review after five years of the accident taking account of decay) Attachment-5 Selection of nuclides to be measured and assessed at the time of ALPS treated water discharge into the sea (Omission)	Add explanations about the selection of nuclides to be measured and assessed
	Selection of radionuclides to be measured and assessed at the time of ALPS treated water discharge in to the sea	Add explanations about the selection of nuclides to be measured and assessed
(Not currently listed)	(Newly described)	
	(Omitted below)	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Chapter III, Part 3 (Supplementary explanation on security) 2.2 Dose assessment)

Current	Revised	Reason for Revision
2.2 Dose assessment	2.2 Dose assessment	
(Omission)	(Omission)	
 2.2.3 Dose Assessment by Radioactive Liquid Waste, etc. 2.2.3.1 Dose assessment method Nuclides to be assessed For ALPS treated water, radionuclides other than tritium and tritium shall be assessed. The selection of radionuclides other than tritium shall be stipulated in 3.2.1.2.3 (5) "Liquid waste management methods." 		Appropriate description
(Omitted below)	(Omitted below)	

Current	Revised	Reason for Revision
Reference Material	Reference Material	
Action in response to "Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station"	Action in response to "Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station"	
(Omission)	(Omission)	
An assessment result of the <u>design</u> stage at the time of <u>April</u> , 2022 in relation to radiation impact to person and environment on the above item (6).	An assessment result of the <u>construction</u> stage at the time of <u>November</u> , 2022 in relation to radiation impact to person and environment on the above item (6).	Change associated with the revision of Radiological Environmental Impact
(Omission)	(Omission)	Assessment Report.
Attachment-2 Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (<u>Design</u> stage <u>/ Revised version</u>)	Attachment-2 Radiological Environmental Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Construction stage)	Change associated with the revision of Radiological Environmental Impact Assessment Report.

Comparison Table of amendments in the implementation Fian for Current	Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference Document 1) Revised	Reason for Revision
Attachment-1	Attachment-1	
Action in Response to the Basic Policy of the Government	Action in Response to the Basic Policy of the Government	
(Omission)	(Omission)	
Appendix-2	Appendix-2	
Supplemental explanation on the small volume discharge at the early stage of discharge into the sea	Supplementary explanation for discharge in small quantities during the early stage of discharge into the sea	Appropriate description based of study of operation method
In the ALPS treated water discharge into the sea, dilution and discharge is to be carried out each tank group for ALPS treated water (approx. 10 thousand m³/tank group) measured/confirmed in the measurement/confirmation facility. In doing so, based on the Basic Policy, discharge shall be carried out cautiously with small volume in the early stage in following 2 steps, and required validation shall be made. Step 1: To confirm the expected dilution in ALPS treated water dilution/discharge facilities, using the discharge	ALPS treated water (approx. 10 thousand m³/tank group) measured/confirmed in the measurement/confirmation facility. In doing so, based on the Basic Policy, "the discharge into the sea will be conducted in small amount at the initial phase" prior to normal discharge, and it will be conducted in the following two steps according to the necessary verification objectives. Step 1: "Direct confirmation of tritium concentration"	
vertical shaft (upper-stream storage), tritium concentration is confirmed directly after the small volume of the ALPS treated water is diluted, and then it is discharged into the sea. (Refer to 1. operation method of the step 1) Step 2: To confirm the secure operation under the operation procedure of ALPS treated water dilution/discharge facilities and the related facility, and no significant change of tritium concentration in the sea due to discharge into the sea, the ALPS treated water is discharged into the sea with adjustment of discharge volume and intervals. Discharge method of the step 2 will be determined in the discharge plan of the first fiscal year of the discharge.	To confirm the expected dilution in ALPS treated water dilution/discharge facilities, using the discharge vertical shaft (upper-stream storage), tritium concentration is confirmed directly after the very small volume of the ALPS treated water is diluted, and then it is discharged into the sea. Step 2: "Confirmed discharge for equipment soundness and operational procedures, etc."	
After the step 2, ALPS treated water in a tank group of approximately 10 thousand m ³ , measured in the measurement/confirmation facility, will be discharged continuously, followed by another tank group with no interval between tank groups.		
1. Operation method of the step 1 After the discharge vertical shaft (upper-stream storage) with the capacity of approx. 2,000 m³ is emptied, one seawater transfer pump is started, small volume of ALPS treated water (20 m³ or less) is transferred to the discharge vertical shaft (upper-stream storage). Thus, sample water is collected from the discharge vertical shaft (upper-stream storage) to measure its tritium concentration. The measured tritium concentration of this sample is compared with the calculated tritium concentration, which determined from the volume of the transferred ALPS treated water and the volume of the seawater used for dilution, to check the two values are at similar level and the measured tritium concentration is less than 1,500Bq/L. After confirming that, the seawater for dilution is transferred again to discharge into the sea.	seawater transfer pump is started, <u>very</u> small volume of ALPS treated water (20 m ³ or less) is transferred to the discharge vertical shaft (upper-stream storage). Thus, sample water is collected from the discharge vertical shaft (upper-stream storage) to measure its tritium concentration. The measured tritium concentration of this sample is compared with the calculated tritium concentration, which determined from the volume of the transferred ALPS treated water and the volume of the seawater used for dilution, to check the two values are at similar level and the measured tritium concentration	
(Omission)	(Omission)	

Current	Revised	Reason for Revision
Attachment-2	Attachment-2	
Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Design stage / Revised version) April 2022	Radiological Environmental Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Construction stage) November 2022	Appropriated description for change of the date
Tokyo Electric Power Company Holdings, Inc.	Tokyo Electric Power Company Holdings, Inc.	

	Comparison 7	Table of amendments in the	Implementation Plan	an for Fukushima Daiichi	Nuclear Power Station as S	Specified Nuclear Facilit	y (Reference, Attachment-2)
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Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)				
Current	Revised	Reason for Revision		
Executive summary (Omission)	Executive summary (Omission)			
Next, the report describes how several proposals for handling of ALPS treated water have been discussed among experts for more than six years since the potential risk associated the storage of contaminated water became apparent in 2013 (Chapter 2), the purpose of this assessment (Chapter 3), the concept of this assessment (Chapter 4), and the mechanism to removal of the target nuclides by ALPS and the overview of the ALPS treated water discharge facility (Chapter 5), respectively. Subsequent chapters 6 and 7 describe the assessment of radiological impacts on humans and marine plants and animals. Each chapter details the concepts of source term, modeling of diffusion and transfer in seawater, exposure pathways, and establishment of representative persons and reference animals and plants, which are the main components of radiological impact assessment.	Next, the report describes how several proposals for handling of ALPS treated water have been discussed among experts for more than six years since the potential risk associated the storage of contaminated water became apparent in 2013 (Chapter 2), the purpose of this assessment (Chapter 3), the concept of this assessment (Chapter 4), and the quality of ALPS treated water, etc., the method of discharge, and the overview of the discharge facility (Chapter 5), respectively. Subsequent chapters 6 and 7 describe the assessment of radiological environmental impacts on humans and marine plants and animals. Each chapter details the concepts of source term, modeling of diffusion and transfer in seawater, exposure pathways, and establishment of representative persons and reference animals and plants, which are the main components of radiological environmental impact assessment.	Appropriate description		
(Omission)	(Omission)			
The results of the assessment of radiological impacts obtained by in-house and external experts based on the above-mentioned reasonable and conservative assumption indicate that (1) in the case of discharge of ALPS treated water from the seabed approximately 1km offshore from the FDNPS, the foreseeable radiological impact on the people who are most likely to be affected in the vicinity of the discharge point is sufficiently small, that is approximately 1/30,000 to 1/3,000 of Japanese safety standard set according to the international guidelines; (2) the impact on plants and animals inhabiting in 10km x 10km sea area around the FDNPS is only about 1/500,000 to 1/20,000 of the lower limit of the level proposed by ICRP as the threshold range beyond which there is concern that some impact may occur on the corresponding plants and animals (derived consideration reference level); and (3) the impact on areas far from the discharge point (transboundary impact) was evaluated undetectably low. This indicates that advanced water treatment by ALPS and the discharge plan to effectively use the period required for decommissioning will restrain the impacts on humans and marine plants and animals, and the impacts will be well within Japan's regulatory standard in accordance with the internationally established safety guidelines.	The results of the assessment of radiological environmental impacts obtained by in-house and external experts based on the above-mentioned reasonable and conservative assumption indicate that (1) in the case of discharge of ALPS treated water from the seabed approximately 1km offshore from the FDNPS, the foreseeable radiological impact on the people who are most likely to be affected in the vicinity of the discharge point is sufficiently small, that is approximately 1/500,000 to 1/50,000 of Japanese safety standard set according to the international guidelines; (2) the impact on plants and animals inhabiting in 10km x 10km sea area around the FDNPS is only about 1/25,000,000 to 1/1,000,000 of the lower limit of the level proposed by ICRP as the threshold range beyond which there is concern that some impact may occur on the corresponding plants and animals (derived consideration reference level); and (3) the impact on areas far from the discharge point (transboundary impact) was evaluated undetectably low. This indicates that advanced water treatment by ALPS and the discharge plan to effectively use the period required for decommissioning will restrain the impacts on humans and marine plants and animals, and the impacts will be well within Japan's regulatory standard in accordance with the internationally established safety guidelines.	Appropriate description due to the selection of nuclides to be measured and assessed		
(Omission)	(Omission)			
Chapter 9 describes the monitoring plan to be implemented in conjunction with the discharge of ALPS treated water into the sea. This includes an enhanced and expanded monitoring plan that includes increased sampling points, target of measurement and frequency. This monitoring plan is regarded as appropriate based on the results of the radiological impact assessment conducted up to Chapter 7.	Chapter 9 describes the monitoring plan to be implemented in conjunction with the discharge of ALPS treated water into the sea. This includes an enhanced and expanded monitoring plan that includes increased sampling points, target of measurement and frequency. This monitoring plan is regarded as appropriate based on the results of the radiological environmental impact assessment conducted up to Chapter 7.	Appropriate description		
(Omission)	(Omission)			
The assessments in this report were conducted on the based on the information available at the design stage of the plan regarding to the discharge into the sea. After the original report was published last November, this report was reviewed and revised based on the progress of our study, opinions received through the public comment survey, reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority. TEPCO plans to further review the assessment and revise this report as necessary to reflect the progress of studies on design and implementation including rigorous selection of target nuclides for measurement, opinions from various sectors, and the knowledge obtained through cross-checks by third-party assessments, etc. and to reflect in the plan and other necessary items respectively.	In November 2021, the assessments in this report were conducted on the based on the information available at the stage of designing the plan for discharge into the sea. In April 2022, this report was reviewed and revised based on the progress of our study, opinions received through the public comment survey, reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority. Subsequently, based on the progress of construction work, the previous reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority, the nuclides to be measured and assessed for the discharge of ALPS treated water into the sea were selected, source terms were reviewed, based on which the assessment was reconsidered as an assessment of the construction stage. TEPCO plans to further review the assessment and revise this report as necessary to reflect the progress of studies on implementation, opinions from various sectors, and the knowledge obtained through cross-checks by third-party assessments, etc. and to reflect in the plan and other necessary items respectively.	Appropriate description for change of date and due to the selection of nuclides to be measured and assessed		
Before discharging ALPS treated water, TEPCO will analyze the radionuclides contained in the ALPS treated water which is pre-diluted and publish the results. In addition, during the initial period of the water discharge into the sea, TEPCO will also directly confirm the conditions of mixing and dilution prior to the discharge into the sea, and publish the results. Moreover, for discharge into the sea, the plan is to start the discharge with a small amount of discharge, while monitoring the impact on the surrounding environment, etc. In the unlikely event of a malfunction of the dilution facility due to trouble, power failure, or other reasons, or if abnormal value is detected by monitoring enhanced and expanded after the start of discharge, TEPCO will stop discharging until it is confirmed that the conditions have been established for safe discharge and will make every effort to ensure the safety of human and marine plants and animals.	Before discharging ALPS treated water, TEPCO will analyze the radionuclides contained in the ALPS treated water which is pre-diluted and publish the results. In addition, during the initial period of the water discharge into the sea, TEPCO will also directly confirm the conditions of mixing and dilution prior to the discharge into the sea, and publish the results. Moreover, for discharge into the sea, the plan is to start the discharge with a small amount of discharge, while monitoring the impact on the surrounding environment, etc. In the unlikely event of a malfunction of the dilution facility due to trouble, power failure, or other reasons, or if any significant difference to the variation range of baseline monitoring is detected by monitoring enhanced and expanded after the start of discharge, TEPCO will stop discharging until it is confirmed that the conditions have been established for safe discharge and will make every effort to ensure the safety of human and marine plants and animals.			

	Current		Revised	Reason for Revision
Table of	Contents		able of Contents	
Executiv	ve summary	ES-i	xecutive summary ES-i	
Overvie	w of the assessment	Overview-i	verview of the assessment Overview	i Appropriate description
1.	Background	1	Background 1	
2.	Consideration of handling of ALPS treated water	4	Consideration of handling of ALPS treated water 4	
3.	Objectives of the assessment	7	Objectives of the assessment 7	
4.	Concept of assessment	8	Concept of assessment 8	
(1)	Dose constraints	8) Dose constraints 8	
(2)	About tritium	9	About tritium 9	
(2) (3)	Assessment of migration and accumulation of nuclides other than tritium	10	Assessment of migration and accumulation of nuclides other than tritium 10	
5.	Properties of ALPS treated water, etc. and discharge method	13	Properties of ALPS treated water, etc. and discharge method 13	
5-1.	Properties of ALPS treated water, etc.	13	1. Properties of ALPS treated water, etc. 13	
5-2.	Discharge method	15	2. Discharge method 16	
5-3.	Facilities for discharge	18	3. Facilities for discharge 18	
5-3-1.	Overview of the facilities for discharge	18	3-1. Overview of the facilities for discharge 18	
5-3-1. 5-3-2.	Measurement/confirmation facility	20	3-2. Measurement/confirmation facility 20	
		20		
5-3-3.	Transfer facility	21 22 23	3-3. Transfer facility 22	
5-3-4.	Dilution facility	<u>ZZ</u>	3-4. Dilution facility 3-5. Discharge facility (related facility) 24 25	
5-3-5.	Discharge facility (related facility)	<u>23</u>	3-5. Discharge facility (related facility)	
6.	Assessment of protection of humans (public)	<u>27</u>	Assessment of protection of humans (public)	
6-1.	Exposure assessment under normal conditions	<u>27</u>	Assessment of protection of humans (public) Exposure assessment under normal conditions 1-1. Assessment procedure 1-2. Assessment method 29 30	
6-1-1.	Assessment procedure	<u>27</u>	1-1. Assessment procedure <u>29</u>	
6-1-2.	Assessment method	<u>28</u>	1-2. Assessment method <u>30</u>	
(1)	Source term (annual discharge amount of each nuclide)	<u>28</u>	Source term (annual discharge amount of each nuclide) <u>30</u>	
(2)	Modeling of diffusion and transfer after discharge	<u>38</u>) Modeling of diffusion and transfer after discharge 38	
(2) (3)	Setting of exposure pathways	$\overline{42}$	Setting of exposure pathways 42	
a.	External exposure	43	External exposure 43	
b.	Internal exposure	27 27 27 28 28 38 42 43 48 70 74 75	Internal exposure 48	
(4)	Setting of the representative person subject to the exposure assessment	$\frac{30}{70}$		
(5)	Dose assessment method	$\frac{70}{74}$	Setting of the representative person subject to the exposure assessment Dose assessment method Assessment result 59 63 64	
6-1-3.	Assessment result	$\frac{71}{75}$	1-3. Assessment result 64	
(1)	Diffusion simulation result	75 75) Diffusion simulation result 64	
(2)	Concentration of each nuclide used for the assessment in the seawater	75 86	Diffusion simulation result Concentration of each nuclide used for the assessment in the seawater 64 75	
	Exposure assessment result			
(3) 6-2.		93 98		
	Potential exposure assessment	<u>98</u>		
6-2-1.	Assessment method	<u>98</u>		
(1)	Identification and selection of potential exposure scenarios	98) Identification and selection of potential exposure scenarios 84	
(2)	Source term (daily discharge amount of each nuclide)	<u>100</u>	Source term (daily discharge amount of each nuclide) 86	
(3)	Modeling of diffusion and transfer, and exposure pathway	100 112 113	Modeling of diffusion and transfer, and exposure pathway	
(4)	Setting of the representative person	113	Setting of the representative person 97	
(5)	Dose assessment method	113	Dose assessment method 97	
6-2-2.	Assessment result	114	1Identification and selection of potential exposure scenarios842Source term (daily discharge amount of each nuclide)863Modeling of diffusion and transfer, and exposure pathway944Setting of the representative person975Dose assessment method972-2.Assessment result986Concentration in the seawater used for the assessment98	
(1)	Concentration in the seawater used for the assessment	114 122 123 123 123	Concentration in the seawater used for the assessment 98	
(2)	Exposure assessment result	<u>122</u>	Exposure assessment result <u>103</u>	
7.	Assessment regarding environmental protection	<u>123</u>	Assessment regarding environmental protection <u>105</u>	
7-1.	Concept of assessment	<u>123</u>	1. Concept of assessment <u>105</u>	
7-1-1.	Assessment procedure	<u>123</u>	1-1. Assessment procedure <u>105</u>	
7-2.	Assessment method		2. Assessment method 106	
7-2-1.	Source term	124 124 124 124 124 124 127 127 137	2-1. Source term <u>106</u>	
7-2-2.	Modeling of diffusion and transfer after discharge	124	2-2. Modeling of diffusion and transfer after discharge 106	
(1)	Selection of the migration model	124) Selection of the migration model 106	
(2)	Assessment of advection and diffusion in the sea area	124	Assessment of advection and diffusion in the sea area 106	
7-2-3.	Setting of exposure pathways	124	2-3. Setting of exposure pathways 106	
7-2-3. 7-2-4.	Selection of reference plants and animals (organisms to be assessed)	127	2-4. Selection of reference plants and animals (organisms to be assessed) 109	
7-2- 4 . 7-2-5.	Dose assessment	127 127	2-4. Selection of reference plants and animals (organisms to be assessed) 2-5. Dose assessment 3. Assessment result 109 115	
	Assessment result	127	3. Assessment result	
7-3.		13 / 127	3. Assessment result 2.1. Concentration in the appropriate the assessment	
7-3-1.	Concentration in the seawater used for the assessment	15/	3-1. Concentration in the seawater used for the assessment 115	
7-3-2.	Exposure assessment result	<u>145</u>	3-2. Exposure assessment result <u>120</u>	

The Japanese version shall prevail.

Current			Revised Revised			son for Revision
8.	Discussion about the uncertainty of the assessment	<u>146</u>	8.	Discussion about the uncertainty of the assessment	21	
8-1.	Uncertainty included in the selection of the source term	146 146	8-1.	Uncertainty included in the selection of the source term	21	
8-1-1.	Uncertainty of the composition of nuclide (epistemic uncertainty)	146	8-1-1.		21	
8-1-2.	Uncertainty of analysis (aleatory uncertainty)	140 147	8-1-2.			
8-1-3.	Summary of the uncertainty of the source term	146 147 147 155 155 155 155	8-1-3.	Summary of the uncertainty of the source term	<u>22</u> 22	
8-2.	Uncertainty of the diffusion and transfer in the environment	155	8-2.	Uncertainty of the diffusion and transfer in the environment	28	
8-2-1.	Uncertainty of meteorological and oceanographic data, etc. (aleatory uncertainty)	155 155	8-2-1.	Uncertainty of meteorological and oceanographic data, etc. (aleatory uncertainty)	28	
8-2-2.	Uncertainty of the simulation model itself (epistemic uncertainty)	155	8-2-2.	Uncertainty of the simulation model itself (epistemic uncertainty)	28 28 28	
8-2-3.	Uncertainty in the selection of migration pathways (epistemic uncertainty)	155	8-2-3.	Uncertainty in the selection of migration pathways (epistemic uncertainty)	<u>28</u>	
8-2-4.	Uncertainty in the concentration factor of seafood and the distribution coefficient of	<u> </u>	8-2-4.	Uncertainty in the concentration factor of seafood and the distribution coefficient of		
02	seabed sediment (epistemic uncertainty)	156	02		29	
8-3.	Uncertainty in the setting of exposure pathways	156	8-3.	Uncertainty in the setting of exposure pathways	29 29 29 30	
8-3-1.	Uncertainty in the selection of exposure pathways (epistemic uncertainty)	156	8-3-1.	Uncertainty in the selection of exposure pathways (epistemic uncertainty)	29	
8-4.	Uncertainty in the selection of the representative person	158	8-4.	Uncertainty in the selection of the representative person	30	
8-4-1.	Uncertainty in the actual life of the representative person (aleatory uncertainty)	158	8-4-1.	Uncertainty in the actual life of the representative person (aleatory uncertainty)	30	
8-4-2.	Uncertainty in the selection of the representative pathway (epistemic uncertainty)	156 156 156 158 158 158 158 159	8-4-2.		30	
8-4-3.	Uncertainty depending on the range of the sea area to be assessed (epistemic uncertainty)	159	8-4-3.		31	
8-5.	Summary about uncertainty	159	8-5.		31	
9.	Monitoring to be performed in response to discharge of ALPS treated water into the sea	161	9.		33	
9-1.	Analytical capability in the Fukushima Daiichi Nuclear Power Station	161 161	9-1.		33	
9-1-1.	Analytical capability in terms of facilities	161	9-1-1.	Analytical capability in terms of facilities	33	
9-1-2.	Analytical capability in terms of competence	163	9-1-2.	Analytical capability in terms of competence	35	
9-1-3.	Our management and supervision	166	9-1-3.	Our management and supervision	35 38	
9-2.	Monitoring within the premises of the Fukushima Daiichi Nuclear Power Station	168	9-2.	Monitoring within the premises of the Fukushima Daiichi Nuclear Power Station	40	
9-2-1.	Source monitoring	169	9-2-1.	Source monitoring 14	41	
9-2-2.	Monitoring at the discharge vertical shaft (upper-stream storage)	174	9-2-2.	Monitoring at the discharge vertical shaft (upper-stream storage)	1 7	
9-2-3.	Monitoring in seawater piping	175	9-2-3.	Monitoring in seawater piping	49	
9-3.	Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station	161 163 166 168 169 174 175 178 179 185 185 186 186	9-3.	Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station	40 41 47 49 51 52 59 59	
9-3-1.	Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO	179	9-3-1.	Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO	52	
9-3-2.	Monitoring by the government and Fukushima prefecture	185	9-3-2.	Monitoring by the government and Fukushima prefecture	59	
(1)	Previous sea area monitoring performed by the government and Fukushima	185	(1)	Previous sea area monitoring performed by the government and Fukushima	59	
a.	Seawater	<u>185</u>	a.	Seawater 15	<u>59</u>	
b.	Seabed sediment	<u>186</u>	b.	Seabed sediment 16	<u>60</u>	
c.	Marine organisms	<u>186</u>	c.		<u>60</u>	
(2)	Sea area monitoring enhanced and expanded by the government in response to discharge		(2)	Sea area monitoring enhanced and expanded by the government in response to discharge		
	of ALPS treated water	<u>186</u>		of ALPS treated water	<u>60</u>	
a.	Seawater	186 186 188	a.	Seawater <u>16</u>	<u>60</u> 62	
b.	Marine biota	<u>188</u>	b.		<u>62</u>	
(3)	Seawater monitoring enhanced and expanded by Fukushima prefecture in response to		(3)	Seawater monitoring enhanced and expanded by Fukushima prefecture in response to		
	discharge of ALPS treated water	<u>190</u>		discharge of ALPS treated water	<u>54</u>	
(4)	Cooperation with the IAEA for sea area monitoring by the government and IAEA		(4)	Cooperation with the IAEA for sea area monitoring by the government and IAEA		
	marine monitoring	<u>192</u>		marine monitoring <u>16</u>	<u>66</u>	
9-4.	Actions to be taken in case of abnormalities	<u>193</u>	9-4.	Actions to be taken in case of abnormalities <u>16</u>	<u>67</u>	
9-5.	Summary of monitoring	<u>194</u>	9-5.	Summary of monitoring <u>16</u>	<u>68</u>	
10.	Summary	<u>195</u>	10.	Summary <u>16</u>	<u>69</u>	
Referen	ces	<u>196</u>	Referen	<u>17</u>	<u>70</u>	
Terms		192 193 194 195 196 198 200	Terms	marine monitoring Actions to be taken in case of abnormalities Summary of monitoring Summary ces 10 11 11 11 11 11 11 11 11 1	<u>72</u>	
Preparat	ion member	<u>200</u>	Preparat	$\underline{1}$ ion member $\underline{1}$	<u>74</u>	

	Current		Revised	Reason for Revision
Attachment		Attachment		
Attachment I	Rationale behind the selection of nuclides subject to <u>removal by</u> ALPS	Attachment I	Rationale behind the selection of nuclides subject to <u>be measured and assessed for discharge of</u> ALPS <u>treated water into the sea</u>	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)		(Omission)		incasured and assessed
Attachment XII	Impact of the assessment range of concentrations in seawater used for the assessment of exposures	Attachment XII Attachment XIII	Impact of the assessment range of concentrations in seawater used for the assessment of exposures Application of uncertainty in the analysis of ALPS treated water	Enhancement of description
References		References	Application of uncertainty in the analysis of ALI 5 treated water	Elmancement of description
Reference A	Site boundary dose assessment of Fukushima Daiichi and the regulatory concentration limit in		Site boundary dose assessment of Fukushima Daiichi and the regulatory concentration limit in	
Reference B Reference C	the Japanese laws Timeline of consideration of each disposal method of ALPS treated water Setting of Management Values and Exposure Assessment of Hypothetical ALPS Treated Wate	Reference B Reference C	the Japanese laws Timeline of consideration of each disposal method of ALPS treated water Setting of previous management values and exposure assessment of hypothetical ALPS treated water	Appropriate description due to the selection of nuclides to be
Reference D	Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water	Reference D	Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water	measured and assessed
Reference E	State of consultation with domestic and foreign stakeholders	Reference E Reference F Reference G	State of consultation with domestic and foreign stakeholders Rationale behind the selection of nuclides subject to removal by ALPS Annual discharge limit and optimization estimation results for individual nuclide based on dose constraint	Change in the position of the description of the rationale behind the selection of nuclides subject to removal by ALPS due to the selection of nuclides to be measured and assessed, and enhanced description

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2	Comparison Table of amendments in the In	oplementation Plan for Fukushima Dajichi N	Juclear Power Station as Specified 1	Nuclear Facility (Reference, Attachment-2)
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Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)		
Current	Revised	Reason for Revision
Overview of the assessment	Overview of the assessment	
(Omission)	(Omission)	
In compiling this report, in-house experts with knowledge on the radiological impact assessments were selected and assigned, and external experts were invited as members to submit their opinions in three fields of human radiation protection, environmental protection, and marine diffusion calculation.	In compiling this report, in-house experts with knowledge on the radiological <u>environmental</u> impact assessments were selected and assigned, and external experts were invited as members to submit their opinions in three fields of human radiation protection, environmental protection, and marine diffusion calculation.	Appropriate description
(Omission)	(Omission)	
Assessment of radioactive nuclides and diffusion	Assessment of radioactive nuclides and diffusion	
The nuclides to be assessed are a total of 64 nuclides including tritium (H-3), carbon 14 (C-14), and 62 nuclides subject to removal by ALPS (for the rationale behind the procedure to estimate radioactive materials contained in contaminated water and select 62 nuclides as nuclides subject to removal by ALPS, see Attachment I "Rationale behind the selection of nuclides subject to removal by ALPS"). The nuclide composition of ALPS treated water differs for each tank groups ² depending on the composition and concentrations of radioactive materials in contaminated water before treatment, and lifetime of each adsorbent at the time of treatment in ALPS, etc. Therefore, the nuclide compositions of ALPS treated water used for the assessment were the nuclide compositions of the three tank groups in which measurement and assessment of 64 nuclides had actually been completed (for details, see 6-1-2.(1)).	The nuclides to be assessed are a total of 31 nuclides including tritium (H-3) and carbon 14 (C-14) (for the rationale behind the procedure to estimate radioactive materials contained in contaminated water and to select 30 nuclides other than tritium as nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea, see Attachment I "Rationale behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea"). The nuclide composition of ALPS treated water differs for each tank groups depending on the composition and concentrations of radioactive materials in contaminated water before treatment, and lifetime of each adsorbent at the time of treatment in ALPS, etc. Therefore, the nuclide compositions of ALPS treated water used for the assessment were the nuclide compositions of the three tank groups in which measurement and assessment of 62 nuclides subject to removal by ALPS, tritium, and carbon 14 had actually been completed, plus analysis results of nuclides such as Se-79 (for details, see 6-1-2. (1)).	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)	(Omission)	
Therefore, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium in discharged water after seawater dilution is less than 0.01, and the impact of radiation will be further reduced (for details, see 5-2).	Therefore, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium in discharged water after seawater dilution is less than 0.01, and the impact of radiation will be further reduced (for details, see 5-2).	
(Omission)	(Omission)	
Changes in response to new information and the result of monitoring	Changes in response to new information and the result of monitoring	
The assessment described in this report was conducted based on the information available at this point in time during the design stage of the plan for discharge into the sea. After the original report was issued last November, and revised based on the assessment reflecting the comments received from the public, comments pointed out by the Nuclear Regulation Authority, the findings of review by the IAEA, etc. We are planning to revise this report further in order to reflect findings obtained through consideration of design including rigorous selection of nuclides to be measured and operation associated with the plan, opinions from various sectors, reviews by experts of the IAEA, cross-checks by third-party assessments, etc., and to modify the planned discharge program and its implementation as necessary.	The assessment described in this report was conducted based on the information available in November 2021 at this point in time during the design stage of the plan for discharge into the sea. In April 2022, it was revised based on the assessment reflecting the comments received from the public, comments pointed out by the Nuclear Regulation Authority, the findings of review by the IAEA, etc. Subsequently, based on the progress of construction work, the previous reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority, the nuclides to be measured and assessed for the discharge of ALPS treated water into the sea were selected, source terms were reviewed, based on which the assessment was reconsidered as an assessment of the construction stage. We are planning to revise this report further in order to reflect findings obtained through consideration of operation associated with the plan, opinions from various sectors, reviews by experts of the IAEA, cross-checks by third-party assessments, etc., and to modify the planned discharge program and its implementation as necessary.	Appropriate description for change of the date
Before discharging ALPS treated water, we will analyze the radionuclides contained in the ALPS treated water before dilution, and publish the results. In addition, during the initial period of the water discharge into the sea, we will also directly confirm the conditions of mixing and dilution before discharge into the sea and publish the results. Moreover, for discharge into the sea, TEPCO will carefully start the discharge with a small amount while monitoring the impact on the surrounding environment, etc. In case that the dilution facility fails due to malfunction, power failure, or other reasons, or if abnormal value is detected by monitoring after the start of discharge, TEPCO will stop discharge until it is confirmed that the conditions for safe discharge of the ALPS treated water have been securely re-established, and make every effort to ensure the safety of human and marine plants and animals.	Before discharging ALPS treated water, we will analyze the radionuclides contained in the ALPS treated water before dilution, and publish the results. In addition, during the initial period of the water discharge into the sea, we will also directly confirm the conditions of mixing and dilution before discharge into the sea and publish the results. Moreover, for discharge into the sea, TEPCO will carefully start the discharge with a small amount while monitoring the impact on the surrounding environment, etc. In case that the dilution facility fails due to malfunction, power failure, or other reasons, or if any significant difference to the variation range of baseline monitoring is detected by monitoring after the start of discharge, TEPCO will stop discharge until it is confirmed that the conditions for safe discharge of the ALPS treated water have been securely re-established, and make every effort to ensure the safety of human and marine plants and animals.	Appropriate description

Comparison Table of amendments in the Im	plementation Plan for Fukushima Daiichi Nuclear Power Station as Sr	pecified Nuclear Facility (Reference, Attachment-2)

Current	Revised	Reason for Revision
1. Background	1. Background	
(Omission)	(Omission)	
Currently, by multilayered countermeasures, we manage to prevent leakage of contaminated water out of the building and reduce the daily generated amount from about 540 m³ (as of May 2014) to about 140 m³ (as of 2020), and we are aiming to further reduce the daily generated amount to less than 100 m³ by 2025.	Currently, by multilayered countermeasures, we manage to prevent leakage of contaminated water out of the building and also reduce the daily generated amount from about 540 m³ (as of May 2014) to about 130 m³ (as of 2021), and we are aiming to further reduce the daily generated amount to less than 100 m³ by 2025.	Appropriate description for change of the date
(Omission)	(Omission)	
Water in which the sum of the ratios to regulatory concentrations limits is not less than 1 even after treatment is called "treated water to be purified." "ALPS treated water" and "treated water to be purified" are collectively called "ALPS treated water, etc.") (See Reference A "Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws"). As of <u>January</u> 2022, there are <u>1 047</u> tanks that store strontium treated water (water before ALPS treatment) and ALPS treated water, etc., and the stored amount is about <u>1.29</u> million m³, while the capacity is about 1.37 million m³. Although it is necessary to carefully examine the effect of the measures to control the generation of contaminated water and prediction of the amount of contaminated water generated, the planned capacity is expected to reach after the summer of 2023.	Water in which the sum of the ratios to regulatory concentrations limits is not less than 1 even after treatment is called "treated water to be purified." "ALPS treated water" and "treated water to be purified" are collectively called "ALPS treated water, etc.") (See Reference A "Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws"). As of October 2022, there are 1 066 tanks that store strontium treated water (water before ALPS treatment) and ALPS treated water, etc., and the stored amount is about 1.32 million m³, while the capacity is about 1.37 million m³. Although it is necessary to carefully examine the effect of the measures to control the generation of contaminated water and prediction of the amount of contaminated water generated, the planned capacity is expected to reach after the summer of 2023.	
(Omission)	(Omission)	
In order to safely and steadily proceed with the decades-long decommissioning, it is necessary to continue to steadily reduce overall risk at the FDNPS by removing as much radioactive material as possible using water treatment facilities including ALPS, implementing discharge in a safe manner that does not substantially affect humans and plants and animals, and appropriately storing spent fuels in temporary storage in dry cask to be installed in the future. (Omission)	In order to safely and steadily proceed with the decades-long decommissioning, storing ALPS treated water, etc. for long time is not practical (for details, see Reference B "Timeline of consideration of each disposal method of ALPS treated water"), it is necessary to continue to steadily reduce overall risk at the FDNPS by removing as much radioactive material as possible using water treatment facilities including ALPS, implementing discharge in a safe manner that does not substantially affect humans and plants and animals, and appropriately storing spent fuels in temporary storage in dry cask to be installed in the future. (Omission)	Enhancement of description

Current	Revised	Reason for Revision
3. Objectives of the assessment	3. Objectives of the assessment	
The objective of this Radiological Impact Assessment is as follows.	The objective of this Radiological Environmental Impact Assessment is as follows.	Appropriate description
(Omission)	(Omission)	
4. Concept of assessment	4. Concept of assessment	
(Omission)	(Omission)	
(1) Dose constraints	(1) Dose constraints	
(Omission)	(Omission)	
As shown in "TEPCO's Action in response to Government's Policy" (April 2021) above, we set the annual discharge amount of tritium to 22 TBq/year (2.2E+13Bq/year) as an evaluation condition of this report and assessed the impact of radiation.	As shown in "TEPCO's Action in response to Government's Policy" (April 2021) above, we set the annual discharge amount of tritium to 22 TBq/year (2.2E+13Bq/year) as an evaluation condition of this report and assessed the radiological environmental impact.	
(Omission)	(Omission)	
(3) Assessment of migration and accumulation of nuclides other than tritium	(3) Assessment of migration and accumulation of nuclides other than tritium	
(Omission)	(Omission)	
Thanks to these considerations, we can assess accumulation of radioactive materials in the environment due to long-term discharge, though this assessment is performed for just one year. Thus, the peak dose value is considered not higher than the value in this assessment. (Omission)	Thanks to these considerations, we can assess accumulation of radioactive materials in the environment due to long-term discharge, though this assessment is performed for just one year. Thus, the peak dose value is considered not higher than the value in this assessment. In this report, although the source term was revised, there is no need to change the concept of advection and dispersion of radioactive materials. (Omission)	New description due to the selection of the nuclides to be measured and assessed

Current	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2) Revised	Reason for Revision
5. Properties of ALPS treated water, etc. and discharge method 5-1. Properties of ALPS treated water, etc.	5. Properties of ALPS treated water, etc. and discharge method 5-1. Properties of ALPS treated water, etc.	
(Omission)	(Omission)	
The rationale behind the selection of 62 nuclides subject to removal by ALPS is shown in <u>Attachment I</u> "Rationale behind the selection of nuclides subject to removal by ALPS" and the mechanism to remove radioactive materials from contaminated water is shown in Attachment II "Properties of ALPS treated water, etc."	The rationale behind the selection of 62 nuclides subject to removal by ALPS is shown in Reference F "Rationale behind the selection of nuclides subject to removal by ALPS" and the mechanism to remove radioactive materials from contaminated water is shown in Attachment II "Properties of ALPS treated water, etc."	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)	(Omission)	
The targets in this report include not only about 1.28 m³ of ALPS treated water, etc., already stored in the FDNPS, but also contaminated water generated even after discharge into the sea is started, because such water is planned to be discharged into the sea as ALPS treated water after the purification by water treatment facilities including ALPS.	On the other hand, among the 62 nuclides to be removed by ALPS, it is possible that some nuclides are now sufficiently decayed to have sufficiently small abundances since for these 62 nuclides the inventory data set of one year after the accident at FDNPS, was used for the assessment. In light of the above, TEPCO conducted thorough studies to select the target nuclides for ALPS treated water discharge into the sea and newly selected 30 nuclides as nuclides to be measured and assessed (Table5-1-2). This report assesses 31 nuclides, including tritium, as target nuclides for dose assessment	
(Omission)	(Omission)	

Current	Revised	Reason for Revision
(Not currently listed)	Table5-1-2 Tritium and nuclides to be measured and assessed for discharge of ALPS treated water into the sea	New description due to the
	Regulatory	selection of the nuclides to be
	Target nuclides concentration	measured and assessed
	(Physical half life) limit	
	(Bq/L)	
	<u>1</u> <u>H-3(approx.12Years)</u> <u>6.0E+04</u>	
	<u>2</u> <u>C-14(approx.5700Years)</u> <u>2.0E+03</u>	
	<u>3 Mn-54(approx.310Days) 1.0E+03</u>	
	4 <u>Co-60(approx.5.3Years)</u> <u>2.0E+02</u>	
	5 Ni-63(approx.100Years) 6.0E+03	
	6 Se-79(approx.300,000Years) 2.0E+02	
	7 Sr-90(approx.29Years) 3.0E+01	
	8 Y-90(approx.64 Hours) 3.0E+02	
	9 <u>Tc-99(approx.210,000Years)</u> <u>1.0E+03</u>	
	10 Ru-106(approx.370Days) 1.0E+02	
	11 Cd-113m(approx.14Years) 4.0E+01	
	12 Sb-125(approx.2.8Years) 8.0E+02	
	13 <u>Te-125m(approx.57 Days)</u> 9.0E+02	
	14 <u>I-129(approx.16M Years)</u> 9.0E+00	
	<u>15</u> <u>Cs-134(approx.2.1Years)</u> <u>6.0E+01</u>	
	<u>16</u> <u>Cs-137(approx.30Years)</u> <u>9.0E+01</u>	
	17 <u>Ce-144(approx.280Days)</u> 2.0E+02	
	<u>18</u> <u>Pm-147(approx.2.6Years)</u> <u>3.0E+03</u>	
	<u>19</u> <u>Sm-151(approx.90Years)</u> <u>8.0E+03</u>	
	<u>20</u> <u>Eu-154(approx.8.6Years)</u> <u>4.0E+02</u>	
	<u>21</u> <u>Eu-155(approx.4.8Years)</u> <u>3.0E+03</u>	
	<u>22</u> <u>U-234(approx.250,000Years)</u> <u>2.0E+01</u>	
	23 U-238(approx.4.5B Years) 2.0E+01	
	24 Np-237(approx.2.1MYears) 9.0E+00	
	25 Pu-238(approx.88Years) 4.0E+00	
	26 Pu-239(approx.24000Years) 4.0E+00	
	27 Pu-240(approx.6600Years) 4.0E+00	
	28 <u>Pu-241(approx.14Years)</u> 2.0E+02	
	29 <u>Am-241(approx.430Years)</u> 5.0E+00	
	30 Cm-243(approx.29Years) 6.0E+00	
	31 Cm-244(approx.18Years) 7.0E+00	
	*Half-life shows in 2 significant digits referring to ICRP Publication 107 "Nuclear Decay Data for	
	Dosimetry Calculations" [16]	•

Comparison Table of amendments in the Implementation Plan for	Fukushima Daiichi Nuclear Power Station as S	Specified Nuclear Facility (Reference, Attachmen	-2)
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	Current	Revised Revised Reference, Attachment-2)	Reason for Revision
5-2. Discharge method		5-2. Discharge method	
 Before dilution and discharge, we shall measure and assess the concentration of the radioactive materials in ALPS treated water (tritium, 62 nuclides, and C-14) and announce the results of the measurement and assessment every time, as well as perform third-party measurement, assessment, announcement, etc., and announce the results. 		 Before dilution and discharge, we shall measure and assess the concentration of the radioactive materials in ALPS treated water (30 nuclides to be measured and assessed and tritium) and announce the results of the measurement and assessment every time, as well as perform third-party measurement, assessment, announcement, etc., and announce the results. Nuclides that are not included as the nuclides to be measured and assessed among nuclides subject to removal by ALPS (62 nuclides) will be measured and the results will be announced, as well. 	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)		(Omission)	
• If the transfer facility or dilution facility does not function as planned due to malfunction, power failure, etc., we will stop the discharge immediately. If any abnormal value is detected in sea area monitoring, we will stop discharge and investigate the state. When resuming discharge, confirm the safety of discharge.		• If the transfer facility or dilution facility does not function as planned due to malfunction, power failure, etc., we will stop the discharge immediately. If any significant difference to the variation range of baseline monitoring is detected in sea area monitoring, we will stop discharge and investigate the state. When resuming discharge, confirm the safety of discharge.	Appropriate description
(Omission)		(Omission)	
Secondary treatment of treated water to be purified Analysis of ALPS treated water	 Table 5-2-1 Specific items to be implemented The amount of radioactive materials excluding tritium in treated water to be purified to be discharged into the environment is reduced by secondary treatment by ALPS, etc., to ensure that radioactive materials other than tritium surely falls below the regulatory standard value related to safety (until the sum of the ratios to regulatory concentrations limits of nuclides other than tritium becomes less than 1). Before dilution and discharge, we shall announce the measurement and assessment results of the concentration of radioactive materials of 62 nuclides (nuclides subject to removal by ALPS) and C-14 every time, as well as perform third-party measurement, assessment, announcement, etc. 	Secondary treatment of treated water to be purified The amount of radioactive materials excluding tritium in treated water to be purified to be discharged into the environment is reduced by secondary treatment by ALPS, etc., to ensure that radioactive materials other than tritium surely falls below the regulatory standard value related to safety (until the sum of the ratios to regulatory concentrations limits of nuclides other than tritium becomes less than 1). Analysis of ALPS treated water • Before dilution and discharge, we shall announce the measurement and assessment results of the concentration of radioactive materials of tritium, 30 nuclides to be measured and assessed and nuclides subject to removal by ALPS that are out of above every time, as well as perform third-party measurement, assessment, announcement, etc.	Appropriate description due to the selection of nuclides to be measured and assessed
Dilution and discharge (including emergency actions)	 Tritium, which is difficult to remove, is diluted with a sufficient amount of seawater (100 or more times) before discharge so that the concentration will be sufficiently lower than the regulatory concentration limit. Thanks to this, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium in discharged water becomes less than 0.01. The tritium concentration shall be the same as the operation target of the discharge concentration of the groundwater bypass, subdrain, etc. (less than 1,500Bq/L). The upper limit of the annual discharge amount of tritium shall be 22 TBq (2.2E+13Bq) per year, which is the discharge control value at FDNPS before the accident, for the time being. The annual discharge amount of tritium is reviewed as needed based on the progress of decommissioning. If the transfer facility or dilution facility does not function as planned due to a failure, outage, etc., stop the discharge immediately. 	Dilution and discharge (including emergency actions) Tritium, which is difficult to remove, is diluted with a sufficient amount of seawater (100 or more times) before discharge so that the concentration will be sufficiently lower than the regulatory concentration limit. Thanks to this, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium in discharged water becomes less than 0.01. The tritium concentration shall be the same as the operation target of the discharge concentration of the groundwater bypass, subdrain, etc. (less than 1,500Bq/L). The upper limit of the annual discharge amount of tritium shall be 22 TBq (2.2E+13Bq) per year, which is the discharge control value at FDNPS before the accident, for the time being. The annual discharge amount of tritium is reviewed as needed based on the progress of decommissioning. If the transfer facility or dilution facility does not function as planned due to a failure, outage, etc., stop the discharge immediately.	

Comparison Table of amendments in the In	uplementation Plan for Fukushima Dajichi Nuclear Power Station as S	Specified Nuclear Facility (Reference, Attachment-2)

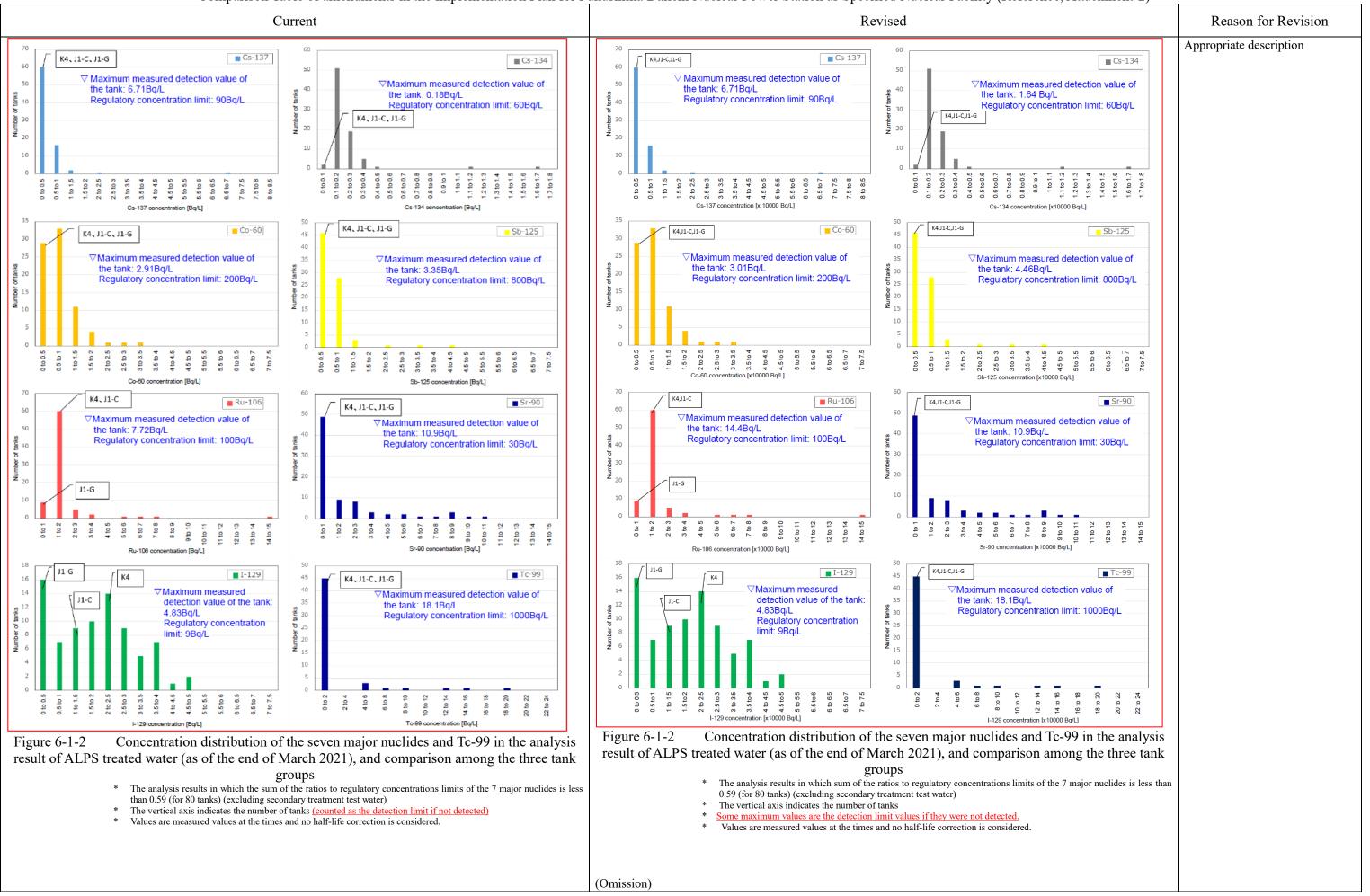
					em ruelear i ower stati	on as Specified Nuclear Facility (Refe	ence, retaemment 2)	
		Current				Revised		Reason for Revision
Sea area monitoring	If <u>any abnormal value is detected</u> in sea area monitoring, stop discharge and investigate the state. When resuming discharge, confirm the safety of discharge.				monito and in the safe nitoring • Sea are since dischar • Monito - Tritiu	significant difference to the variation oring is detected in sea area monitoring vestigate the state. When resuming duety of discharge. The amonitoring is started according to the about one year before the schedularge. The amonitoring is started according to the about one year before the schedularge. The amonitoring is started according to the about one year before the schedularge. The amonitoring is started according to the about one year before the schedularge.	g, stop discharge scharge, confirm he plan enhanced date to start re enhanced.	Appropriate description
	 The measure sampled amo The radioactive is announced. 	ment and assessment rocu ment sample continued t unt of fish and seaweeds a ity measurement result at nalysis, announcement, et	o be seawater but the time of dischart		- The range of the	neasurement and assessment focusing measurement sample continued to be led amount of fish and seaweeds are indicactivity measurement result at the nunced. -party analysis, announcement, etc., and	seawater but the creased. time of discharge	
on the environment for with the same ratio to reconsideration of management of Hypothe management values. If of analysis in the measure to secondary treatment.	eight nuclides with relative egulatory concentration lime ement values is shown in ical ALPS Treated Water." he concentration of any of rement/confirmation facility These eight nuclides will be which will be conducted p		due to concentration in harge of ALPS treated anagement Values and es subject to management value the management value shall not be discharged with the review result of	r. The of ALPS treate of all the result ubject	environment for nuclides w	ge amount of radioactivity are set for further ith relative impacts of human exposure as m	r reduction of the impact of anagement before discharge	Appropriate description due to the selection of nuclides to be measured and assessed
<u>Target n</u>	Regulatory	Operation mit management value (Bq/L)	Ratio to regulatory concentration limit					
<u>C-1</u>	4 2.0E+03	5.0E+02	2.5E-01					
Fe-5	9 <u>4.0E+02</u>	<u>2.0E-01</u>	<u>5.0E-04</u>					
<u>Ag-11</u>	<u>0m</u> <u>3.0E+02</u>	6.0E-02	<u>2.0E-04</u>					
<u>Cd-11</u>	<u>3m</u> <u>4.0E+01</u>	2.0E-01	5.0E-03					
<u>Cd-11</u>	<u>3.0E+02</u>	4.0E+00	1.3E-02					
<u>Sn-11</u>	9m <u>2.0E+03</u>	<u>6.0E+01</u>	3.0E-02					
<u>Sn-1</u>	<u>4.0E+02</u>	8.0E+00	2.0E-02					
O., 1	26 2.0E+02	4.0E-01	2.0E-03					

Current	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2) Revised	Reason for Revision
5-3. Facilities for discharge "TEPCO's Action in response to Government's Policy" shows a conceptual diagram of the facilities for discharging into the sea (Figure 5-3-1), but the assessment was performed reflecting the state of consideration of the facilities for discharge shown below by the following design clarification.	into the sea (Figure 5-3-1). Subsequent to that, the design of the facilities was concretized, and thereafter finalized through the IAEA review and NRA review meetings. The assessment was performed reflecting the status of	Appropriate description for change of the date
	consideration of the facilities for discharge shown below. For more details on the discharge facilities see "Application for amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility" [17].	Enhancement of description
(Omission)	(Omission)	

Current	Revised	Reason for Revision
5-3-2. Measurement/confirmation facility For the measurement/confirmation facility, we will use 30 out of 35 tanks installed in the K4 tank areas in the center of the site 33.5 m above sea level near ALPS. To sample and analyze homogenized water, use 10 tanks, whose total capacity is about 10,000 m³, as 1 group, and install a stirring device in each tank and a circulation device in each tank group. Since we have to deal with three purposes, namely receiving, measurement/confirmation, and discharge, set up three tanks groups and operate them on a rotation basis.	5-3-2. Measurement/confirmation facility For the measurement/confirmation facility, we will use 30 out of 35 tanks, each of which has a capacity of 1,000m³, installed in the K4 tank areas in the center of the site 33.5 m above sea level near ALPS. To sample and analyze homogenized water, use 10 tanks, whose nominal total capacity is about 10,000 m³, as 1 group, and install total 30 units of a stirring device in each tank and a circulation device with two circulation pumps of which the capacity is 160m³/h for each pump in each tank group. In principle, setting aside time more than the required time for two rounds of water flow of measurement/confirmation tank for operation time (this is not an option when enough circulation/agitation is confirmed by examination, even after the service started). Since we have to deal with three purposes, namely receiving, measurement/confirmation, and discharge, set up three tanks groups and operate them on a rotation basis.	Appropriate description for change of the date and enhancement of description
(Omission)	(Omission)	
(Not currently listed)	In the discharge process, the tritium concentration of ALPS treated water is registered in monitoring/control device, and ALPS treated water transfer flow rate is set within the maximum 500m³/day (minimum flow rate (annual average) is equal to or greater than the volume of contaminated water generated) so that the tritium concentration contained in the released water is less than 1,500Bq/L which is the upper limit of the operation. To prevent human error, the tritium concentration confirmed in the process of measurement/confirmation should be mechanically read by a scanner and registered in monitoring/control device. Monitoring/control device automatically calculates ALPS treated water transfer flow rate from the registered tritium concentration and seawater flow rate.	
5-3-3. Transfer facility The transfer facility is mainly composed of ALPS treated water transfer pump and transfer piping, etc. In the transfer facility, the ALPS treated water transfer pump consists of two units, namely operating unit and spare unit, and is installed in the ALPS transfer facility building near the measurement/confirmation facility to transfer ALPS treated water from the tanks of the measurement/confirmation facility 33.5 m above sea level to the dilution facility. Install a radiation detector to detect gamma rays for emergency isolation in the building in order to prevent water from being discharged without sufficient purification. In the transfer facility, the transfer piping is installed to connect the measurement/confirmation facility 33.5 m above sea level to the seawater piping 2.5 m above sea level. Install an emergency isolation valve in two points in the transfer piping to enable to stop transfer of ALPS treated water in the event of an abnormality. One point is set before the injection part of the seawater piping in order to minimize the discharge amount of ALPS treated water in the event of an abnormality. The other point is set in the ALPS electrical equipment room set up inside the seawall to be newly constructed 11.5m above sea level in preparation for cases that the former emergency isolation valve does not work due to water immersion, etc., caused by the expected Japan Trench tsunami. In the same room, a flowmeter to measure the flow rate of ALPS treated water to be transferred to the seawater pipe header and the flow rate adjustment valve to adjust the flow rate as specified are installed.	installed in the ALPS transfer facility building near the measurement/confirmation facility to transfer ALPS treated water from the tanks of the measurement/confirmation facility 33.5 m above sea level to the dilution facility. Install a radiation detector (scintillation detectors) to detect gamma rays for emergency isolation in the building in order to prevent water from being discharged without sufficient purification. In the transfer facility, the transfer piping is installed to connect the measurement/confirmation facility 33.5 m above	
(Omission)	(Omission)	
5-3-4. Dilution facility	5-3-4. Dilution facility	
(Omission)	(Omission)	
The dilution facility is installed in a location 2.5 m above sea level in the sea side of Units 5/6. A flowmeter is installed in the seawater transfer piping to ensure that the tritium concentration is less than 1,500Bq/L by dilution with a high volume of water (100 or more times). For the seawater transfer pump, the intake channel for the existing Unit 5 circulation water pump is reused. Conservatively, three pumps are installed. The capacity of the seawater transfer pump shall be about 170,000 m³/day/unit, at which the flowrate of the seawater transfer pump can be measured, in order to enable sufficient dilution with seawater. Figure 5-3-5 shows the schematic diagram of the dilution facility.	The dilution facility is installed in a location 2.5 m above sea level in the sea side of Units 5/6. A flowmeter is installed in the seawater transfer piping to ensure that the tritium concentration is less than 1,500Bq/L by dilution with a high volume of water (100 or more times). For the seawater transfer pump, the intake channel for the existing Unit 5 circulation water pump is reused. Conservatively, three pumps (one pump out of three is for spare) are installed. The capacity of the seawater transfer pump shall be about 7,086 m³/h/unit, at which the flowrate of the seawater transfer pump can be measured, in order to enable sufficient dilution with seawater. And no flowrate adjustment is performed. Figure 5-3-5 shows the schematic diagram of the dilution facility.	
(Omission)	(Omission)	

25

Current	Revised	Reason for Revision
6. Assessment of protection of humans (general public) 6-1. Exposure assessment under normal conditions	6. Assessment of protection of humans (general public) 6-1. Exposure assessment under normal conditions	
(Omission)	(Omission)	
6-1-2. Assessment method (1) Source term (annual discharge amount of each nuclide) The target nuclides of the <u>radioactive</u> impact assessment related to discharge into the sea of ALPS treated water <u>are a total of</u> 64 nuclides: <u>tritium, C-14, and</u> 62 nuclides subject to removal by ALPS (<u>Table 5-1-1</u>). In "TEPCO's Action in response to Government's Policy," the upper limit of the annual discharge amount of tritium is set to 22 TBq (2.2E+13Bq), which is the discharge control value of the FDNPS before the accident, for the time being.	6-1-2. Assessment method (1) Source term (annual discharge amount of each nuclide) As shown in 5-1, the target nuclides of the radiological environmental impact assessment related to discharge into the sea of ALPS treated water were 64 nuclides: 62 nuclides subject to removal by ALPS, tritium and C-14. However, TEPCO performs the radioactive environmental impact assessment with 31 nuclides, as target nuclides for dose assessment, which include tritium and 30 selected nuclides as nuclides to be measured and assessed (Table 5-1-2) in response to findings pointed by the NRA and the IAEA. In "TEPCO's Action in response to Government's Policy," the upper limit of the annual discharge amount of tritium is set to 22 TBq (2.2E+13Bq), which is the discharge control value of the FDNPS before the accident, for inthe time	Appropriate description due to the selection of nuclides to be measured and assessed
The discharge amount of 63 nuclides other than tritium is calculated by the product of the composition of nuclides in ALPS treated water (concentration of each nuclide) and the annual discharge volume of water. Though the composition of nuclides in ALPS treated water varies among tank groups, it is to be set using the compositions of nuclides of three tank groups at this time, namely K4, J1-C, and J1-G, of which the analysis results of all of the 64 nuclides are available.	being. The discharge amount of <u>30</u> nuclides other than tritium is calculated by the product of the composition of nuclides in ALPS treated water (concentration of each nuclide) and the annual discharge volume of water. Though the composition of nuclides in ALPS treated water varies among tank groups, <u>TEPCO continues to use</u> the compositions of nuclides of three tank groups namely K4, J1-C, and J1-G, of which the analysis results of all of the 64 nuclides, <u>previously designated as target nuclides for dose assessment</u> , are available. <u>Although Se-79</u> , which is newly selected as nuclides to be measured and assessed and it has not been subject to analysis of 64 nuclides in each of three tank groups-to date, was not detected in the additional measurement carried out for this nuclide's selection process, its concentration at the outlet of ALPS (detection limit value) will be used in common for all three tank groups. For U-238 and Np-237 of alpha nuclides, the results of analysis on gross alpha were used, as before.	
i.K4 tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.29) ii.J1-C tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.35) iii.J1-G tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.22)	i.K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28) ii.J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23) iii.J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)	
(Omission)	(Omission)	
On the other hands, abundance of some nuclides may be sufficiently small at present due to enough decay, because of using inventory data of one year after the earthquake to select 62 nuclides for removal targets by ALPS. In light of the above circumstances, for discharging ALPS treated water into the sea, the selection of target nuclides for measurement will be carried out after thorough verification once again, in which case this assessment will be revised. New target nuclides may be added, but the revision of the target nuclides for measurement is expected to have almost no impact on the exposure assessment, because it was verified that the sum of the measured radioactive concentration of 7 major nuclides, Te-99 and C-14 of ALPS treated water is not differ from the measured gross beta as to suspect the existence of nuclides other than the current 64 nuclides, and because the nuclides to be added as targets for measurement are expected to have only a small impact on the human body due to low-energy radiation.	(Deleted)	



16

Comparison Table of amendments in the I	nplementation Plan for Fukushima Daiichi Nuclear Power Station as S	Specified Nuclear Facility (Reference, Attachment-2)
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Comparison Table of amendments in the Implementation Plan for F	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Current	Revised	Reason for Revision
(Omission) On the other hand, the tritium concentration of stored ALPS treated water, etc., varies as shown in Figure 6-1-3, so the assumed annual discharge volume of treated water depends on the concentration of tritium contained in ALPS treated water to be discharged. The annual discharge volume of water is in inverse proportion to the tritium concentration; the lower the tritium concentration is, the greater the annual discharge amount of 63 nuclides other than tritium becomes. The relationships are as shown in the following equation.	On the other hand, the tritium concentration of stored ALPS treated water, etc., varies as shown in Figure 6-1-3, so the assumed annual discharge volume of treated water depends on the concentration of tritium contained in ALPS treated water to be discharged. The annual discharge volume of water is in inverse proportion to the tritium concentration; the lower the tritium concentration is, the greater the annual discharge amount of 30 nuclides other than tritium becomes. The relationships are as shown in the following equation.	Appropriate description due to the selection of nuclides to be measured and assessed
than tritium becomes. The relationships are as shown in the following equation. (Omission) (1) The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq). (2) The annual discharge amount of each nuclide is calculated from (1) and the tritium concentration. (3) The annual discharge amount of each nuclide is calculated from the concentration of 63 nuclides and the product of the annual discharge amount calculated in (2). Some of the nuclides below the detection limit value have short half-lives or have already decayed because more than 11 years have clapsed since the accident, but conservatively they are assumed to exist at the detection limit. (Omission)	(Omission) (1) The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq). (2) The annual discharge volume of water is calculated from (1) and the tritium concentration. (3) The annual discharge amount of each nuclide is calculated from the concentration of 31 nuclides and the product of the annual discharge amount calculated in (2). Some of the nuclides below the detection limit value may not actually be present, but conservatively they are assumed to exist at the detection limit. (Omission)	

			Current					Revised		Reason for Revision
Table 6-1-1 Source term based on the nuclide composition of measured values					Table 6-1-1 Source term based on the nuclide composition of measured values					
			(annual discharg					(annual discharg		
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks	
H-3	1.9E+05	1.2E+08	2.2E+13	• For the annual discharge amount of	H-3	1.9E+05	1.2E+08	2.2E+13	• For the annual discharge amount of	
C-14	1.5E+01		1.7E+09	tritium, the upper limit value of the annual discharge amount is used	C-14	1.5E+01		1.7E+09	tritium, the upper limit value of the annual discharge amount is used	
Mn-54	6.7E-03		7.8E+05	• Dilute with seawater 100 or more	Mn-54	6.7E-03	_	7.8E+05	• Dilute with seawater 100 or more	Appropriate description due to the
<u>Fe-59</u>	<u>1.7E-02</u>		2.0E+06	times before discharge so that the tritium concentration becomes less	Co-60	4.4E-01	-	5.1E+07	times before discharge so that the tritium concentration becomes less	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	<u>8.0E-03</u>		9.3E+05	than 1,500Bq/L	Ni-63	2.2E+00	-	2.5E+08	than 1,500Bq/L	measured and assessed
Co-60	4.4E-01		5.1E+07		<u>Se-79</u>	<u>1.5E+00</u>		<u>1.7E+08</u>		
Ni-63	2.2E+00		2.5E+08		Sr-90	2.2E-01	-	2.5E+07		
<u>Zn-65</u>	<u>1.5E-02</u>		<u>1.7E+06</u>		Y-90	2.2E-01		2.5E+07		
<u>Rb-86</u>	<u>1.9E-01</u>		<u>2.2E+07</u>		Tc-99	7.0E-01	-	8.1E+07		
<u>Sr-89</u>	<u>1.0E-01</u>		1.2E+07		Ru-106	1.6E+00	-	1.9E+08		
Sr-90	2.2E-01		2.5E+07		Cd-113m	1.8E-02	-	2.1E+06		
Y-90	2.2E-01		2.5E+07		Sb-125	3.3E-01	_	3.8E+07		
<u>Y-91</u>	2.2E+00		2.5E+08		Te-125m	3.3E-01		3.8E+07		
<u>Nb-95</u>	<u>1.0E-02</u>		<u>1.2E+06</u>		I-129	2.1E+00		2.4E+08		
Tc-99	7.0E-01		8.1E+07		Cs-134	4.5E-02		5.2E+06		
<u>Ru-103</u>	<u>1.0E-02</u>		<u>1.2E+06</u>		Cs-137	4.2E-01		4.9E+07		
Ru-106	1.6E+00		1.9E+08		Ce-144	6.3E-02		7.3E+06		
<u>Rh-103m</u>	<u>1.0E-02</u>		<u>1.2E+06</u>		Pm-147	1.9E-01		2.2E+07		
<u>Rh-106</u>	<u>1.6E+00</u>		<u>1.9E+08</u>		Sm-151	9.0E-04		1.0E+05		
<u>Ag-110m</u>	<u>5.6E-03</u>		<u>6.5E+05</u>		Eu-154	1.2E-02		1.4E+06		
Cd-113m	1.8E-02		2.1E+06		Eu-155	3.3E-02		3.8E+06		
<u>Cd-115m</u>	<u>6.4E-01</u>		7.4E+07		<u>U-234</u>	<u>6.3E-04</u>		<u>7.3E+04</u>		
<u>Sn-119m</u>	<u>1.7E-01</u>		2.0E+07		<u>U-238</u>	<u>6.3E-04</u>		<u>7.3E+04</u>		
<u>Sn-123</u>	<u>1.2E+00</u>		<u>1.4E+08</u>		<u>Np-237</u>	<u>6.3E-04</u>		<u>7.3E+04</u>		
<u>Sn-126</u>	<u>2.7E-02</u>		3.1E+06		Pu-238	6.3E-04		7.3E+04		
<u>Sb-124</u>	<u>9.5E-03</u>		<u>1.1E+06</u>		Pu-239	6.3E-04		7.3E+04		
Sb-125	3.3E-01		3.8E+07		Pu-240	6.3E-04		7.3E+04		
Te-123m	9.2E-03		1.1E+06		Pu-241	2.8E-02		3.2E+06		
Te-125m	3.3E-01		3.8E+07		Am-241	6.3E-04		7.3E+04		
<u>Te-127</u>	<u>3.2E-01</u>		3.7E+07		Cm-243	6.3E-04		7.3E+04		
<u>Te-127m</u>	3.2E-01		3.7E+07		Cm-244	6.3E-04		7.3E+04		
<u>Te-129</u>	<u>8.1E-02</u>		<u>9.4E+06</u>				•			
<u>Te-129m</u>	<u>3.2E-01</u>		3.7E+07							
I-129	2.1E+00		2.4E+08							
Cs-134	4.5E-02		5.2E+06							
<u>Cs-135</u>	<u>2.5E-06</u>		2.9E+02							
<u>Cs-136</u>	<u>3.0E-02</u>		3.5E+06							
Cs-137	4.2E-01		4.9E+07							

Ba-137m 4.2E-01 4.9E+07 Appropriate description of number of selection	Con		Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Bis 40 2.5E.02 2.9E.02 2.9		Current	Revised	Reason for Revision
Ce_141 C_25_0_2 C_29_0_0 Ce_144 G_3E_0_2 7.3E_106 Pe_1444 G_3E_0_2 7.3E_106 Pe_1444 G_3E_0_2 7.3E_106 Pe_1446 O_3E_0_2 7.3E_106 Pe_1447 1.9E_0_1 Pe_148 S_0E_0_1 S_3E_0_2 Pe_148 S_0E_0_1 S_3E_0_2 Pe_148 S_0E_0_1 S_3E_0_2 Pe_148 S_0E_0_1 S_3E_0_2 Pe_154 1.2E_0_2 3.2E_106 Pe_154 1.2E_0_2 3.3E_10_2 Pe_155 3.3E_0_2 3.3E_10_6 Pe_156 3.3E_0_2 3.3E_10_6 Pe_230 S_0E_0_2 3.2E_106 Pe_240 S_0E_0_2 3.2E_106 Pe_240 S_0E_0_2 3.2E_106 Pe_241 S_0E_0_2 3.2E_106 Pe_241 S_0E_0_2 3.2E_106 Pe_241 S_0E_0_2 3.2E_106 Pe_242 S_0E_0_2 3.2E_106 Pe_243 S_0E_0_2 3.2E_106 Pe_244 S_0E_0_2 3.2E_106 Pe_245 S_0E_0_2 3.2E_106 Pe_246 S_0E_0_2 7.3E_104 Pe_247 S_0E_0_2 3.2E_106 Pe_248 S_0E_0_2 7.3E_104 Pe_249 S_0E_0_2 3.2E_106 Pe_240 S_0E_0_2 7.3E_104 Pe_241 S_0E_0_2 3.2E_106 Pe_242 S_0E_0_2 7.3E_104 Am_242 3.9E_0_5 4.5E_103 Am_243 S_0E_0_4 7.3E_104 Am_245 S_0E_0_4 7.3E_104 Am_246 S_0E_0_4 7.3E_104 Am_247 S_0E_0_4 7.3E_104 Am_248 S_0E_0_4 7.3E_104 Am_248 S_0E_0_4 7.3E_104 Am				Appropriate description due to the selection of nuclides to be
Ce-141 2.5E-02 2.9E-06 Ce-144 6.3E-02 7.3E-06 Pr-144 6.3E-02 7.3E-06 Pm-146 9.8E-02 7.3E-06 Pm-147 1.9E-01 2.2E-07 Pm-148 5.0E-01 5.8E-07 Pm-148m 8.4E-03 9.7E-05 Sm-151 9.0E-04 1.0E-05 Eu-152 2.8E-02 3.2E-06 Eu-153 3.2E-06 1.4E-06 Fu-153 3.2E-02 3.2E-06 Fu-153 3.2E-02 3.2E-06 Fu-150 2.8E-02 3.2E-06 Pu-238 6.3E-04 7.3E-04 Pu-241 2.8E-04 7.3E-04 Pu-241 6.3E-04 7.3E-04 Am-241 6.3E-04 7.3E-04 Am-243 6.3E-04 7.3E-04 Am-243 6.3E-04 7.3E-04 Cm-243 6.3E-04 7.3E-04 Cm-243 6.3E-04 7.3E-04	<u>Ba-140</u> <u>9.5E-02</u>	<u>1.1E+07</u>		measured and assessed
Pr.144 6.3F02 7.3F.06 Pr.144m 6.3F02 7.3F.06 Pm.147 1.9F.01 2.2F.07 Pm.148 5.0E-01 5.8E-02 Pm.148m 8.0E-01 5.8E-03 Pm.148m 9.0F.04 1.0Fr.05 Sm.151 9.0F.04 1.0Fr.05 Sm.151 2.8F.02 3.2Fr.06 Eu-154 1.2E-02 3.2Fr.06 Eu-155 3.3E-02 3.7Fr.06 Gd-153 3.2F-02 3.7Fr.06 Tb-160 2.8E-02 3.2E+106 Pu-238 6.3E-04 7.3Fr.04 Pu-240 6.3E-04 7.3Fr.04 Pu-241 2.8F-02 3.2E+06 Am-241 6.3F-04 7.3Fr.04 Am-242m 3.9F-05 4.5Fr.03 Am-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	<u>Ce-141</u> <u>2.5E-02</u>	<u>2.9E+06</u>		
Pr. 144m 6.3E-02 2.3E+06 Pm-146 9.8E-02 1.1E+07 Pm-147 1.9E-01 2.2E+07 Pm-148m 5.0E-01 5.8E+07 Pm-148m 8.4E-03 9.7E+05 San-151 9.0E-04 1.0E+05 Eu-152 2.8E+02 3.2E+06 Fu-154 1.2E-02 1.4E+06 Eu-155 3.3E+02 3.8E+06 Gu-153 3.2E-02 3.7E+06 Tb-160 2.8E+02 3.2E+06 Pu-238 6.3E-04 7.3E+04 Pu-239 6.3E-04 7.3E+04 Pu-241 2.8E+02 3.2E+06 Am-241 6.3E-04 7.3E+04 Am-241 6.3E-04 7.3E+04 Am-242 3.0E-05 4.5E+03 Am-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	Ce-144 6.3E-02	7.3E+06		
Pm-146 9.8E-02 1.1E+07 Pm-147 1.9E-01 2.2E+07 Pm-148 5.0E-01 5.8E+07 Pm-148m 8.4E-03 9.7E+05 Sm-151 9.0E-04 1.0E+05 bu-152 2.8E-02 3.2E+06 Eu-155 3.3E-06 1.4E+06 Eu-155 3.3E+06 3.2E+06 Gd-153 3.2E+02 3.7E+06 Tb-160 2.8E-02 3.2E+06 Pu-238 6.3E-04 7.3E+04 Pu-249 6.3E-04 7.3E+04 Pu-240 6.3E-04 7.3E+04 Pu-241 2.8E-02 3.2E+06 Am-241 6.3E-04 7.3E+04 Am-242 3.9E-05 4.5E+03 Am-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	<u>Pr-144</u> <u>6.3E-02</u>	<u>7.3E+06</u>		
Pm-147 1.9E-01 2.2E+07 Pm-148 5.0E-01 5.8E+07 Pm-148m 8.4E-03 9.7E+05 Sm-151 9.0E-04 1.0F+05 Eu-152 2.8E-02 3.2E+06 Eu-154 1.2E-02 1.4E+06 Eu-155 3.3E-02 3.7E+06 Ge-153 3.2E-02 3.7E+06 To-160 2.8E-02 3.2E+06 Pu-238 6.3E-04 7.3E+04 Pu-240 6.3E-04 7.3E+04 Pu-241 2.8E-02 3.2E+06 Am-241 6.3E-04 7.3E+04 Am-242 3.9E-05 4.5E+03 Am-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	<u>Pr-144m</u> <u>6.3E-02</u>	<u>7.3E+06</u>		
Pm-148 5.0E-01 Pm-148m 8.4E-03 Sm-151 9.0E-04 Eu-152 2.8E-02 Eu-155 3.3E-02 Eu-155 3.3E-02 Gd-153 3.2E-02 Th-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-243 6.3E-04 Cm-243 6.3E-04 Cm-245 6.3E-04 Cm-246 7.3E-04	<u>Pm-146</u> <u>9.8E-02</u>	<u>1.1E+07</u>		
Pm:148m 8.4E-03 9.7E+05 Sm:151 9.0F-04 1.0E+05 Eu:152 2.8E-02 3.2E+06 Eu:155 3.3E-02 1.4E+06 Eu:155 3.3E-02 3.8E+06 Gd-153 3.2E-02 3.7E+06 Tb-160 2.8E-02 3.2E+06 Pu-238 6.3E-04 7.3E+04 Pu-239 6.3E-04 7.3E+04 Pu-241 2.8E-02 3.2E+06 Am-241 6.3E-04 7.3E+04 Pu-243 6.3E-04 7.3E+04 Am-243 6.3E-04 7.3E+04 Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	Pm-147 1.9E-01	2.2E+07		
Sm-151 9.0E-04 Eu-152 2.8E-02 Eu-154 1.2E-02 Eu-155 3.3E-02 Gd-153 3.2E-02 Tb-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-24m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-245 6.3E-04 Cm-246 7.3E+04	<u>Pm-148</u> <u>5.0E-01</u>	<u>5.8E+07</u>		
Eu-152 2.8E-02 Eu-154 1.2E-02 Eu-155 3.3E-02 Gd-153 3.2E-02 Tb-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 T,3E+04 T,3E+04		<u>9.7E+05</u>		
Eu-154 1.2E-02 Eu-155 3.3E-02 Gd-153 3.2E-02 Tb-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04				
Eu-155 3.3E-02 Gd-153 3.2E-02 Tb-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-243 6.3E-04 T.3E+04 7.3E+04				
Gd-153 3.2E-02 3.7E+06 Tb-160 2.8E-02 3.2E+06 Pu-238 6.3E-04 7.3E+04 Pu-239 6.3E-04 7.3E+04 Pu-240 6.3E-04 7.3E+04 Pu-241 2.8E-02 3.2E+06 Am-241 6.3E-04 7.3E+04 Am-242m 3.9E-05 4.5E+03 Am-243 6.3E-04 7.3E+04 Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04				
Tb-160 2.8E-02 Pu-238 6.3E-04 Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-243 6.3E-04 7.3E+04	Eu-155 3.3E-02	3.8E+06		
Pu-238 6.3E-04 7.3E+04 Pu-239 6.3E-04 7.3E+04 Pu-240 6.3E-04 7.3E+04 Pu-241 2.8E-02 3.2E+06 Am-241 6.3E-04 7.3E+04 Am-242m 3.9E-05 4.5E+03 Am-243 6.3E-04 7.3E+04 Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04				
Pu-239 6.3E-04 Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-243 6.3E-04 7.3E+04 7.3E+04 7.3E+04				
Pu-240 6.3E-04 Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-243 6.3E-04 7.3E+04 7.3E+04	Pu-238 6.3E-04	7.3E+04		
Pu-241 2.8E-02 Am-241 6.3E-04 Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 7.3E+04 7.3E+04	Pu-239 6.3E-04	7.3E+04		
Am-241 6.3E-04 7.3E+04 Am-242m 3.9E-05 4.5E+03 Am-243 6.3E-04 7.3E+04 Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	Pu-240 6.3E-04	7.3E+04		
Am-242m 3.9E-05 Am-243 6.3E-04 Cm-242 6.3E-04 Cm-243 6.3E-04 Cm-244 7.3E+04 7.3E+04	Pu-241 2.8E-02	3.2E+06		
Am-243 6.3E-04 7.3E+04 Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	Am-241 6.3E-04	7.3E+04		
Cm-242 6.3E-04 7.3E+04 Cm-243 6.3E-04 7.3E+04	<u>Am-242m</u> 3.9E-05	<u>4.5E+03</u>		
Cm-243 6.3E-04 7.3E+04	<u>Am-243</u> <u>6.3E-04</u>	<u>7.3E+04</u>		
	<u>Cm-242</u> <u>6.3E-04</u>	<u>7.3E+04</u>		
Cm-244 6.3E-04 7.3E+04	Cm-243 6.3E-04	7.3E+04		
	Cm-244 6.3E-04	7.3E+04		

			Current					Revised		Reason for Revision
Table	Table 6-1-2 Source term based on the nuclide composition of measured values (J1-C tank group) (annual discharge amount)					Table 6-1-2 Source term based on the nuclide composition of measured values (J1-C tank group) (annual discharge amount)				
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	ge amount) Remarks	Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks	
H-3	8.2E+05	2.7E+07	2.2E+13	For the annual discharge amount of	H-3	8.2E+05	2.7E+07	2.2E+13	For the annual discharge amount of	
C-14	1.8E+01		4.8E+08	tritium, the upper limit value of the annual discharge amount is used	C-14	1.8E+01		4.8E+08	tritium, the upper limit value of the annual discharge amount is used	
Mn-54	3.8E-02		1.0E+06	• Dilute with seawater 100 or more	Mn-54	3.8E-02		1.0E+06	• Dilute with seawater 100 or more	
<u>Fe-59</u>	<u>8.7E-02</u>	-	2.3E+06	times before discharge so that the	Co-60	3.3E-01]	8.9E+06	times before discharge so that the	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	<u>4.1E-02</u>		<u>1.1E+06</u>	tritium concentration becomes less than 1,500Bq/L	Ni-63	8.5E+00]	2.3E+08	tritium concentration becomes less than 1,500Bq/L	measured and assessed
Co-60	3.3E-01		8.9E+06	•	<u>Se-79</u>	1.5E+00		4.0E+07		
Ni-63	8.5E+00		2.3E+08		Sr-90	3.6E-02		9.7E+05		
<u>Zn-65</u>	<u>9.4E-02</u>		<u>2.5E+06</u>		Y-90	3.6E-02		9.7E+05		
<u>Rb-86</u>	<u>5.0E-01</u>		1.3E+07		Tc-99	1.2E+00		3.2E+07		
<u>Sr-89</u>	<u>5.4E-02</u>		<u>1.4E+06</u>		Ru-106	1.4E+00		3.8E+07		
Sr-90	3.6E-02		9.7E+05		Cd-113m	8.5E-02		2.3E+06		
Y-90	3.6E-02		9.7E+05		Sb-125	2.3E-01]	6.2E+06		
<u>Y-91</u>	1.7E+01		4.6E+08		Te-125m	2.3E-01]	6.2E+06		
<u>Nb-95</u>	<u>5.0E-02</u>		1.3E+06		I-129	1.2E+00	1	3.2E+07		
Tc-99	1.2E+00		3.2E+07		Cs-134	7.6E-02]	2.0E+06		
<u>Ru-103</u>	<u>5.3E-02</u>		<u>1.4E+06</u>		Cs-137	1.9E-01		5.1E+06		
Ru-106	1.4E+00		3.8E+07		Ce-144	5.7E-01	1	1.5E+07		
<u>Rh-103m</u>	<u>5.3E-02</u>		<u>1.4E+06</u>		Pm-147	8.0E-01	1	2.1E+07		
<u>Rh-106</u>	<u>1.4E+00</u>		3.8E+07		Sm-151	1.1E-02	1	3.0E+05		
<u>Ag-110m</u>	4.3E-02		<u>1.2E+06</u>		Eu-154	1.1E-01	1	3.0E+06		
Cd-113m	8.5E-02		2.3E+06		Eu-155	3.4E-01	1	9.1E+06		
<u>Cd-115m</u>	2.7E+00		<u>7.2E+07</u>		<u>U-234</u>	3.3E-02	1	8.9E+05		
<u>Sn-119m</u>	<u>4.2E+01</u>		<u>1.1E+09</u>		<u>U-238</u>	3.3E-02	1	8.9E+05		
<u>Sn-123</u>	<u>6.6E+00</u>		1.8E+08		<u>Np-237</u>	3.3E-02	1	8.9E+05		
<u>Sn-126</u>	<u>2.9E-01</u>		<u>7.8E+06</u>		Pu-238	3.3E-02	1	8.9E+05		
<u>Sb-124</u>	<u>9.7E-02</u>		2.6E+06		Pu-239	3.3E-02	1	8.9E+05		
Sb-125	2.3E-01		6.2E+06		Pu-240	3.3E-02	1	8.9E+05		
Te-123m	9.2E-02		2.5E+06		Pu-241	1.2E+00	1	3.2E+07		
Te-125m	2.3E-01	-	6.2E+06		Am-241	3.3E-02	1	8.9E+05		
<u>Te-127</u>	<u>4.7E+00</u>	-	1.3E+08		Cm-243	3.3E-02	1	8.9E+05		
<u>Te-127m</u>	<u>4.9E+00</u>	1	1.3E+08		Cm-244	3.3E-02	1	8.9E+05		
<u>Te-129</u>	<u>6.2E-01</u>	1	1.7E+07			0.02.02	ı	0.52 00		
<u>Te-129m</u>	1.4E+00	1	3.8E+07							
I-129	1.2E+00	1	3.2E+07							
Cs-134	7.6E-02	1	2.0E+06							
<u>Cs-135</u>	1.2E-06		3.2E+01							
<u>Cs-136</u>	4.7E-02		1.3E+06							
Cs-137	1.9E-01		5.1E+06							

	Current	n Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Revised	Reason for Revision
<u>Ba-137m</u> <u>1.9E-01</u>	<u>5.1E+06</u>		Appropriate description due to the
<u>Ba-140</u> <u>2.0E-01</u>	<u>5.4E+06</u>		selection of nuclides to be measured and assessed
<u>Ce-141</u> <u>2.6E-01</u>	7.0E+06		medicated and discussed
Ce-144 5.7E-01	1.5E+07		l
<u>Pr-144</u> <u>5.7E-01</u>	<u>1.5E+07</u>		
<u>Pr-144m</u> <u>5.7E-01</u>	<u>1.5E+07</u>		
<u>Pm-146</u> <u>6.7E-02</u>	<u>1.8E+06</u>		
Pm-147 8.0E-01	2.1E+07		
<u>Pm-148</u> <u>2.3E-01</u>	<u>6.2E+06</u>		
<u>Pm-148m</u> <u>4.8E-02</u>	<u>1.3E+06</u>		
Sm-151 1.1E-02	3.0E+05		
<u>Eu-152</u> <u>2.8E-01</u>	<u>7.5E+06</u>		
Eu-154 1.1E-01	3.0E+06		
Eu-155 3.4E-01	9.1E+06		
Gd-153 2.6E-01	7.0E+06		
<u>Tb-160</u> <u>1.4E-01</u>	3.8E+06		
Pu-238 3.3E-02 Pu-239 3.3E-02	8.9E+05		
0.02 12	8.9E+05		
0.02 12	8.9E+05		
1.22 00	3.2E+07		
0.02 12	8.9E+05		
Am-242m 5.9E-04 Am-243 3.3E-02	1.6E+04 8.9E+05		
<u>Cm-242</u> 3.3E-02	8.9E+05 8.9E+05		
Cm-243 3.3E-02	8.9E+05		
Cm-244 3.3E-02	8.9E+05		
3.3E-02	6.9E+03		

			Current					Revised		Reason for Revision
Table 6-1-3 Source term based on the nuclide composition of measured values					Table 6-1-3 Source term based on the nuclide composition of measured values					
			(annual discharg					(annual dischar		
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks	
H-3	2.7E+05	8.1E+07	2.2E+13	For the annual discharge amount of	H-3	2.7E+05	8.1E+07	2.2E+13	For the annual discharge amount	
C-14	1.6E+01		1.3E+09	tritium, the upper limit value of the annual discharge amount is used	C-14	1.6E+01		1.3E+09	of tritium, the upper limit value of the annual discharge amount is used	
Mn-54	3.8E-02		3.1E+06	• Dilute with seawater 100 or more	Mn-54	3.8E-02		3.1E+06	• Dilute with seawater 100 or more	
<u>Fe-59</u>	<u>7.2E-02</u>		5.9E+06	times before discharge so that the tritium concentration becomes less	Co-60	2.3E-01		1.9E+07	times before discharge so that the tritium concentration becomes less	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	3.7E-02		3.0E+06	than 1,500Bq/L	Ni-63	8.8E+00		7.2E+08	than 1,500Bq/L	measured and assessed
Co-60	2.3E-01		1.9E+07		<u>Se-79</u>	1.5E+00		1.2E+08		
Ni-63	8.8E+00		7.2E+08		Sr-90	3.2E-02		2.6E+06		
<u>Zn-65</u>	8.0E-02		6.5E+06		Y-90	3.2E-02		2.6E+06		
<u>Rb-86</u>	<u>4.7E-01</u>		3.8E+07		Тс-99	1.3E+00		1.1E+08		
<u>Sr-89</u>	4.5E-02		3.7E+06		Ru-106	4.8E-01		3.9E+07		
Sr-90	3.2E-02		2.6E+06		Cd-113m	8.6E-02		7.0E+06		
Y-90	3.2E-02		2.6E+06		Sb-125	1.4E-01		1.1E+07		
<u>Y-91</u>	<u>1.2E+01</u>		9.8E+08		Te-125m	1.4E-01		1.1E+07		
<u>Nb-95</u>	<u>4.7E-02</u>		3.8E+06		I-129	3.3E-01		2.7E+07		
Tc-99	1.3E+00		1.1E+08		Cs-134	6.7E-02		5.5E+06		
<u>Ru-103</u>	<u>5.1E-02</u>		<u>4.2E+06</u>		Cs-137	3.3E-01		2.7E+07		
Ru-106	4.8E-01		3.9E+07		Ce-144	5.5E-01		4.5E+07		
<u>Rh-103m</u>	<u>5.1E-02</u>		<u>4.2E+06</u>		Pm-147	7.2E-01		5.9E+07		
<u>Rh-106</u>	<u>4.8E-01</u>		3.9E+07		Sm-151	1.0E-02		8.1E+05		
<u>Ag-110m</u>	<u>4.0E-02</u>		3.3E+06		Eu-154	1.0E-01		8.1E+06		
Cd-113m	8.6E-02		7.0E+06		Eu-155	1.8E-01		1.5E+07		
<u>Cd-115m</u>	2.3E+00		1.9E+08		<u>U-234</u>	<u>2.8E-02</u>		<u>2.3E+06</u>		
<u>Sn-119m</u>	4.0E+01		3.3E+09		<u>U-238</u>	<u>2.8E-02</u>		<u>2.3E+06</u>		
<u>Sn-123</u>	<u>6.3E+00</u>		<u>5.1E+08</u>		<u>Np-237</u>	<u>2.8E-02</u>		<u>2.3E+06</u>		
<u>Sn-126</u>	<u>1.5E-01</u>		1.2E+07		Pu-238	2.8E-02		2.3E+06		
<u>Sb-124</u>	<u>8.4E-02</u>		<u>6.8E+06</u>		Pu-239	2.8E-02		2.3E+06		
Sb-125	1.4E-01		1.1E+07		Pu-240	2.8E-02		2.3E+06		
<u>Te-123m</u>	<u>6.7E-02</u>		<u>5.5E+06</u>		Pu-241	1.0E+00		8.1E+07		
Te-125m	1.4E-01		1.1E+07		Am-241	2.8E-02		2.3E+06		
<u>Te-127</u>	4.3E+00		3.5E+08		Cm-243	2.8E-02		2.3E+06		
<u>Te-127m</u>	4.5E+00		3.7E+08		Cm-244	2.8E-02		2.3E+06		
<u>Te-129</u>	<u>5.9E-01</u>		4.8E+07							
<u>Te-129m</u>	1.2E+00		9.8E+07							
I-129	3.3E-01		2.7E+07							
Cs-134	6.7E-02		5.5E+06							
<u>Cs-135</u>	<u>2.1E-06</u>		<u>1.7E+02</u>							
<u>Cs-136</u>	<u>3.6E-02</u>		<u>2.9E+06</u>							
Cs-137	3.3E-01		2.7E+07							
<u>Ba-137m</u>	3.3E-01		2.7E+07							

	Comparison Table of amendments in the Implementation Plan for Current	Revised	Reason for Revision
<u>Ba-140</u> <u>1.7E-01</u>	1.4E+07		Appropriate description due to the
<u>Ce-141</u> <u>1.2E-01</u>	<u>9.8E+06</u>		selection of nuclides to be
Ce-144 5.5E-01	4.5E+07		measured and assessed
<u>Pr-144</u> <u>5.5E-01</u>	4.5E+07		
<u>Pr-144m</u> <u>5.5E-01</u>	4.5E+07		
<u>Pm-146</u> <u>6.3E-02</u>	<u>5.1E+06</u>		
Pm-147 7.2E-01	5.9E+07		
<u>Pm-148</u> <u>4.5E-01</u>	3.7E+07		
<u>Pm-148m</u> <u>4.1E-02</u>	3.3E+06		
Sm-151 1.0E-02	8.1E+05		
<u>Eu-152</u> <u>1.9E-01</u>	1.5E+07		
Eu-154 1.0E-01	8.1E+06		
Eu-155 1.8E-01	1.5E+07		
<u>Gd-153</u> <u>1.9E-01</u>	<u>1.5E+07</u>		
<u>Tb-160</u> <u>1.4E-01</u>	<u>1.1E+07</u>		
Pu-238 2.8E-02	2.3E+06		
Pu-239 2.8E-02	2.3E+06		
Pu-240 2.8E-02	2.3E+06		
Pu-241 1.0E+00	8.1E+07		
Am-241 2.8E-02	2.3E+06		
<u>Am-242m</u> <u>5.1E-04</u>	<u>4.2E+04</u>		
<u>Am-243</u> <u>2.8E-02</u>	<u>2.3E+06</u>		
<u>Cm-242</u> <u>2.8E-02</u>	<u>2.3E+06</u>		
Cm-243 2.8E-02	2.3E+06		
Cm-244 2.8E-02	2.3E+06		

Comparison Table of amendments in the Im	plementation Plan for Fukushima	Daiichi Nuclear Power Station as S	pecified Nuclear Facility (Reference, Attachment-2)

Current	Revised	Reason for Revision
(2) Modeling of diffusion and transfer after discharge	(2) Modeling of diffusion and transfer after discharge	
(Omission)	(Omission)	
(1) Assessment of advection and diffusion in the sea area	(1) Assessment of advection and diffusion in the sea area	
For the calculation of diffusion of radioactive materials in the sea area, the area sea model "ROMS: Regional Ocean Modeling System" applied to off-shore of Fukushima by Central Research Institute of Electric Power Industry (CRIEPI) is used. This model was verified to have high reproducibility by reproduction calculation of the cesium concentration in the seawater from actual past meteorological and oceanographic data and comparison with actual data for diffusion of cesium leaked into the sea due to the Accident at the FDNPS (Tsumune et al., 2020) [4], and also used in "TEPCO Draft Study Responding to the Subcommittee Report on Handling ALPS Treated Water," [17] which was issued on March 24, 2020. The concentration was calculated from the model of the sea area near the FDNPS at high resolution in order to set the discharge point and the FDNPS port facilities more correctly. It was verified that higher resolution improved the reproducibility of the concentration in the seawater of cesium leaked due to the accident at the FDNPS. Attachment VII "Validity of the diffusion simulation" shows discussion about the validity of diffusion simulation.	For the calculation of diffusion of radioactive materials in the sea area, the area sea model "ROMS: Regional Ocean Modeling System" applied to off-shore of Fukushima by Central Research Institute of Electric Power Industry (CRIEPI) is used. This model was verified to have high reproducibility by reproduction calculation of the cesium concentration in the seawater from actual past meteorological and oceanographic data and comparison with actual data for diffusion of cesium leaked into the sea due to the Accident at the FDNPS (Tsumune et al., 2020) [4], and also used in "TEPCO Draft Study Responding to the Subcommittee Report on Handling ALPS Treated Water," [18] which was issued on March 24, 2020. The concentration was calculated from the model of the sea area near the FDNPS at high resolution in order to set the discharge point and the FDNPS port facilities more correctly. It was verified that higher resolution improved the reproducibility of the concentration in the seawater of cesium leaked due to the accident at the FDNPS. Attachment VII "Validity of the diffusion simulation" shows discussion about the validity of diffusion simulation.	Appropriate description for addition of references
(Omission)	(Omission)	
•For the drive force of the sea surface, we used the result of reanalysis (wind velocity, short wave, long wave, atmospheric pressure, ambient temperature, humidity, and precipitation) with a short-term weather prediction system (Numerical Weather Forecasting and Analysis System (NuWFAS), Hashimoto et al., 2010) [18], which interpolate the short-term weather prediction of the Japan Meteorological Agency (JMA-GSM) using the mesoscale weather model (Weather Research and Forecasting model (WRF), Skamarock, et al, 2008 [19]). The time resolution of the output of NuWFAS is about 1 hour and the horizontal resolution is 5 km, so in the simulation, the result with the time and horizontal direction interpolated was given. •As the original data of the boundary conditions and data assimilation (nudging), we used the results (water temperature, salt content, and sea surface height) of the reanalysis data of tidal currents updated in real-time (Japan Coastal Ocean Prediction Experiment 2 (JCOPE2, Miyazawa et al., 2009) [20].	•For the drive force of the sea surface, we used the result of reanalysis (wind velocity, short wave, long wave, atmospheric pressure, ambient temperature, humidity, and precipitation) with a short-term weather prediction system (Numerical Weather Forecasting and Analysis System (NuWFAS), Hashimoto et al., 2010 [19]), which interpolate the short-term weather prediction of the Japan Meteorological Agency (JMA-GSM) using the mesoscale weather model (Weather Research and Forecasting model (WRF), Skamarock, et al, 2008 [20]). The time resolution of the output of NuWFAS is about 1 hour and the horizontal resolution is 5 km, so in the simulation, the result with the time and horizontal direction interpolated was given. •As the original data of the boundary conditions and data assimilation (nudging), we used the results (water temperature, salt content, and sea surface height) of the reanalysis data of tidal currents updated in real-time (Japan Coastal Ocean Prediction Experiment 2 (JCOPE2, Miyazawa et al., 2009) [21].	
(Omission)	(Omission)	
(3) Setting of exposure pathways	(3) Setting of exposure pathways	
(Omission)	(Omission)	
a. External exposure (1) External exposure from sea surface	a. External exposure (1) External exposure from sea surface	
(Omission)	(Omission)	
For the effective dose conversion factor from the gamma rays from the sea surface, the value in the Handbook for Determining Environmental Impacts of Decommissioning Work [21] (hereinafter called "Decommissioning Handbook") was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-5).	For the effective dose conversion factor from the gamma rays from the sea surface, the value in the Handbook for Determining Environmental Impacts of Decommissioning Work [22] (hereinafter called "Decommissioning Handbook") was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-5).	
(Omission)	(Omission)	
(2) External exposure from hulls	(2) External exposure from hulls	
(Omission)	(Omission)	

Comparison Table of amendments in the Implementation Plan for F	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Current	Revised	Reason for Revision
For the effective dose conversion factor from the gamma rays from radioactive materials adhered to hulls, the value of the Decommissioning Handbook was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-6). The factor of migration to hulls was assumed to be constantly in the equilibrium state with the concentration in the seawater at $100((Bq/m2)/(Bq/L))$ according to "Application for the Designation of Reprocessing Business of Rokkasho Plant" (Japan Nuclear Fuel Service, 1989). [22]	For the effective dose conversion factor from the gamma rays from radioactive materials adhered to hulls, the value of the Decommissioning Handbook was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-6). The factor of migration to hulls was assumed to be constantly in the equilibrium state with the concentration in the seawater at $100((Bq/m2)/(Bq/L))$ according to "Application for the Designation of Reprocessing Business of Rokkasho Plant" (Japan Nuclear Fuel Service, 1989). [23]	Appropriate description for addition of references
(Omission)	(Omission)	
b. Internal exposure	b. Internal exposure	
(Omission)	(Omission)	
Internal exposure from inhalation of seawater spray Internal exposure from inhalation of seawater spray is assessed because seawater spray caused by waves is considered to be inhaled at beaches. The assessment procedure is based on the IAEA-TECDOC-1759 "Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure" [23] (hereinafter called "TECDOC-1759").	Internal exposure from inhalation of seawater spray Internal exposure from inhalation of seawater spray is assessed because seawater spray caused by waves is considered to be inhaled at beaches. The assessment procedure is based on the IAEA-TECDOC-1759 "Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure" [24] (hereinafter called "TECDOC-1759").	
(Omission)	(Omission)	
Rs is the respiration rate, and 0.925 m3/h, 0.363 m3/h, and 0.119 m3/h are used for adult, child under school age, and infant, respectively, according to "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [24].	Rs is the respiration rate, and 0.925 m3/h, 0.363 m3/h, and 0.119 m3/h are used for adult, child under school age, and infant, respectively, according to "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [25].	
(Omission)	(Omission)	
(8) Internal exposure from ingestion of seafood	(8) Internal exposure from ingestion of seafood	
(Omission)	(Omission)	Appropriate description for
For the concentration factor of seafood, the factor specified in IAEA Technical Reports Series No.422 "Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment" [25] (hereinafter called "TRS-422") and UCRL-50564 Rev.1 "CONCENTRATION FACTORS OF CHEMICAL ELEMENTS IN EDIBLE AQUATIC ORGANISMS" [26] (hereinafter called "UCRL-50564 Rev.1") was used (Table 6-1-12).	For the concentration factor of seafood, the factor specified in IAEA Technical Reports Series No.422 "Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment" [26] (hereinafter called "TRS-422") was used (Table 6-1-12).	
(Omission)	(Omission)	

Current				
Table 6-1-5	Dose conversion factor fo	r the effective dose of radiation from the sea sur	face	
	(Decommissioning handbook [21] and others are shown in remarks)			
	Dose conversion factor for			
Nuclide	the effective dose	Remarks		
	((mSv/h)/(Bq/L))			

(D		[21] and others are shown in remarks)
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/L))	Remarks
H-3	0.0E+00	Defined 0 due to pure β nuclide
C-14	0.0E+00	Defined 0 due to pure β nuclide
Mn-54	1.7E-07	
<u>Fe-59</u>	<u>3.2E-11</u>	_
<u>Co-58</u>	<u>2.0E-07</u>	_
Co-60	5.0E-07	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide
<u>Zn-65</u>	<u>1.2E-07</u>	_
<u>Rb-86</u>	5.0E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Sr-89</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
Sr-90	1.6E-09	
Y-90	-	Contained in the parent nuclide Sr-90
<u>Y-91</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Nb-95</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
Tc-99	1.5E-11	
<u>Ru-103</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
Ru-106	4.5E-08	
<u>Rh-103m</u>	Ξ	Contained in the parent nuclide Ru-103
<u>Rh-106</u>	Ξ	Contained in the parent nuclide Ru-106
<u>Ag-110m</u>	<u>5.0E-07</u>	Conservatively set to the same value as that of Co-60
Cd-113m	7.4E-11	
<u>Cd-115m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Sn-119m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Sn-123</u>	5.0E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Sn-126</u>	<u>1.1E-08</u>	_
<u>Sb-124</u>	5.0E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
Sb-125	8.7E-08	
<u>Te-123m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
Te-125m	6.6E-09	
<u>Te-127</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Te-127m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
<u>Te-129</u>	=	Contained in the parent nuclide Te-129m
<u>Te-129m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source

Table 6-1-5 Dose conversion factor for the effective dose of radiation from the sea surface (Decommissioning handbook [22] and others are shown in remarks)

Revised

	Dose conversion factor for	and others are snown in remarks)
Nuclide	the effective dose ((mSv/h)/(Bq/L))	Remarks
H-3	0.0E+00	Defined 0 due to pure β nuclide
C-14	0.0E+00	Defined 0 due to pure β nuclide
Mn-54	1.7E-07	
Co-60	5.0E-07	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide
<u>Se-79</u>	<u>4.8E-12</u>	_
Sr-90	1.6E-09	
Y-90	-	Contained in the parent nuclide Sr-90
Tc-99	1.5E-11	
Ru-106	4.5E-08	
Cd-113m	7.4E-11	
Sb-125	8.7E-08	
Te-125m	6.6E-09	
I-129	4.6E-09	
Cs-134	3.1E-07	
Cs-137	1.2E-07	
Ce-144	1.3E-08	
Pm-147	8.2E-12	
Sm-151	1.7E-12	
Eu-154	2.5E-07	
Eu-155	5.0E-07	Conservatively, the same value as that of Co-60 is se because no value is given to this nuclide in the source
<u>U-234</u>	<u>5.9E-11</u>	_
<u>U-238</u>	<u>5.2E-09</u>	_
<u>Np-237</u>	<u>4.4E-08</u>	
Pu-238	4.7E-11	
Pu-239	2.6E-11	
Pu-240	4.6E-11	
Pu-241	2.9E-08	
Am-241	4.6E-09	
Cm-243	4.4E-08	Conservatively, the same value as that of Am-243 is se because no value is given to this nuclide in the source
Cm-244	4.5E-11	

Appropriate description for addition of references and due to the selection of nuclides to be measured and assessed

Reason for Revision

		Current	Revised	Reason for Revision
I-129	4.6E-09			
Cs-134	3.1E-07			
<u>Cs-135</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		Appropriate description due to the selection of nuclides to be
<u>Cs-136</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		measured and assessed
Cs-137	1.2E-07	ceedade no variae is given to ano naende in the source		
<u>Ba-137m</u>		Contained in the parent nuclide Cs-137		
	5.0E-07	Conservatively, the same value as that of Co-60 is set		
<u>Ba-140</u>	<u>3.0E-07</u>	because no value is given to this nuclide in the source		
<u>Ce-141</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Ce-144	1.3E-08			
<u>Pr-144</u>	Ξ	Contained in the parent nuclide Ce-144		
<u>Pr-144m</u>	Ξ.	Contained in the parent nuclide Ce-144		
<u>Pm-146</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pm-147	8.2E-12			
<u>Pm-148</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Pm-148m</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Sm-151	1.7E-12			
<u>Eu-152</u>	<u>2.3E-07</u>	_		
Eu-154	2.5E-07			
Eu-155	5.0E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Gd-153</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Tb-160</u>	<u>5.0E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pu-238	4.7E-11			
Pu-239	2.6E-11			
Pu-240	4.6E-11			
Pu-241	2.9E-08			
Am-241	4.6E-09			
<u>Am-242m</u>	3.1E-09	_		
Am-243	4.4E-08			
<u>Cm-242</u>	4.8E-11			
Cm-243	4.4E-08	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the source		
Cm-244	4.5E-11	cedade no varae is given to this natural in the source		

	-	Current			Revised	Reason for Revision
Table 6-1-	6 Dose conversion factor	or for the effective dose of radiation from hulls	Table 6-1	-6 Dose conversion factor	or for the effective dose of radiation from hulls	
(De		[21] and others are shown in remarks)	 (D		[22] and others are shown in remarks)	Appropriate description for
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/m²))	Remarks	Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/m²))	Remarks	addition of references and due to the selection of nuclides to be measured and assessed
H-3	0.0E+00	Defined 0 due to pure β nuclide	H-3	0.0E+00	Defined 0 due to pure β nuclide	
C-14	0.0E+00	Defined 0 due to pure β nuclide	C-14	0.0E+00	Defined 0 due to pure β nuclide	
Mn-54	1.4E-09		Mn-54	1.4E-09		
Fe-59	4.2E-12	_	Co-60	3.5E-09		
Co-58	1.6E-09	_	Ni-63	0.0E+00	Defined 0 due to pure β nuclide	
Co-60	3.5E-09		<u>Se-79</u>	<u>1.5E-12</u>	_	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide	Sr-90	5.8E-11		
<u>Zn-65</u>	1.0E-09	_	Y-90	-	Contained in the parent nuclide Sr-90	
<u>Rb-86</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set	Tc-99	2.8E-12		
<u> </u>	<u>5.51. ()</u>	because no value is given to this nuclide in the source Conservatively, the same value as that of Co-60 is set	Ru-106	4.0E-10		
<u>Sr-89</u>	<u>3.5E-09</u>	because no value is given to this nuclide in the source	Cd-113m	7.2E-12		
Sr-90	5.8E-11		Sb-125	8.3E-10		
Y-90	-	Contained in the parent nuclide Sr-90	Te-125m	4.4E-10		
Y-91	3.5E-09	Conservatively, the same value as that of Co-60 is set	I-129	3.0E-10		
	<u> </u>	because no value is given to this nuclide in the source Conservatively, the same value as that of Co-60 is set	Cs-134	2.4E-09		
<u>Nb-95</u>	<u>3.5E-09</u>	because no value is given to this nuclide in the source	Cs-137	9.5E-10		
Tc-99	2.8E-12		Ce-144	1.6E-10		
<u>Ru-103</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set	Pm-147	1.9E-12		
Ru-106	4.0E-10	because no value is given to this nuclide in the source	Sm-151	8.7E-13		
Rh-103m		Contained in the parent nuclide Ru-103	Eu-154	1.8E-09		
<u>Rh-106</u>	= =	Contained in the parent nuclide Ru-106	Eu-155	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	
<u>Ag-110m</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	<u>U-234</u>	<u>9.4E-11</u>	_	
Cd-113m	7.2E-12	because no value is given to this nuclide in the source	<u>U-238</u>	2.5E-10	_	
		Conservatively, the same value as that of Co-60 is set	<u>Np-237</u>	<u>1.4E-09</u>	_	
<u>Cd-115m</u>	3.5E-09	because no value is given to this nuclide in the source	Pu-238	1.1E-10		
<u>Sn-119m</u>	<u>3.5E-09</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pu-239	3.9E-11		
<u>Sn-123</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set	Pu-240	1.0E-10		
		because no value is given to this nuclide in the source	Pu-241	7.7E-10		
<u>Sn-126</u>	<u>2.3E-10</u>	Conservatively, the same value as that of Co-60 is set	Am-241	2.0E-10		
<u>Sb-124</u>	3.5E-09	because no value is given to this nuclide in the source	Cm-243	1.1E-09	Conservatively, the same value as that of Am-243 is set	
Sb-125	8.3E-10		Cm-244	1.0E-10	because no value is given to this nuclide in the source	
<u>Te-123m</u>	<u>3.5E-09</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	CIII-244	1.0L-10		
Te-125m	4.4E-10					
<u>Te-127</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				
<u>Te-127m</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set				
<u>Te-129</u>		because no value is given to this nuclide in the source Contained in the parent nuclide Te-129m				
<u>Te-129m</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				

		Current	Revised	Reason for Revision
I-129	3.0E-10			
Cs-134	2.4E-09			
<u>Cs-135</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		Appropriate description due to the selection of nuclides to be
<u>Cs-136</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		measured and assessed
Cs-137	9.5E-10			
<u>Ba-137m</u>	Ξ	Contained in the parent nuclide Cs-137		
<u>Ba-140</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Ce-141</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Ce-144	1.6E-10			
<u>Pr-144</u>	Ξ	Contained in the parent nuclide Ce-144		
<u>Pr-144m</u>		Contained in the parent nuclide Ce-144		
<u>Pm-146</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pm-147	1.9E-12			
<u>Pm-148</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Pm-148m</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Sm-151	8.7E-13			
<u>Eu-152</u>	1.8E-09	_		
Eu-154	1.8E-09			
Eu-155	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Gd-153</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Tb-160</u>	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pu-238	1.1E-10			
Pu-239	3.9E-11			
Pu-240	1.0E-10			
Pu-241	7.7E-10			
Am-241	2.0E-10			
<u>Am-242m</u>	8.3E-10	_		
<u>Am-243</u>	1.1E-09	_		
<u>Cm-242</u>	1.1E-10	_		
Cm-243	1.1E-09	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the source		
Cm-244	1.0E-10			
Cm-244	1.0E-10			

Current					Revised	Reason for Revision
Table 6-1-7		the effective dose of radiation from seawater during and underwater work	Table 6-1-7			
(I	· ·	x [21] and others are shown in remarks)		(Decommissioning handboo	k [22] and others are shown in remarks)	Appropriate description for addition of references and due to
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/L))	Remarks	Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/L))	Remarks	the selection of nuclides to be measured and assessed
H-3	0.0E+00		H-3	0.0E+00		
C-14	0.0E+00		C-14	0.0E+00		
Mn-54	4.8E-07		Mn-54	4.8E-07		
<u>Fe-59</u>	6.8E-07	_	Co-60	1.4E-06		
<u>Co-58</u>	4.7E-07	_	Ni-63	0.0E+00		
Co-60	1.4E-06		<u>Se-79</u>	<u>0.0E+00</u>		
Ni-63	0.0E+00		Sr-90	7.2E-13		
<u>Zn-65</u>	3.3E-07	_	Y-90	-	Contained in the parent nuclide Sr-90	
<u>Rb-86</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set	Тс-99	4.0E-13		
		because no value is given to this nuclide in the source Conservatively, the same value as that of Co-60 is set	Ru-106	1.2E-07		
<u>Sr-89</u>	<u>1.4E-06</u>	because no value is given to this nuclide in the source	Cd-113m	4.2E-11		
Sr-90	7.2E-13		Sb-125	2.5E-07		
Y-90	-	Contained in the parent nuclide Sr-90	Te-125m	2.0E-08		
<u>Y-91</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	I-129	1.4E-08		
NIL OF	1 40 06	Conservatively, the same value as that of Co-60 is set	Cs-134	9.0E-07		
<u>Nb-95</u>	<u>1.4E-06</u>	because no value is given to this nuclide in the source	Cs-137	3.4E-07		
Tc-99	4.0E-13		Ce-144	2.8E-08		
<u>Ru-103</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pm-147	2.5E-12		
Ru-106	1.2E-07		Sm-151	8.3E-12		
<u>Rh-103m</u>	=	Contained in the parent nuclide Ru-103	Eu-154	6.4E-07		
<u>Rh-106</u>	=	Contained in the parent nuclide Ru-106 Conservatively, the same value as that of Co-60 is set	Eu-155	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	
<u>Ag-110m</u>	<u>1.4E-06</u>	because no value is given to this nuclide in the source	<u>U-234</u>	<u>1.0E-09</u>	_	
Cd-113m	4.2E-11		<u>U-238</u>	<u>1.6E-08</u>	_	
<u>Cd-115m</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	<u>Np-237</u>	<u>1.5E-07</u>	_	
G 110	1.45.06	Conservatively, the same value as that of Co-60 is set	Pu-238	1.1E-09		
<u>Sn-119m</u>	<u>1.4E-06</u>	because no value is given to this nuclide in the source	Pu-239	5.2E-10		
<u>Sn-123</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pu-240	9.9E-10		
<u>Sn-126</u>	3.2E-08	eccusion of the control of the security of the	Pu-241	8.1E-08		
<u>Sb-124</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set	Am-241	1.9E-08		
		because no value is given to this nuclide in the source	Cm-243	1.4E-07	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the	
Sb-125	2.5E-07	Conservatively, the same value as that of Co-60 is set	CIII-2-13	1.7L-07	source	
<u>Te-123m</u>	<u>1.4E-06</u>	because no value is given to this nuclide in the source	Cm-244	9.0E-10		
Te-125m	2.0E-08					
<u>Te-127</u>	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				
<u>Te-127m</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				

Contained in the parent nuclide Te-129m

<u>Te-129</u>

		Current	Revised	Reason for Revision
<u>Te-129m</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		Appropriate description due to the selection of nuclides to be
I-129	1.4E-08			measured and assessed
Cs-134	9.0E-07			
<u>Cs-135</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Cs-136</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Cs-137	3.4E-07	Common no i mane lo gri en to mio nacina in me come		
<u>Ba-137m</u>	-	Contained in the parent nuclide Cs-137		
<u>Ba-140</u>	<u>-</u> <u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Ce-141</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Ce-144	2.8E-08	because no value is given to this natival in the source		
<u>Pr-144</u>	<u>=</u>	Contained in the parent nuclide Ce-144		
<u>Pr-144m</u>		Contained in the parent nuclide Ce-144		
<u>Pm-146</u>	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pm-147	2.5E-12			
<u>Pm-148</u>	<u>1.4E-06</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Pm-148m</u>	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Sm-151	8.3E-12			
<u>Eu-152</u>	6.6E-07	_		
Eu-154	6.4E-07			
Eu-155	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Gd-153</u>	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Tb-160</u>	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pu-238	1.1E-09			
Pu-239	5.2E-10			
Pu-240	9.9E-10			
Pu-241	8.1E-08			
Am-241	1.9E-08			
<u>Am-242m</u>	1.4E-08			
<u>Am-243</u>	1.4E-07			
<u>Cm-242</u>	1.1E-09			
Cm-243	1.4E-07	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the source		
Cm-244	9.0E-10			

		Current			Reason for Revision	
Table 6-1-8	Dose conversion factor f	or the effective dose of radiation from beach sand	Table 6-1-8	Dose conversion factor f	or the effective dose of radiation from beach sand	
		[21] and others are shown in remarks)			[22] and others are shown in remarks)	Appropriate description for
Nuclide	Dose conversion factor for the effective dose	Remarks	Nuclide	Dose conversion factor for the effective dose	Remarks	addition of references and due to the selection of nuclides to be measured and assessed
H-3	((mSv/h)/(Bq/kg)) 0.0E+00	Defined 0 due to pure β nuclide	H-3	((mSv/h)/(Bq/kg)) 0.0E+00	Defined 0 due to pure β nuclide	
C-14	0.0E+00	Defined 0 due to pure β nuclide	C-14	0.0E+00	Defined 0 due to pure β nuclide	
Mn-54	1.6E-07	Defined 6 due to pure p nuende	Mn-54	1.6E-07	Defined 6 due to pure p nuclide	
Fe-59	1.6E-11		Co-60	4.7E-07		
<u>Co-58</u>	1.9E-07	_	Ni-63	0.0E+00	Defined 0 due to pure β nuclide	
Co-60	4.7E-07	_	Se-79	1.8E-12	Defined 6 due to pure p nuclide	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide	Sr-90	1.2E-09	_	
Zn-65	1.1E-07	Defined 6 due to pure p nuende	Y-90	1.21-09	Contained in the parent nuclide Sr-90	
		Conservatively, the same value as that of Co-60 is set	Tc-99	6.3E-12	Contained in the parent nuclide 51-90	
<u>Rb-86</u>	<u>4.7E-07</u>	because no value is given to this nuclide in the source	Ru-106	4.3E-08		
<u>Sr-89</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Cd-113m	4.1E-11		
Sr-90	1.2E-09	because no value is given to this nuclide in the source	Sb-125	8.3E-08		
Y-90	-	Contained in the parent nuclide Sr-90	Te-125m	1.9E-09		
		Conservatively, the same value as that of Co-60 is set	I-129	1.3E-09		
<u>Y-91</u>	4.7E-07	because no value is given to this nuclide in the source	Cs-134	3.1E-07		
<u>Nb-95</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Cs-137	1.2E-07		
Tc-99	6.3E-12	decides no value is given to this nacride in the source	Ce-144	1.0E-08		
<u>Ru-103</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set	Pm-147	3.5E-12		
Ru-106	4.3E-08	because no value is given to this nuclide in the source	Sm-151	6.3E-13		
Rh-103m	4.3E-06	Contained in the parent nuclide Ru-103	Eu-154	2.3E-07		
Rh-106		Contained in the parent nuclide Ru-106	Eu-155	4.7E-07	Conservatively, the same value as that of Co-60 is set	
<u>Ag-110m</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set	<u>U-234</u>	4.1E-11	because no value is given to this nuclide in the source	
Cd-113m	4.1E-11	because no value is given to this nuclide in the source	<u>U-238</u>	3.9E-09	_	
		Conservatively, the same value as that of Co-60 is set	<u>Np-237</u>	3.7E-08	_	
<u>Cd-115m</u>	<u>4.7E-07</u>	because no value is given to this nuclide in the source	Pu-238	3.6E-11	_	
<u>Sn-119m</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pu-239	2.1E-11		
<u>Sn-123</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set	Pu-240	3.5E-11		
		because no value is given to this nuclide in the source	Pu-241	2.0E-08		
<u>Sn-126</u>	5.2E-09	Conservatively, the same value as that of Co-60 is set	Am-241	1.7E-09		
<u>Sb-124</u>	4.7E-07	because no value is given to this nuclide in the source			Conservatively, the same value as that of Am-243 is	
Sb-125	8.3E-08		Cm-243	3.1E-08	set because no value is given to this nuclide in the	
<u>Te-123m</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Cm-244	3.6E-11	source	
Te-125m	1.9E-09	Security value is given to this natified in the source	L 277	3.02 11		
		Conservatively, the same value as that of Co-60 is set				
<u>Te-127</u>	4.7E-07	because no value is given to this nuclide in the source				
<u>Te-127m</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				
<u>Te-129</u>	_	Contained in the parent nuclide Te-129m				
<u>Te-129m</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set				
	2 01	because no value is given to this nuclide in the source				
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		Current	Revised	Reason for Revision
I-129	1.3E-09			
Cs-134	3.1E-07			
<u>Cs-135</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		Appropriate description due to the selection of nuclides to be
<u>Cs-136</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		measured and assessed
Cs-137	1.2E-07			
<u>Ba-137m</u>	<u>=</u>	Contained in the parent nuclide Cs-137		
<u>Ba-140</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Ce-141</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Ce-144	1.0E-08			
<u>Pr-144</u>	Ξ	Contained in the parent nuclide Ce-144		
<u>Pr-144m</u>	Ξ	Contained in the parent nuclide Ce-144		
<u>Pm-146</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pm-147	3.5E-12			
<u>Pm-148</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Pm-148m</u>	<u>4.7E-07</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Sm-151	6.3E-13			
<u>Eu-152</u>	2.1E-07	_		
Eu-154	2.3E-07			
Eu-155	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Gd-153</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Tb-160</u>	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pu-238	3.6E-11			
Pu-239	2.1E-11			
Pu-240	3.5E-11			
Pu-241	2.0E-08			
Am-241	1.7E-09			
<u>Am-242m</u>	2.0E-09			
<u>Am-243</u>	3.1E-08	- -		
	3.7E-11			
<u>Cm-242</u> Cm-243	3.1E-08	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the		
		source		
Cm-244	3.6E-11			

		Current			Revised	Reason for Revision
Table 6-1-9	Dose conversion factor fo	or the effective dose of radiation from fishing nets	Table 6-1-9	Dose conversion factor fo	or the effective dose of radiation from fishing nets	
(D		[21] and others are shown in remarks)	(D		[22] and others are shown in remarks)	Appropriate description for addition of references and due to
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/kg))	Remarks	Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/kg))	Remarks	the selection of nuclides to be measured and assessed
H-3	0.0E+00	Defined 0 due to pure β nuclide	H-3	0.0E+00	Defined 0 due to pure β nuclide	
C-14	0.0E+00	Defined 0 due to pure β nuclide	C-14	0.0E+00	Defined 0 due to pure β nuclide	
Mn-54	3.2E-08		Mn-54	3.2E-08		
<u>Fe-59</u>	2.2E-12	_	Co-60	9.9E-08		
<u>Co-58</u>	<u>3.7E-08</u>	_	Ni-63	0.0E+00	Defined 0 due to pure β nuclide	
Co-60	9.9E-08		<u>Se-79</u>	2.0E-13	_	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide	Sr-90	2.1E-10		
<u>Zn-65</u>	2.3E-08	_	Y-90	-	Contained in the parent nuclide Sr-90	
<u>Rb-86</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set	Tc-99	7.9E-13		
		because no value is given to this nuclide in the source Conservatively, the same value as that of Co-60 is set	Ru-106	8.2E-09		
<u>Sr-89</u>	9.9E-08	because no value is given to this nuclide in the source	Cd-113m	5.9E-12		
Sr-90	2.1E-10		Sb-125	1.5E-08		
Y-90	-	Contained in the parent nuclide Sr-90	Te-125m	2.3E-10		
<u>Y-91</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	I-129	1.6E-10		
NII 05	0.05.00	Conservatively, the same value as that of Co-60 is set	Cs-134	5.9E-08		
<u>Nb-95</u>	<u>9.9E-08</u>	because no value is given to this nuclide in the source	Cs-137	2.2E-08		
Tc-99	7.9E-13		Ce-144	2.0E-09		
<u>Ru-103</u>	<u>9.9E-08</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pm-147	4.2E-13		
Ru-106	8.2E-09	Security in value is given to any native in the source	Sm-151	5.8E-14		
<u>Rh-103m</u>		Contained in the parent nuclide Ru-103	Eu-154	4.7E-08		
<u>Rh-106</u>	=	Contained in the parent nuclide Ru-106	Eu-155	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	
<u>Ag-110m</u>	<u>9.9E-08</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	<u>U-234</u>	<u>2.9E-12</u>	_	
Cd-113m	5.9E-12		<u>U-238</u>	<u>7.1E-10</u>	_	
<u>Cd-115m</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set	<u>Np-237</u>	<u>6.2E-09</u>	_	
		because no value is given to this nuclide in the source Conservatively, the same value as that of Co-60 is set	Pu-238	1.7E-12		
<u>Sn-119m</u>	9.9E-08	because no value is given to this nuclide in the source	Pu-239	1.9E-12		
<u>Sn-123</u>	<u>9.9E-08</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source	Pu-240	1.8E-12		
<u>Sn-126</u>	7.0E-10	because no value is given to this nuclide in the source	Pu-241	3.1E-09		
		Conservatively, the same value as that of Co-60 is set	Am-241	2.1E-10		
<u>Sb-124</u>	<u>9.9E-08</u>	because no value is given to this nuclide in the source	G 242	4.05.00	Conservatively, the same value as that of Am-243 is	
Sb-125	1.5E-08	Conservatively, the same value as that of Co-60 is set	Cm-243	4.8E-09	set because no value is given to this nuclide in the source	
<u>Te-123m</u>	<u>9.9E-08</u>	because no value is given to this nuclide in the source	Cm-244	2.1E-12		
Te-125m	2.3E-10					
<u>Te-127</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				
<u>Te-127m</u>	<u>9.9E-08</u>	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source				
<u>Te-129</u>		Contained in the parent nuclide Te-129m				
<u>Te-129m</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set				
	<u>9.9E-08</u>	because no value is given to this nuclide in the source				

		Current	Revised	Reason for Revision
I-129	1.6E-10			
Cs-134	5.9E-08			
<u>Cs-135</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		Appropriate description due to the selection of nuclides to be
<u>Cs-136</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		measured and assessed
Cs-137	2.2E-08			
<u>Ba-137m</u>		Contained in the parent nuclide Cs-137		
<u>Ba-140</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Ce-141</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Ce-144	2.0E-09			
<u>Pr-144</u>	Ξ	Contained in the parent nuclide Ce-144		
<u>Pr-144m</u>	= =	Contained in the parent nuclide Ce-144		
<u>Pm-146</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pm-147	4.2E-13			
<u>Pm-148</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Pm-148m</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Sm-151	5.8E-14			
<u>Eu-152</u>	4.3E-08	_		
Eu-154	4.7E-08			
Eu-155	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Gd-153</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
<u>Tb-160</u>	9.9E-08	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source		
Pu-238	1.7E-12			
Pu-239	1.9E-12			
Pu-240	1.8E-12			
Pu-241	3.1E-09			
Am-241	2.1E-10			
<u>Am-242m</u>	2.7E-10	_		
<u>Am-243</u>	4.8E-09	_		
<u>Cm-242</u>	1.8E-12	_		
Cm-243	4.8E-09	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the source		
Cm-244	2.1E-12	Source		

	Current				Revised					Reason for Revision
Ta	ıble 6-1-10	Effective dose	factor of in	gestion (GSR Part 3 [13])	Ta	ble 6-1-10	Effective dose	factor of in	gestion (GSR Part 3 [13])	
Target nuclide	Ef	ffective dose fact (mSv/Bq)	tor	Remarks	Target nuclide	Ef	fective dose fac (mSv/Bq)	tor	Remarks	
	Adult	Child under school age	Infant			Adult	Child under school age	Infant		
H-3 (THO)	1.8E-08	3.1E-08	6.4E-08	Used for the assessment of ingestion of water	H-3 (THO)	1.8E-08	3.1E-08	6.4E-08	Used for the assessment of ingestion of water	
H-3 (considering OBT)	2.0E-08	3.5E-08	7.0E-08	Used for the assessment of ingestion of seafood assuming that 10% of tritium to be ingested is OBT	H-3 (considering OBT)	2.0E-08	3.5E-08	7.0E-08	Used for the assessment of ingestion of seafood assuming that 10% of tritium to be ingested is OBT	
C-14	5.8E-07	9.9E-07	1.4E-06		C-14	5.8E-07	9.9E-07	1.4E-06		
Mn-54	7.1E-07	1.9E-06	5.4E-06		Mn-54	7.1E-07	1.9E-06	5.4E-06		
<u>Fe-59</u>	1.8E-06	<u>7.5E-06</u>	3.9E-05	_	Co-60	3.4E-06	1.7E-05	5.4E-05		Appropriate description due to the
<u>Co-58</u>	7.4E-07	<u>2.6E-06</u>	7.3E-06	_	Ni-63	1.5E-07	4.6E-07	1.6E-06		selection of nuclides to be measured and assessed
Co-60	3.4E-06	1.7E-05	5.4E-05		<u>Se-79</u>	2.9E-06	<u>1.9E-05</u>	<u>4.1E-05</u>		
Ni-63	1.5E-07	4.6E-07	1.6E-06		Sr-90	2.8E-05	4.7E-05	2.3E-04	Including the impact of the progeny nuclide	
<u>Zn-65</u>	3.9E-06	<u>9.7E-06</u>	3.6E-05	_	Y-90	2.7E-06	1.0E-05	3.1E-05		
<u>Rb-86</u>	2.8E-06	<u>9.9E-06</u>	3.1E-05	_	Tc-99	6.4E-07	2.3E-06	1.0E-05		
<u>Sr-89</u>	2.6E-06	<u>8.9E-06</u>	3.6E-05		Ru-106	7.0E-06	2.5E-05	8.4E-05	Including the impact of the progeny nuclide	
Sr-90	2.8E-05	4.7E-05	2.3E-04	Including the impact of the progeny nuclide	Cd-113m	2.3E-05	3.9E-05	1.2E-04	Indirect	
Y-90	2.7E-06	1.0E-05	3.1E-05		Sb-125	1.1E-06	3.4E-06	1.1E-05		
<u>Y-91</u>	2.4E-06	<u>8.8E-06</u>	2.8E-05		Te-125m	8.7E-07	3.3E-06	1.3E-05		
<u>Nb-95</u>	<u>5.8E-07</u>	<u>1.8E-06</u>	4.6E-06		I-129	1.1E-04	1.7E-04	1.8E-04		
Tc-99	6.4E-07	2.3E-06	1.0E-05		Cs-134	1.9E-05	1.3E-05	2.6E-05		
<u>Ru-103</u>	<u>7.3E-07</u>	<u>2.4E-06</u>	<u>7.1E-06</u>	Including the impact of the progeny nuclide	Cs-137	1.3E-05	9.6E-06	2.1E-05	Including the impact of the progeny	
Ru-106	7.0E-06	2.5E-05	8.4E-05	Including the impact of the progeny nuclide	Ce-144	5.2E-06	1.9E-05	6.6E-05	nuclide Including the impact of the progeny	
<u>Rh-103m</u>	3.8E-09	1.3E-08	4.7E-08		Pm-147	2.6E-07	9.6E-07	3.6E-06	nuclide	
Rh-106	_	_	Ξ.	Independent intake is not considered because the half-life is short enough	Sm-151	9.8E-08	3.3E-07	1.5E-06		
<u>Kii 100</u>	Ξ	Ξ	_	(about 30 seconds).	Eu-154	2.0E-06	6.5E-06	2.5E-05		
<u>Ag-110m</u>	2.8E-06	<u>7.8E-06</u>	<u>2.4E-05</u>	_	Eu-155	3.2E-07	1.1E-06	4.3E-06		
Cd-113m	2.3E-05	3.9E-05	1.2E-04		<u>U-234</u>	4.9E-05	8.8E-05	3.7E-04		
<u>Cd-115m</u>	3.3E-06	<u>9.7E-06</u>	<u>4.1E-05</u>	_	<u>U-238</u>	4.5E-05	8.0E-05	3.4E-04		
<u>Sn-119m</u>	3.4E-07	<u>1.3E-06</u>	<u>4.1E-06</u>		Np-237	1.1E-04	1.4E-04	2.0E-03		
<u>Sn-123</u>	<u>2.1E-06</u>	<u>7.8E-06</u>	2.5E-05	_	Pu-238	2.3E-04	3.1E-04	4.0E-03	_	
<u>Sn-126</u>	<u>4.7E-06</u>	<u>1.6E-05</u>	<u>5.0E-05</u>	_	Pu-239	2.5E-04	3.3E-04	4.2E-03		
<u>Sb-124</u>	2.5E-06	<u>8.4E-06</u>	2.5E-05	_	Pu-240	2.5E-04	3.3E-04	4.2E-03		
Sb-125	1.1E-06	3.4E-06	1.1E-05		Pu-241	4.8E-06	5.5E-06	5.6E-05		
<u>Te-123m</u>	<u>1.4E-06</u>	4.9E-06	<u>1.9E-05</u>	_	Am-241	2.0E-04	2.7E-04	3.7E-03		
Te-125m	8.7E-07	3.3E-06	1.3E-05		Cm-243	1.5E-04	2.2E-04	3.2E-03		
<u>Te-127</u>	<u>1.7E-07</u>	<u>6.2E-07</u>	<u>1.5E-06</u>	_	Cm-244	1.2E-04	1.9E-04	2.9E-03		
<u>Te-127m</u>	2.3E-06	<u>9.5E-06</u>	<u>4.1E-05</u>	_		1				
<u>Te-129</u>	<u>6.3E-08</u>	2.1E-07	7.5E-07	_						

		•	Current	namento in the implementation i la	Revised	1 1 definity (10010101100, 11thdelliffett-2)	Reason for Revision
T 100	2.00.05			Including the impact of the progeny			Appropriate description due to the
<u>Te-129m</u>	3.0E-06	<u>1.2E-05</u>	4.4E-05	nuclide nuclide			selection of nuclides to be
I-129	1.1E-04	1.7E-04	1.8E-04				measured and assessed
Cs-134	1.9E-05	1.3E-05	2.6E-05				
<u>Cs-135</u>	2.0E-06	1.7E-06	<u>4.1E-06</u>	_			
<u>Cs-136</u>	3.0E-06	<u>6.1E-06</u>	<u>1.5E-05</u>				
Cs-137	1.3E-05	9.6E-06	2.1E-05	Including the impact of the progeny nuclide			
<u>Ba-137m</u>	=	Ξ	Ξ	Independent intake is not considered because the half-life is short enough (about 2.6 minutes).			
<u>Ba-140</u>	<u>2.6E-06</u>	<u>9.2E-06</u>	3.2E-05	_			
<u>Ce-141</u>	<u>7.1E-07</u>	2.6E-06	<u>8.1E-06</u>	_			
Ce-144	5.2E-06	1.9E-05	6.6E-05	Including the impact of the progeny nuclide			
<u>Pr-144</u>	<u>5.0E-08</u>	1.7E-07	6.4E-07				
<u>Pr-144m</u>	=	=	=	Independent intake is not considered because the half-life is short enough (about 7.2 minutes).			
<u>Pm-146</u>	9.0E-07	2.8E-06	1.0E-05	_			
Pm-147	2.6E-07	9.6E-07	3.6E-06				
<u>Pm-148</u>	2.7E-06	9.7E-06	3.0E-05	_			
<u>Pm-148m</u>	<u>1.7E-06</u>	<u>5.5E-06</u>	1.5E-05	_			
Sm-151	9.8E-08	3.3E-07	1.5E-06				
<u>Eu-152</u>	<u>1.4E-06</u>	<u>4.1E-06</u>	1.6E-05	_			
Eu-154	2.0E-06	6.5E-06	2.5E-05				
Eu-155	3.2E-07	1.1E-06	4.3E-06				
<u>Gd-153</u>	<u>2.7E-07</u>	9.4E-07	2.9E-06	_			
<u>Tb-160</u>	<u>1.6E-06</u>	<u>5.4E-06</u>	<u>1.6E-05</u>	_			
Pu-238	2.3E-04	3.1E-04	4.0E-03				
Pu-239	2.5E-04	3.3E-04	4.2E-03				
Pu-240	2.5E-04	3.3E-04	4.2E-03				
Pu-241	4.8E-06	5.5E-06	5.6E-05				
Am-241	2.0E-04	2.7E-04	3.7E-03				
<u>Am-242m</u>	<u>1.9E-04</u>	2.3E-04	3.1E-03	_			
<u>Am-243</u>	2.0E-04	2.7E-04	3.6E-03	_			
<u>Cm-242</u>	<u>1.2E-05</u>	3.9E-05	<u>5.9E-04</u>	_			
Cm-243	1.5E-04	2.2E-04	3.2E-03				
Cm-244	1.2E-04	1.9E-04	2.9E-03				

	Current					Reason for Revision				
Ta	ble 6-1-11 l	Effective dose	factor of inl	nalation (GSR Part 3 [13])	Ta	ble 6-1-11	Effective dose	factor of inh	nalation (GSR Part 3 [13])	
Torget muslide	E	ffective dose fac (mSv/Bq)	tor	Domente	Target nuclide	Е	ffective dose fac (mSv/Bq)	tor	Remarks	
Target nuclide	Adult	Child under school age	Infant	Remarks	Target nuclide	Adult	Child under school age	Infant		
H-3	1.8E-08	3.1E-08	6.4E-08	The conversion factor of tritium vapor is used	H-3	1.8E-08	3.1E-08	6.4E-08	The conversion factor of tritium vapor is used	
C-14	5.8E-06	1.1E-05	1.9E-05		C-14	5.8E-06	1.1E-05	1.9E-05		
Mn-54	1.5E-06	3.8E-06	7.5E-06		Mn-54	1.5E-06	3.8E-06	7.5E-06		
<u>Fe-59</u>	4.0E-06	<u>8.1E-06</u>	2.1E-05	_	Co-60	3.1E-05	5.9E-05	9.2E-05		Appropriate description due to the
<u>Co-58</u>	2.1E-06	4.5E-06	9.0E-06	_	Ni-63	1.3E-06	2.7E-06	4.8E-06		selection of nuclides to be measured and assessed
Co-60	3.1E-05	5.9E-05	9.2E-05		<u>Se-79</u>	6.8E-06	1.3E-05	2.3E-05	_	
Ni-63	1.3E-06	2.7E-06	4.8E-06		Sr-90	1.6E-04	2.7E-04	4.2E-04	Including the impact of the progeny nuclide	
<u>Zn-65</u>	2.2E-06	<u>5.7E-06</u>	1.5E-05	_	Y-90	1.5E-06	4.2E-06	1.3E-05	nucnue	
<u>Rb-86</u>	9.3E-07	3.4E-06	1.2E-05	_	Tc-99	1.3E-05	2.4E-05	4.1E-05		
<u>Sr-89</u>	7.9E-06	1.7E-05	3.9E-05	Including the impact of the progeny	Ru-106	6.6E-05	1.4E-04	2.6E-04	Including the impact of the progeny nuclide	
Sr-90	1.6E-04	2.7E-04	4.2E-04	nuclide nuclide	Cd-113m	1.1E-04	1.8E-04	3.0E-04		
Y-90	1.5E-06	4.2E-06	1.3E-05		Sb-125	1.2E-05	2.4E-05	4.2E-05		
<u>Y-91</u>	<u>8.9E-06</u>	1.9E-05	<u>4.3E-05</u>		Te-125m	4.2E-06	7.8E-06	1.7E-05		
<u>Nb-95</u>	<u>1.8E-06</u>	<u>3.6E-06</u>	<u>7.7E-06</u>		I-129	3.6E-05	6.1E-05	7.2E-05		
Tc-99	1.3E-05	2.4E-05	4.1E-05		Cs-134	2.0E-05	4.1E-05	7.0E-05		
<u>Ru-103</u>	3.0E-06	6.0E-06	<u>1.3E-05</u>	Including the impact of the progeny nuclide	Cs-137	3.9E-05	7.0E-05	1.1E-04	Including the impact of the progeny nuclide	
Ru-106	6.6E-05	1.4E-04	2.6E-04	Including the impact of the progeny nuclide	Ce-144	5.3E-05	1.4E-04	3.6E-04	Including the impact of the progeny nuclide	
<u>Rh-103m</u>	2.7E-09	<u>6.7E-09</u>	<u>2.0E-08</u>	_	Pm-147	5.0E-06	1.1E-05	2.1E-05		
<u>Rh-106</u>	=	=	Ξ	Independent intake is not considered because the half-life is short enough (about 30 seconds).	Sm-151 Eu-154	4.0E-06 5.3E-05	6.7E-06 9.7E-05	1.1E-05 1.6E-04		
<u>Ag-110m</u>	1.2E-05	2.6E-05	4.6E-05	(about 30 seconds).	Eu-155	6.9E-06	9.7E-03 1.4E-05	2.6E-05		
Cd-113m	1.1E-04	1.8E-04	3.0E-04	 _	<u>U-234</u>	9.4E-03	1.4E-03 1.9E-02	3.3E-02		
Cd-115m	7.7E-06	1.7E-05	4.6E-05		<u>U-238</u>	8.0E-03	1.6E-02	2.9E-02	_	
Sn-119m	2.2E-06	4.7E-06	1.0E-05	 _	Np-237	5.0E-02	6.0E-02	9.8E-02	_	
<u>Sn-123</u>	8.1E-06	1.8E-05	4.0E-05	 _	Pu-238	1.1E-01	1.4E-01	2.0E-01	_	
<u>Sn-126</u>	2.8E-05	6.2E-04	1.2E-04	-	Pu-239	1.2E-01	1.5E-01	2.1E-01		
Sb-124	8.6E-06	1.8E-05	3.9E-05	_	Pu-240	1.2E-01	1.5E-01	2.1E-01		
Sb-125	1.2E-05	2.4E-05	4.2E-05	 	Pu-241	2.3E-03	2.6E-03	2.8E-03		
<u>Te-123m</u>	5.1E-06	9.8E-06	2.0E-05		Am-241	9.6E-02	1.2E-01	1.8E-01		
Te-125m	4.2E-06	7.8E-06	1.7E-05	 _	Cm-243	6.9E-02	9.5E-02	1.6E-01		
<u>Te-127</u>	1.4E-07	3.9E-07	1.7E 03		Cm-244	5.7E-02	8.3E-02	1.5E-01		
<u>Te-127m</u>	9.8E-06	2.0E-05	4.1E-05	 _						
<u>Te-129</u>	3.9E-08	1.0E-07	3.5E-07	_						
<u>Te-129m</u>	7.9E-06	1.7E-05	3.8E-05	Including the impact of the progeny nuclide						

		•	Current	manients in the imprementation i al	Revised	Reason for Revision
I-129	3.6E-05	6.1E-05	7.2E-05			
Cs-134	2.0E-05	4.1E-05	7.0E-05			Appropriate description due to the
<u>Cs-135</u>	8.6E-06	1.6E-05	2.7E-05	_		selection of nuclides to be
<u>Cs-136</u>	2.8E-06	6.0E-06	1.5E-05	_		measured and assessed
Cs-137	3.9E-05	7.0E-05	1.1E-04	Including the impact of the progeny nuclide		
<u>Ba-137m</u>	=	=	=	Independent intake is not considered because the half-life is short enough (about 2.6 minutes).		
<u>Ba-140</u>	<u>5.8E-06</u>	<u>1.2E-05</u>	2.9E-05	_		
<u>Ce-141</u>	3.8E-06	<u>7.1E-06</u>	<u>1.6E-05</u>	_		
Ce-144	5.3E-05	1.4E-04	3.6E-04	Including the impact of the progeny nuclide		
<u>Pr-144</u>	1.8E-08	<u>5.2E-08</u>	<u>1.9E-07</u>	_		
<u>Pr-144m</u>	=	Ξ	Ξ	Independent intake is not considered because the half-life is short enough (about 7.2 minutes).		
<u>Pm-146</u>	2.1E-05	3.9E-05	6.4E-05	_		
Pm-147	5.0E-06	1.1E-05	2.1E-05			
<u>Pm-148</u>	2.2E-06	<u>5.5E-06</u>	1.5E-05	_		
<u>Pm-148m</u>	5.7E-06	1.2E-05	2.5E-05	_		
Sm-151	4.0E-06	6.7E-06	1.1E-05			
<u>Eu-152</u>	4.2E-05	7.0E-05	1.1E-04	_		
Eu-154	5.3E-05	9.7E-05	1.6E-04			
Eu-155	6.9E-06	1.4E-05	2.6E-05			
<u>Gd-153</u>	2.1E-06	6.5E-06	1.5E-05	_		
<u>Tb-160</u>	7.0E-06	1.5E-05	3.2E-05	_		
Pu-238	1.1E-01	1.4E-01	2.0E-01			
Pu-239	1.2E-01	1.5E-01	2.1E-01			
Pu-240	1.2E-01	1.5E-01	2.1E-01			
Pu-241	2.3E-03	2.6E-03	2.8E-03			
Am-241	9.6E-02	1.2E-01	1.8E-01			
<u>Am-242m</u>	9.2E-02	1.1E-01	1.6E-01	_		
<u>Am-243</u>	9.6E-02	1.2E-01	1.8E-01	_		
<u>Cm-242</u>	5.9E-03	1.2E-02	2.7E-02	_		
Cm-243	6.9E-02	9.5E-02	1.6E-01			
Cm-244	5.7E-02	8.3E-02	1.5E-01			

Table 6-1-12	Concentration fact	tor for seafood
(TRS-422 [25]	and others are show	wn in remarks)

Current

Target Nuclide	Concentra	tion factor ((Bq/	kg)/(Bq/L))	Remarks
rarger muchue	Fish	Invertebrate	Seaweeds	NCHIALKS
H-3	1.0E+00	1.0E+00	1.0E+00	
C-14	2.0E+04	2.0E+04	1.0E+04	
Mn-54	1.0E+03	5.0E+04	6.0E+03	
<u>Fe-59</u>	3.0E+04	<u>5.0E+05</u>	2.0E+04	
<u>Co-58</u>	7.0E+02	2.0E+04	6.0E+03	
Co-60	7.0E+02	2.0E+04	6.0E+03	
Ni-63	1.0E+03	2.0E+03	2.0E+03	
<u>Zn-65</u>	1.0E+03	8.0E+04	2.0E+03	
<u>Rb-86</u>	9.0E+00	1.7E+01	1.7E+01	Excerpted from UCRL-50564 Rev.1
<u>Sr-89</u>	3.0E+00	1.0E+01	1.0E+01	
Sr-90	3.0E+00	1.0E+01	1.0E+01	
Y-90	-	-	-	Equilibrium state with the parent nuclide Sr-90
<u>Y-91</u>	2.0E+01	1.0E+03	1.0E+03	_
<u>Nb-95</u>	3.0E+01	1.0E+03	3.0E+03	_
Tc-99	8.0E+01	5.0E+02	3.0E+04	
<u>Ru-103</u>	2.0E+00	5.0E+02	2.0E+03	_
Ru-106	2.0E+00	5.0E+02	2.0E+03	
<u>Rh-103m</u>	=	Ξ	П	Equilibrium state with the parent nuclide Ru-103
<u>Rh-106</u>	=	=	Ξ	Equilibrium state with the parent nuclide Ru-106
<u>Ag-110m</u>	1.0E+04	6.0E+04	5.0E+03	_
Cd-113m	5.0E+03	8.0E+04	2.0E+04	
<u>Cd-115m</u>	5.0E+03	8.0E+04	2.0E+04	_
<u>Sn-119m</u>	5.0E+05	5.0E+05	2.0E+05	_
<u>Sn-123</u>	5.0E+05	5.0E+05	2.0E+05	_
<u>Sn-126</u>	5.0E+05	5.0E+05	2.0E+05	_
<u>Sb-124</u>	6.0E+02	3.0E+02	2.0E+01	_
Sb-125	6.0E+02	3.0E+02	2.0E+01	
Te-123m	1.0E+03	1.0E+03	1.0E+04	
Te-125m	1.0E+03	1.0E+03	1.0E+04	
<u>Te-127</u>	1.0E+03	1.0E+03	1.0E+04	_
<u>Te-127m</u>	1.0E+03	1.0E+03	1.0E+04	_
<u>Te-129</u>	=	=	Ξ.	Equilibrium state with the parent nuclide Te-129m
<u>Te-129m</u>	1.0E+03	1.0E+03	1.0E+04	_
I-129	9.0E+00	1.0E+01	1.0E+04	
Cs-134	1.0E+02	6.0E+01	5.0E+01	

Table 6-1-12 Concentration factor for seafood (TRS-422 [26] and others are shown in remarks)

Revised

Target Nuclide	Concentra	tion factor ((Bq/	kg)/(Bq/L))	Remarks
	Fish	Invertebrate	Seaweeds	Tentan
H-3	1.0E+00	1.0E+00	1.0E+00	
C-14	2.0E+04	2.0E+04	1.0E+04	
Mn-54	1.0E+03	5.0E+04	6.0E+03	
Co-60	7.0E+02	2.0E+04	6.0E+03	
Ni-63	1.0E+03	2.0E+03	2.0E+03	
<u>Se-79</u>	1.0E+04	1.0E+04	1.0E+03	_
Sr-90	3.0E+00	1.0E+01	1.0E+01	
Y-90	-	-	-	Equilibrium state with the parent nuclide Sr-90
Тс-99	8.0E+01	5.0E+02	3.0E+04	
Ru-106	2.0E+00	5.0E+02	2.0E+03	
Cd-113m	5.0E+03	8.0E+04	2.0E+04	
Sb-125	6.0E+02	3.0E+02	2.0E+01	
Te-125m	1.0E+03	1.0E+03	1.0E+04	
I-129	9.0E+00	1.0E+01	1.0E+04	
Cs-134	1.0E+02	6.0E+01	5.0E+01	
Cs-137	1.0E+02	6.0E+01	5.0E+01	
Ce-144	5.0E+01	2.0E+03	5.0E+03	
Pm-147	3.0E+02	7.0E+03	3.0E+03	
Sm-151	3.0E+02	7.0E+03	3.0E+03	
Eu-154	3.0E+02	7.0E+03	3.0E+03	
Eu-155	3.0E+02	7.0E+03	3.0E+03	
<u>U-234</u>	1.0E+00	3.0E+01	1.0E+02	_
<u>U-238</u>	1.0E+00	3.0E+01	1.0E+02	_
<u>Np-237</u>	1.0E+00	4.0E+02	5.0E+01	_
Pu-238	1.0E+02	3.0E+03	4.0E+03	
Pu-239	1.0E+02	3.0E+03	4.0E+03	
Pu-240	1.0E+02	3.0E+03	4.0E+03	
Pu-241	1.0E+02	3.0E+03	4.0E+03	
Am-241	1.0E+02	1.0E+03	8.0E+03	
Cm-243	1.0E+02	1.0E+03	5.0E+03	
Cm-244	1.0E+02	1.0E+03	5.0E+03	

 $[\]ast$ $\;$ For invertebrates, the value of molluscs (excluding cephalopods) was used.

Appropriate description for addition of references and due to the selection of nuclides to be measured and assessed

Reason for Revision

		_ cmpunson	Current		Revised Revised	Reason for Revision
<u>Cs-135</u>	1.0E+02	6.0E+01	5.0E+01	_		Appropriate description due to the
<u>Cs-136</u>	1.0E+02	6.0E+01	5.0E+01	_		selection of nuclides to be measured and assessed
Cs-137	1.0E+02	6.0E+01	5.0E+01			measured and assessed
<u>Ba-137m</u>	=	=	=	Equilibrium state with the parent nuclide Cs-137		
<u>Ba-140</u>	1.0E+01	1.0E+01	7.0E+01	_		
<u>Ce-141</u>	5.0E+01	2.0E+03	5.0E+03	_		
Ce-144	5.0E+01	2.0E+03	5.0E+03			
<u>Pr-144</u>	Ξ	Ξ	=	Equilibrium state with the parent nuclide Ce-144		
<u>Pr-144m</u>	Ξ	=	=	Equilibrium state with the parent nuclide Ce-144		
<u>Pm-146</u>	3.0E+02	7.0E+03	3.0E+03	_		
Pm-147	3.0E+02	7.0E+03	3.0E+03			
<u>Pm-148</u>	3.0E+02	7.0E+03	3.0E+03	_		
<u>Pm-148m</u>	3.0E+02	7.0E+03	3.0E+03	_		
Sm-151	3.0E+02	7.0E+03	3.0E+03			
<u>Eu-152</u>	3.0E+02	7.0E+03	3.0E+03	_		
Eu-154	3.0E+02	7.0E+03	3.0E+03			
Eu-155	3.0E+02	7.0E+03	3.0E+03			
<u>Gd-153</u>	3.0E+02	7.0E+03	3.0E+03	_		
<u>Tb-160</u>	6.0E+01	3.0E+03	2.0E+03	_		
Pu-238	1.0E+02	3.0E+03	4.0E+03			
Pu-239	1.0E+02	3.0E+03	4.0E+03			
Pu-240	1.0E+02	3.0E+03	4.0E+03			
Pu-241	1.0E+02	3.0E+03	4.0E+03			
Am-241	1.0E+02	1.0E+03	8.0E+03			
<u>Am-242m</u>	1.0E+02	1.0E+03	8.0E+03	_		
<u>Am-243</u>	1.0E+02	1.0E+03	8.0E+03	_		
<u>Cm-242</u>	1.0E+02	1.0E+03	5.0E+03	_		
Cm-243	1.0E+02	1.0E+03	5.0E+03			
Cm-244	1.0E+02	1.0E+03	5.0E+03			
* For invertebrates, t	he value of moll	uscs (excluding	(cephalopods) w	as used.		

Current	Revised	Reason for Revision
(4) Setting of the representative person subject to the exposure assessment	(4) Setting of the representative person subject to the exposure assessment	
(Omission)	(Omission)	
(2) Characteristics of the representative person	(2) Characteristics of the representative person	
(Omission)	(Omission)	
i. Individual who ingests the average amount of seafood The average ingestion amount of those who are aged 20 or older is used as the value of adult. 1/2 and 1/5 of the value of adult are used as the values of child under school age (assumed to be aged 5 or older) and infant (assumed to be aged 1), respectively, based on "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [24].	i. Individual who ingests the average amount of seafood The average ingestion amount of those who are aged 20 or older is used as the value of adult. 1/2 and 1/5 of the value of adult are used as the values of child under school age (assumed to be aged 5 or older) and infant (assumed to be aged 1), respectively, based on "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [25].	Appropriate description for addition of references
(Omission)	(Omission)	
i. External exposure from sea surface and external exposure from hulls The nearest ports to the south and north of the FDNPS is 5 km or more away from the FDNPS. Fishing is widely performed by ships from fishing ports in the sea area, including the area around the FDNPS centering on the fishing ports. In the assessment, conservatively, fishing is assumed to be performed in the range of within 5 km to the north and south and 10 km off the coast of the FDNPS (range of 10 km × 10 km around the FDNPS (Figure 6-1-11)). The concentration in the seawater used for the assessment is the annual average concentration on the sea surface (top layer) within 10 km × 10 km around the FDNPS, including areas where no fishing is conducted on a daily basis.	i. External exposure from sea surface and external exposure from hulls The nearest ports to the south and north of the FDNPS is 5 km or more away from the FDNPS. Fishing is widely performed by ships from fishing ports in the sea area, including the area around the FDNPS centering on the fishing ports. Therefore, to assess the external exposure from sea surface and external exposure from hulls, it seems appropriate to assess the entire sea area centering on the fishing ports. But in this assessment, the assessment area is conservatively set within 5 km to the north and south and 10 km off the coast of the FDNPS (range of 10 km × 10 km around the FDNPS (Figure 6-1-11)). The concentration in the seawater used for the assessment is the annual average concentration on the sea surface (top layer) within 10 km × 10 km around the FDNPS, including areas where no fishing is conducted on a daily basis.	Enhancement of description
ii. External exposure from seawater during swimming, etc., external exposure from beach sand, internal exposure from ingestion of water, and internal exposure from inhalation of seawater spray All of these were assumed as exposure while staying on a beach. The coastline around the FDNPS is a Difficult-to-Return Zone and intermediate storage facilities are installed there, but there is a beach in the habitable area in the north side. Therefore, the assessment point is set to the nearby beach to the north of the FDNPS and the concentration in the seawater is set to the annual average concentration in the seawater (all layers) in front of the beach. Since the water depth is less than 5m near the coast, mixing of the upper and lower layers is remarkable, so that there is little difference between the concentration on the sea surface and the average concentration of all layers.	ii. External exposure from seawater during swimming, etc., external exposure from beach sand, internal exposure from ingestion of water, and internal exposure from inhalation of seawater spray The coastline around the FDNPS is a Difficult-to-Return Zone and intermediate storage facilities are installed there, but there is a beach in the habitable area in the north side. Since the result of dispersion assessment shows that the annual average concentration of radioactive materials in seawater near those sand beaches is high, the assessment point for these pathways is set to be the nearby beach to the north of the FDNPS and the concentration in the seawater used for the assessment is set to be the annual average concentration in the seawater (all layers) in front of the beach. Since the water depth is less than 5m near the coast, mixing of the upper and lower layers is remarkable, so that there is little difference between the concentration on the sea surface and the average concentration of all layers.	
iii. External exposure from fishing nets and internal exposure from ingestion of seafood It is considered that radioactive materials will migrate from seawater to fishing nets at the time of fishing. In addition, fish are caught by fishing and delivered to the dinner table as seafood. Therefore, fishing is performed only within the range of $10 \text{ km} \times 10 \text{ km}$ around the FDNPS for point of assessment as with i. conservatively, but fish are found from the surface layer to the bottom layer and fishing nets are used at depths appropriate for the fish to be caught, so the concentration in the seawater is the annual average concentration in the seawater (all layers) in front of the beach.	iii. External exposure from fishing nets and internal exposure from ingestion of seafood It is considered that radioactive materials will migrate from seawater to fishing nets at the time of fishing. In addition, fish are caught by fishing and delivered to the dinner table as seafood. Therefore, only within the range of 10 km × 10 km around the FDNPS for point of assessment as with i. conservatively, but fish are found from the surface layer to the bottom layer and fishing nets are used at depths appropriate for the fish to be caught, so the concentration is the annual average concentration in the seawater (all layers) in front of the beach.	
(Omission)	(Omission)	

Comparison Table of amendments in the Implementation Plan for Fu	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Current	Revised	Reason for Revision
6-1-3. Assessment result (1) Diffusion simulation result The tritium concentration in the seawater after advection and diffusion was calculated using the model shown in 6-1-2.(2) assuming discharge of a total of 22 TBq (2.2E+13Bq) of tritium per year at an even pace throughout the year from the seabed about 1 km off the coast of the FDNPS. The calculation based on the meteorological and oceanographic conditions was performed for two years: 2014 and 2019. Though there is no large difference between the results of the two years, we decided to use the calculation result based on the meteorological and oceanographic conditions of 2019, in which the average concentration around the FDNPS is higher, for the assessment. Figures 6-1-12 to 6-1-16 show the calculation result. Figures 6-1-12 and 6-1-16 show the annual average concentrations of the sea surfaces of a wide area and the area around the FDNPS, respectively. The range of concentrations over 1Bq/L on the sea surface is about 3 km around the FDNPS.	6-1-3. Assessment result (1) Diffusion simulation result The tritium concentration in the seawater after advection and diffusion was calculated using the model shown in 6- 1-2. (2) assuming discharge of a total of 22 TBq (2.2E+13Bq) of tritium per year at an even pace throughout the year from the seabed about 1 km off the coast of the FDNPS. The calculation based on the meteorological and oceanographic conditions was performed for two years: 2014 and 2019. Though there is no large difference between the results of the two years, we decided to use the calculation result based on the meteorological and oceanographic conditions of 2019, in which the average concentration around the FDNPS is higher, for the assessment. Figures 6- 1-12 to 6-1-16 show the calculation result. Figures 6-1-12 and 6-1-18 show the annual average concentrations of the sea surfaces of a wide area and the area around the FDNPS, respectively. The range of concentrations over 1Bq/L on the sea surface is about 3 km around the FDNPS.	Appropriate description
(Omission)	(Omission)	
To verify the impact of the variation of meteorological and oceanographic data between years, simulation calculation was performed using the meteorological and oceanographic data of 2015 to 2018 and 2020. Table 6-1-15 and Figure 6-1-19 show the calculation results of 7 years from 2014 and 2020. The calculation of the seven years is not a continuous calculation of the seven years but a collection of calculations of individual years, but the flow in the sea area changes on a daily basis and no accumulation trend is observed. On the other hand, the annual variation of the average concentration and diffusion range within 10 km × 10 km from the FDNPS is so small that there is no problem with using the calculation result of 2019 for a long-term assessment. We also verified the concentration on the boundary of the calculation area from the calculation result of seven years mentioned above. As a result, it turned out that the maximum value of daily average concentrations on the boundary of the calculation area was 1.4E-02Bq/L. The maximum annual mean concentration was up to 2.6 E-04 Bq/L (2015, top layer), measured at the eastern boundary of the region. This concentration is 3 to 4 orders of magnitude lower than the tritium concentration in the sea water in the sea area around Japan (about 0.1 to 1Bq/L) and 2 to 3 orders of magnitude lower than the assessment result of 10 km × 10 km around the FDNPS, and no large variation in the concentration between years is observed, so the scale of the calculation area is sufficient and the impact of radiation outside the calculation area of this assessment is sufficiently small. Table 6-1-16 shows the maximum concentration on the model boundary of each assessment year.	To verify the impact of the variation of meteorological and oceanographic data between years, simulation calculation was performed using the meteorological and oceanographic data of 2015 to 2018 and 2020. Table 6-1-15 and Figure 6-1-19 show the calculation results of 7 years from 2014 and 2020. The calculation of the seven years is not a continuous calculation of the seven years but a collection of calculations of individual years, but the flow in the sea area changes on a daily basis and no accumulation trend is observed in calculation results of each year. On the other hand, the annual variation of the average concentration and diffusion range within 10 km × 10 km from the FDNPS is so small that there is no problem with using the calculation result of 2019 for a long-term assessment. We also verified the concentration on the boundary of the calculation area from the calculation result of seven years mentioned above. As a result, it turned out that the maximum value of daily average concentrations on the calculation region boundary was 1.4E-02Bq/L. The maximum annual mean concentration of the calculation region boundary was up to 2.6 E-04 Bq/L (2015, top layer), measured at the eastern boundary of the region. This concentration is 3 to 4 orders of magnitude lower than the tritium concentration in the sea water in the sea area around Japan (about 0.1 to 1Bq/L) and 2 to 3 orders of magnitude lower than the assessment result of 10 km × 10 km around the FDNPS, and no large variation in the concentration between years is observed, so the scale of the calculation area is sufficient and the impact of radiation on the environment outside the calculation area of this assessment is sufficiently small. Table 6-1-16 shows the maximum value of annual mean concentration on the calculation area boundary of each assessment year.	
(Omission)	(Omission)	

Current	Revised	Reason for Revision
(2) Concentration of each nuclide used for the assessment in the seawater	(2) Concentration of each nuclide used for the assessment in the seawater	

(Omission)

 Table 6-1-18
 Concentration in the seawater used for the assessment

			of nuclides in the K4 ta	
	Annual	Concentration in	the seawater used for the	assessment (Bq/L)
Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layer	Beach assessment point Average of all layers
Н-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01
C-14	1.7E+09	4.4E-06	9.5E-06	6.9E-05
Mn-54	7.8E+05	2.0E-09	4.2E-09	3.1E-08
<u>Fe-59</u>	2.0E+06	<u>5.0E-09</u>	1.1E-08	7.9E-08
<u>Co-58</u>	9.3E+05	<u>2.4E-09</u>	<u>5.1E-09</u>	3.7E-08
Co-60	5.1E+07	1.3E-07	2.8E-07	2.0E-06
Ni-63	2.5E+08	6.5E-07	1.4E-06	1.0E-05
<u>Zn-65</u>	1.7E+06	<u>4.4E-09</u>	9.5E-09	<u>6.9E-08</u>
<u>Rb-86</u>	2.2E+07	<u>5.6E-08</u>	1.2E-07	8.8E-07
<u>Sr-89</u>	1.2E+07	<u>2.9E-08</u>	6.3E-08	4.6E-07
Sr-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06
Y-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06
<u>Y-91</u>	2.5E+08	6.5E-07	1.4E-06	1.0E-05
<u>Nb-95</u>	1.2E+06	<u>2.9E-09</u>	<u>6.3E-09</u>	4.6E-08
Tc-99	8.1E+07	2.1E-07	4.4E-07	3.2E-06
<u>Ru-103</u>	1.2E+06	<u>2.9E-09</u>	6.3E-09	4.6E-08
Ru-106	1.9E+08	4.7E-07	1.0E-06	7.4E-06
<u>Rh-103m</u>	1.2E+06	<u>2.9E-09</u>	6.3E-09	4.6E-08
<u>Rh-106</u>	1.9E+08	<u>4.7E-07</u>	1.0E-06	<u>7.4E-06</u>
<u>Ag-110m</u>	6.5E+05	<u>1.7E-09</u>	3.5E-09	2.6E-08
Cd-113m	2.1E+06	5.3E-09	1.1E-08	8.3E-08
<u>Cd-115m</u>	7.4E+07	<u>1.9E-07</u>	4.0E-07	3.0E-06
<u>Sn-119m</u>	2.0E+07	<u>5.0E-08</u>	1.1E-07	7.9E-07
<u>Sn-123</u>	1.4E+08	3.5E-07	7.6E-07	5.6E-06
<u>Sn-126</u>	3.1E+06	8.0E-09	1.7E-08	1.3E-07
<u>Sb-124</u>	1.1E+06	2.8E-09	<u>6.0E-09</u>	4.4E-08
Sb-125	3.8E+07	9.7E-08	2.1E-07	1.5E-06
<u>Te-123m</u>	1.1E+06	<u>2.7E-09</u>	<u>5.8E-09</u>	4.3E-08
Te-125m	3.8E+07	9.7E-08	2.1E-07	1.5E-06
T. 107	2.75 . 07	0.45.00	2.05.07	1.50.06

9.4E-08

2.0E-07

1.5E-06

 Table 6-1-18
 Concentration in the seawater used for the assessment

(Sou	irce term base	d on the composition of nuclides in the K4 tank group)									
	Annual	Concentration in t	the seawater used for the	assessment (Bq/L)							
Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layer	Beach assessment point Average of all layers							
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01							
C-14	1.7E+09	4.4E-06	9.5E-06	6.9E-05							
Mn-54	7.8E+05	2.0E-09	2.0E-09 4.2E-09								
Co-60	5.1E+07	1.3E-07	1.3E-07 2.8E-07								
Ni-63	2.5E+08	6.5E-07	1.4E-06	1.0E-05							
<u>Se-79</u>	1.7E+08	<u>4.4E-07</u>	9.5E-07	<u>6.9E-06</u>							
Sr-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06							
Y-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06							
Tc-99	8.1E+07	2.1E-07	4.4E-07	3.2E-06							
Ru-106	1.9E+08	4.7E-07	1.0E-06	7.4E-06							
Cd-113m	2.1E+06	5.3E-09	1.1E-08	8.3E-08							
Sb-125	3.8E+07	9.7E-08	2.1E-07	1.5E-06							
Te-125m	3.8E+07	9.7E-08	2.1E-07	1.5E-06							
I-129	2.4E+08	6.2E-07	1.3E-06	9.7E-06							
Cs-134	5.2E+06	1.3E-08	2.8E-08	2.1E-07							
Cs-137	4.9E+07	1.2E-07	2.7E-07	1.9E-06							
Ce-144	7.3E+06	1.9E-08	4.0E-08	2.9E-07							
Pm-147	2.2E+07	5.6E-08	1.2E-07	8.8E-07							
Sm-151	1.0E+05	2.7E-10	5.7E-10	4.2E-09							
Eu-154	1.4E+06	3.5E-09	7.6E-09	5.6E-08							
Eu-155	3.8E+06	9.7E-09	2.1E-08	1.5E-07							
<u>U-234</u>	7.3E+04	<u>1.9E-10</u>	4.0E-10	<u>2.9E-09</u>							
<u>U-238</u>	7.3E+04	<u>1.9E-10</u>	4.0E-10	2.9E-09							
<u>Np-237</u>	7.3E+04	<u>1.9E-10</u>	4.0E-10	<u>2.9E-09</u>							
Pu-238	7.3E+04	1.9E-10	4.0E-10	2.9E-09							
Pu-239	7.3E+04	1.9E-10	4.0E-10	2.9E-09							
Pu-240	7.3E+04	1.9E-10	4.0E-10	2.9E-09							
Pu-241	3.2E+06	8.3E-09	1.8E-08	1.3E-07							
Am-241	7.3E+04	1.9E-10	4.0E-10	2.9E-09							
Cm-243	7.3E+04	1.9E-10	4.0E-10	2.9E-09							

Appropriate description due to the selection of nuclides to be measured and assessed

3.7E + 07

<u>Te-127</u>

(Omission)

		Current		implementation Plan for F	drasiiiia Baileii I	vacical 1 owel	Revised		orenee, retuenment 2)	Reason for Revision
<u>Te-127m</u>	3.7E+07	<u>9.4E-08</u>	2.0E-07	<u>1.5E-06</u>	Cm-244	7.3E+04	1.9E-10	4.0E-10	2.9E-09	Appropriate description due to
<u>Te-129</u>	3.7E+07	9.4E-08	2.0E-07	<u>1.5E-06</u>					During swimming	the selection of nuclides to be measured and assessed
<u>Te-129m</u>	3.7E+07	<u>9.4E-08</u>	2.0E-07	<u>1.5E-06</u>		exposure	From fishing nets	From sea surface	From beach sand Ingestion of seawater	
I-129	2.4E+08	6.2E-07	1.3E-06	9.7E-06	asse	ssment	Ingestion of seafood	From hulls	Inhalation of seawater	
Cs-134	5.2E+06	1.3E-08	2.8E-08	2.1E-07					spray	
<u>Cs-135</u>	2.9E+02	<u>7.4E-13</u>	<u>1.6E-12</u>	<u>1.2E-11</u>						
<u>Cs-136</u>	3.5E+06	<u>8.8E-09</u>	1.9E-08	1.4E-07						
Cs-137	4.9E+07	1.2E-07	2.7E-07	1.9E-06						
<u>Ba-137m</u>	4.9E+07	1.2E-07	2.7E-07	<u>1.9E-06</u>						
<u>Ba-140</u>	1.1E+07	2.8E-08	<u>6.0E-08</u>	<u>4.4E-07</u>						
<u>Ce-141</u>	2.9E+06	7.4E-09	<u>1.6E-08</u>	<u>1.2E-07</u>						
Ce-144	7.3E+06	1.9E-08	4.0E-08	2.9E-07						
<u>Pr-144</u>	7.3E+06	<u>1.9E-08</u>	<u>4.0E-08</u>	<u>2.9E-07</u>						
<u>Pr-144m</u>	7.3E+06	<u>1.9E-08</u>	<u>4.0E-08</u>	<u>2.9E-07</u>						
<u>Pm-146</u>	1.1E+07	<u>2.9E-08</u>	<u>6.2E-08</u>	<u>4.5E-07</u>						
Pm-147	2.2E+07	5.6E-08	1.2E-07	8.8E-07						
<u>Pm-148</u>	5.8E+07	<u>1.5E-07</u>	3.2E-07	<u>2.3E-06</u>						
<u>Pm-148m</u>	9.7E+05	<u>2.5E-09</u>	<u>5.3E-09</u>	<u>3.9E-08</u>						
Sm-151	1.0E+05	2.7E-10	5.7E-10	4.2E-09						
<u>Eu-152</u>	3.2E+06	8.3E-09	1.8E-08	<u>1.3E-07</u>						
Eu-154	1.4E+06	3.5E-09	7.6E-09	5.6E-08						
Eu-155	3.8E+06	9.7E-09	2.1E-08	1.5E-07						
<u>Gd-153</u>	3.7E+06	9.4E-09	2.0E-08	<u>1.5E-07</u>						
<u>Tb-160</u>	3.2E+06	8.3E-09	<u>1.8E-08</u>	<u>1.3E-07</u>						
Pu-238	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
Pu-239	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
Pu-240	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
Pu-241	3.2E+06	8.3E-09	1.8E-08	1.3E-07						
Am-241	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
<u>Am-242m</u>	<u>4.5E+03</u>	<u>1.1E-11</u>	<u>2.5E-11</u>	<u>1.8E-10</u>						
<u>Am-243</u>	<u>7.3E+04</u>	<u>1.9E-10</u>	4.0E-10	<u>2.9E-09</u>						
<u>Cm-242</u>	<u>7.3E+04</u>	<u>1.9E-10</u>	<u>4.0E-10</u>	<u>2.9E-09</u>						
Cm-243	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
Cm-244	7.3E+04	1.9E-10	4.0E-10	2.9E-09						
Target e		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray						

		Cur	rent				Rev	ised		Reason for Revision
,	Table 6-1-19	Concentration in th	e seawater used for th	e assessment	7	Гable 6-1-19	Concentration in th	e seawater used for th	e assessment	
(So	ource term ba	sed on the compositio	on of nuclides in the J1	-C tank group)	(So	urce term ba	sed on the compositio	on of nuclides in the J1	l-C tank group)	
	Annual	Concentration in	the seawater used for the	assessment (Bq/L)		Annual	Concentration in	the seawater used for the	assessment (Bq/L)	
Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers	Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers	
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01	H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01	
C-14	4.8E+08	1.2E-06	2.6E-06	1.9E-05	C-14	4.8E+08	1.2E-06	2.6E-06	1.9E-05	
Mn-54	1.0E+06	2.6E-09	5.6E-09	4.1E-08	Mn-54	1.0E+06	2.6E-09	5.6E-09	4.1E-08	Appropriate description due to
<u>Fe-59</u>	2.3E+06	<u>5.9E-09</u>	1.3E-08	<u>9.3E-08</u>	Co-60	8.9E+06	2.3E-08	4.8E-08	3.5E-07	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	1.1E+06	<u>2.8E-09</u>	<u>6.0E-09</u>	<u>4.4E-08</u>	Ni-63	2.3E+08	5.8E-07	1.2E-06	9.1E-06	measured and assessed
Co-60	8.9E+06	2.3E-08	4.8E-08	3.5E-07	<u>Se-79</u>	4.0E+07	1.0E-07	2.2E-07	<u>1.6E-06</u>	
Ni-63	2.3E+08	5.8E-07	1.2E-06	9.1E-06	Sr-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08	
<u>Zn-65</u>	2.5E+06	<u>6.4E-09</u>	<u>1.4E-08</u>	1.0E-07	Y-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08	
<u>Rb-86</u>	1.3E+07	<u>3.4E-08</u>	<u>7.3E-08</u>	<u>5.4E-07</u>	Tc-99	3.2E+07	8.2E-08	1.8E-07	1.3E-06	
<u>Sr-89</u>	1.4E+06	<u>3.7E-09</u>	<u>7.9E-09</u>	<u>5.8E-08</u>	Ru-106	3.8E+07	9.6E-08	2.0E-07	1.5E-06	
Sr-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08	Cd-113m	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
Y-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08	Sb-125	6.2E+06	1.6E-08	3.4E-08	2.5E-07	
<u>Y-91</u>	4.6E+08	<u>1.2E-06</u>	<u>2.5E-06</u>	<u>1.8E-05</u>	Te-125m	6.2E+06	1.6E-08	3.4E-08	2.5E-07	
<u>Nb-95</u>	1.3E+06	<u>3.4E-09</u>	<u>7.3E-09</u>	<u>5.4E-08</u>	I-129	3.2E+07	8.2E-08	1.8E-07	1.3E-06	
Tc-99	3.2E+07	8.2E-08	1.8E-07	1.3E-06	Cs-134	2.0E+06	5.2E-09	1.1E-08	8.2E-08	
<u>Ru-103</u>	1.4E+06	<u>3.6E-09</u>	<u>7.8E-09</u>	<u>5.7E-08</u>	Cs-137	5.1E+06	1.3E-08	2.8E-08	2.0E-07	
Ru-106	3.8E+07	9.6E-08	2.0E-07	1.5E-06	Ce-144	1.5E+07	3.9E-08	8.3E-08	6.1E-07	
<u>Rh-103m</u>	1.4E+06	3.6E-09	7.8E-09	<u>5.7E-08</u>	Pm-147	2.1E+07	5.5E-08	1.2E-07	8.6E-07	
<u>Rh-106</u>	3.8E+07	<u>9.6E-08</u>	2.0E-07	<u>1.5E-06</u>	Sm-151	3.0E+05	7.5E-10	1.6E-09	1.2E-08	
<u>Ag-110m</u>	<u>1.2E+06</u>	<u>2.9E-09</u>	<u>6.3E-09</u>	<u>4.6E-08</u>	Eu-154	3.0E+06	7.5E-09	1.6E-08	1.2E-07	
Cd-113m	2.3E+06	5.8E-09	1.2E-08	9.1E-08	Eu-155	9.1E+06	2.3E-08	5.0E-08	3.6E-07	
<u>Cd-115m</u>	7.2E+07	<u>1.8E-07</u>	<u>4.0E-07</u>	2.9E-06	<u>U-234</u>	<u>8.9E+05</u>	<u>2.3E-09</u>	<u>4.8E-09</u>	<u>3.5E-08</u>	
<u>Sn-119m</u>	<u>1.1E+09</u>	<u>2.9E-06</u>	<u>6.1E-06</u>	4.5E-05	<u>U-238</u>	8.9E+05	<u>2.3E-09</u>	<u>4.8E-09</u>	<u>3.5E-08</u>	
<u>Sn-123</u>	1.8E+08	<u>4.5E-07</u>	<u>9.7E-07</u>	<u>7.1E-06</u>	<u>Np-237</u>	8.9E+05	<u>2.3E-09</u>	<u>4.8E-09</u>	<u>3.5E-08</u>	
<u>Sn-126</u>	<u>7.8E+06</u>	<u>2.0E-08</u>	<u>4.2E-08</u>	<u>3.1E-07</u>	Pu-238	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
<u>Sb-124</u>	2.6E+06	<u>6.6E-09</u>	<u>1.4E-08</u>	1.0E-07	Pu-239	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
Sb-125	6.2E+06	1.6E-08	3.4E-08	2.5E-07	Pu-240	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
<u>Te-123m</u>	2.5E+06	<u>6.3E-09</u>	<u>1.3E-08</u>	9.9E-08	Pu-241	3.2E+07	8.2E-08	1.8E-07	1.3E-06	
Te-125m	6.2E+06	1.6E-08	3.4E-08	2.5E-07	Am-241	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
<u>Te-127</u>	1.3E+08	3.2E-07	<u>6.9E-07</u>	<u>5.0E-06</u>	Cm-243	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
<u>Te-127m</u>	1.3E+08	<u>3.3E-07</u>	7.2E-07	<u>5.3E-06</u>	Cm-244	8.9E+05	2.3E-09	4.8E-09	3.5E-08	
<u>Te-129</u>	3.8E+07	9.6E-08	2.0E-07	<u>1.5E-06</u>						

		Curi		the implementation is	11 101 1	ukushima Daiichi Nuclear P	Revi		reference, Attachment-2	Reason for Revision
Te-129m	3.8E+07	9.6E-08	2.0E-07	1.5E-06					During swimming	Appropriate description due t
I-129	3.2E+07	8.2E-08	1.8E-07	1.3E-06		Target exposure	From fishing nets	From sea surface	From beach sand	the selection of nuclides to b measured and assessed
Cs-134	2.0E+06	5.2E-09	1.1E-08	8.2E-08		assessment	Ingestion of seafood	From hulls	Ingestion of seawater Inhalation of seawater	incasured and assessed
<u>Cs-135</u>	3.2E+01	8.2E-14	1.8E-13	1.3E-12					spray	
<u>Cs-136</u>	1.3E+06	3.2E-09	6.9E-09	5.0E-08						
Cs-137	5.1E+06	1.3E-08	2.8E-08	2.0E-07						
<u>Ba-137m</u>	5.1E+06	1.3E-08	2.8E-08	2.0E-07						
<u>Ba-140</u>	5.4E+06	1.4E-08	2.9E-08	2.1E-07						
<u>Ce-141</u>	7.0E+06	1.8E-08	3.8E-08	2.8E-07						
Ce-144	1.5E+07	3.9E-08	8.3E-08	6.1E-07						
<u>Pr-144</u>	1.5E+07	3.9E-08	<u>8.3E-08</u>	<u>6.1E-07</u>						
<u>Pr-144m</u>	1.5E+07	3.9E-08	8.3E-08	6.1E-07						
<u>Pm-146</u>	1.8E+06	4.6E-09	9.8E-09	<u>7.2E-08</u>						
Pm-147	2.1E+07	5.5E-08	1.2E-07	8.6E-07						
<u>Pm-148</u>	6.2E+06	1.6E-08	<u>3.4E-08</u>	2.5E-07						
<u>Pm-148m</u>	1.3E+06	3.3E-09	7.0E-09	<u>5.2E-08</u>						
Sm-151	3.0E+05	7.5E-10	1.6E-09	1.2E-08						
<u>Eu-152</u>	7.5E+06	1.9E-08	<u>4.1E-08</u>	3.0E-07						
Eu-154	3.0E+06	7.5E-09	1.6E-08	1.2E-07						
Eu-155	9.1E+06	2.3E-08	5.0E-08	3.6E-07						
<u>Gd-153</u>	7.0E+06	1.8E-08	3.8E-08	2.8E-07						
<u>Tb-160</u>	3.8E+06	9.6E-09	2.0E-08	1.5E-07						
Pu-238	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Pu-239	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Pu-240	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Pu-241	3.2E+07	8.2E-08	1.8E-07	1.3E-06						
Am-241	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
<u>Am-242m</u>	1.6E+04	4.0E-11	<u>8.6E-11</u>	<u>6.3E-10</u>						
<u>Am-243</u>	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
<u>Cm-242</u>	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Cm-243	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Cm-244	8.9E+05	2.3E-09	4.8E-09	3.5E-08						
Target exp assessn		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray						

		Cur	rent	_			Rev	ised		Reason for Revision
,	Table 6-1-20	Concentration in th	e seawater used for th	e assessment	7	Γable 6-1-20	Concentration in th	e seawater used for th	e assessment	
(So	ource term ba	nsed on the compositio	on of nuclides in the J1	-G tank group)	(So	urce term ba	sed on the compositio	on of nuclides in the J1	-G tank group)	
	Annual	Concentration in	the seawater used for the	assessment (Bq/L)		Annual	Concentration in	the seawater used for the	assessment (Bq/L)	
Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers	Target nuclide	discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers	
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01	H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01	
C-14	1.3E+09	3.3E-06	7.1E-06	5.2E-05	C-14	1.3E+09	3.3E-06	7.1E-06	5.2E-05	
Mn-54	3.1E+06	7.9E-09	1.7E-08	1.2E-07	Mn-54	3.1E+06	7.9E-09	1.7E-08	1.2E-07	Appropriate description due to
<u>Fe-59</u>	5.9E+06	<u>1.5E-08</u>	3.2E-08	2.3E-07	Co-60	1.9E+07	4.8E-08	1.0E-07	7.5E-07	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	3.0E+06	<u>7.7E-09</u>	<u>1.6E-08</u>	<u>1.2E-07</u>	Ni-63	7.2E+08	1.8E-06	3.9E-06	2.9E-05	measured and assessed
Co-60	1.9E+07	4.8E-08	1.0E-07	7.5E-07	<u>Se-79</u>	1.2E+08	3.1E-07	<u>6.7E-07</u>	<u>4.9E-06</u>	
Ni-63	7.2E+08	1.8E-06	3.9E-06	2.9E-05	Sr-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07	
<u>Zn-65</u>	6.5E+06	<u>1.7E-08</u>	3.6E-08	2.6E-07	Y-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07	
<u>Rb-86</u>	3.8E+07	<u>9.7E-08</u>	<u>2.1E-07</u>	<u>1.5E-06</u>	Tc-99	1.1E+08	2.7E-07	5.8E-07	4.2E-06	
<u>Sr-89</u>	3.7E+06	<u>9.3E-09</u>	2.0E-08	<u>1.5E-07</u>	Ru-106	3.9E+07	1.0E-07	2.1E-07	1.6E-06	
Sr-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07	Cd-113m	7.0E+06	1.8E-08	3.8E-08	2.8E-07	
Y-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07	Sb-125	1.1E+07	2.9E-08	6.2E-08	4.6E-07	
<u>Y-91</u>	9.8E+08	<u>2.5E-06</u>	<u>5.3E-06</u>	3.9E-05	Te-125m	1.1E+07	2.9E-08	6.2E-08	4.6E-07	
<u>Nb-95</u>	3.8E+06	9.7E-09	2.1E-08	<u>1.5E-07</u>	I-129	2.7E+07	6.8E-08	1.5E-07	1.1E-06	
Tc-99	1.1E+08	2.7E-07	5.8E-07	4.2E-06	Cs-134	5.5E+06	1.4E-08	3.0E-08	2.2E-07	
<u>Ru-103</u>	4.2E+06	<u>1.1E-08</u>	2.3E-08	<u>1.7E-07</u>	Cs-137	2.7E+07	6.8E-08	1.5E-07	1.1E-06	
Ru-106	3.9E+07	1.0E-07	2.1E-07	1.6E-06	Ce-144	4.5E+07	1.1E-07	2.4E-07	1.8E-06	
<u>Rh-103m</u>	4.2E+06	<u>1.1E-08</u>	2.3E-08	<u>1.7E-07</u>	Pm-147	5.9E+07	1.5E-07	3.2E-07	2.3E-06	
<u>Rh-106</u>	3.9E+07	1.0E-07	<u>2.1E-07</u>	<u>1.6E-06</u>	Sm-151	8.1E+05	2.1E-09	4.4E-09	3.3E-08	
<u>Ag-110m</u>	3.3E+06	<u>8.3E-09</u>	1.8E-08	<u>1.3E-07</u>	Eu-154	8.1E+06	2.1E-08	4.4E-08	3.3E-07	
Cd-113m	7.0E+06	1.8E-08	3.8E-08	2.8E-07	Eu-155	1.5E+07	3.7E-08	8.0E-08	5.9E-07	
<u>Cd-115m</u>	1.9E+08	4.8E-07	<u>1.0E-06</u>	<u>7.5E-06</u>	<u>U-234</u>	2.3E+06	<u>5.8E-09</u>	<u>1.2E-08</u>	<u>9.1E-08</u>	
<u>Sn-119m</u>	3.3E+09	<u>8.3E-06</u>	1.8E-05	<u>1.3E-04</u>	<u>U-238</u>	2.3E+06	<u>5.8E-09</u>	<u>1.2E-08</u>	<u>9.1E-08</u>	
<u>Sn-123</u>	5.1E+08	<u>1.3E-06</u>	<u>2.8E-06</u>	<u>2.1E-05</u>	<u>Np-237</u>	2.3E+06	<u>5.8E-09</u>	<u>1.2E-08</u>	<u>9.1E-08</u>	
<u>Sn-126</u>	1.2E+07	<u>3.1E-08</u>	<u>6.7E-08</u>	4.9E-07	Pu-238	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
<u>Sb-124</u>	6.8E+06	<u>1.7E-08</u>	3.7E-08	2.7E-07	Pu-239	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
Sb-125	1.1E+07	2.9E-08	6.2E-08	4.6E-07	Pu-240	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
<u>Te-123m</u>	5.5E+06	<u>1.4E-08</u>	3.0E-08	2.2E-07	Pu-241	8.1E+07	2.1E-07	4.4E-07	3.3E-06	
Te-125m	1.1E+07	2.9E-08	6.2E-08	4.6E-07	Am-241	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
<u>Te-127</u>	3.5E+08	8.9E-07	<u>1.9E-06</u>	<u>1.4E-05</u>	Cm-243	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
<u>Te-127m</u>	3.7E+08	9.3E-07	<u>2.0E-06</u>	<u>1.5E-05</u>	Cm-244	2.3E+06	5.8E-09	1.2E-08	9.1E-08	
<u>Te-129</u>	9.8E+07	2.5E-07	<u>5.3E-07</u>	<u>3.9E-06</u>						

		Curr		1	Takushina Baheni Nuclear 1 0v	Rev			 Reason for Revision
<u>Te-129m</u>	9.8E+07	2.5E-07	<u>5.3E-07</u>	<u>3.9E-06</u>				During swimming	Appropriate description due to
I-129	2.7E+07	6.8E-08	1.5E-07	1.1E-06	Target exposure assessment	From fishing nets	From sea surface	From beach sand Ingestion of seawater	the selection of nuclides to be measured and assessed
Cs-134	5.5E+06	1.4E-08	3.0E-08	2.2E-07	rarget exposure assessment	Ingestion of seafood	From hulls	Inhalation of seawater	
<u>Cs-135</u>	1.7E+02	4.4E-13	9.3E-13	<u>6.8E-12</u>				spray	
<u>Cs-136</u>	2.9E+06	7.5E-09	<u>1.6E-08</u>	<u>1.2E-07</u>					
Cs-137	2.7E+07	6.8E-08	1.5E-07	1.1E-06					
<u>Ba-137m</u>	2.7E+07	<u>6.8E-08</u>	<u>1.5E-07</u>	<u>1.1E-06</u>					
<u>Ba-140</u>	1.4E+07	3.5E-08	7.6E-08	<u>5.5E-07</u>					
<u>Ce-141</u>	9.8E+06	2.5E-08	<u>5.3E-08</u>	3.9E-07					
Ce-144	4.5E+07	1.1E-07	2.4E-07	1.8E-06					
<u>Pr-144</u>	4.5E+07	<u>1.1E-07</u>	<u>2.4E-07</u>	<u>1.8E-06</u>					
<u>Pr-144m</u>	4.5E+07	<u>1.1E-07</u>	2.4E-07	<u>1.8E-06</u>					
<u>Pm-146</u>	5.1E+06	<u>1.3E-08</u>	2.8E-08	<u>2.1E-07</u>					
Pm-147	5.9E+07	1.5E-07	3.2E-07	2.3E-06					
<u>Pm-148</u>	3.7E+07	<u>9.3E-08</u>	2.0E-07	<u>1.5E-06</u>					
<u>Pm-148m</u>	3.3E+06	<u>8.5E-09</u>	<u>1.8E-08</u>	<u>1.3E-07</u>					
Sm-151	8.1E+05	2.1E-09	4.4E-09	3.3E-08					
<u>Eu-152</u>	1.5E+07	3.9E-08	<u>8.4E-08</u>	<u>6.2E-07</u>					
Eu-154	8.1E+06	2.1E-08	4.4E-08	3.3E-07					
Eu-155	1.5E+07	3.7E-08	8.0E-08	5.9E-07					
<u>Gd-153</u>	1.5E+07	3.9E-08	<u>8.4E-08</u>	<u>6.2E-07</u>					
<u>Tb-160</u>	1.1E+07	<u>2.9E-08</u>	<u>6.2E-08</u>	<u>4.6E-07</u>					
Pu-238	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
Pu-239	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
Pu-240	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
Pu-241	8.1E+07	2.1E-07	4.4E-07	3.3E-06					
Am-241	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
<u>Am-242m</u>	4.2E+04	<u>1.1E-10</u>	<u>2.3E-10</u>	<u>1.7E-09</u>					
<u>Am-243</u>	2.3E+06	<u>5.8E-09</u>	<u>1.2E-08</u>	<u>9.1E-08</u>					
<u>Cm-242</u>	2.3E+06	<u>5.8E-09</u>	<u>1.2E-08</u>	<u>9.1E-08</u>					
Cm-243	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
Cm-244	2.3E+06	5.8E-09	1.2E-08	9.1E-08					
Target exposure	assessment	From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray					
(Omission)					(Omission)				

Comparison Table of amendments in the Implementation Plan for F	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Current	Revised	Reason for Revision
(3) Exposure assessment result Tables 6-1-21 to 22 show the result of the exposure assessments of the following three cases using the concentrations in the seawater shown in Tables 6-1-18 to 6-1-20. Source term based on the measured composition of nuclides i. K4 tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.29) ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.35) iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.22)	(3) Exposure assessment result Tables 6-1-18 to 20 show the result of the exposure assessments of the following three cases using the concentrations in the seawater shown in Tables 6-1-21 to 6-1-22. Source term based on the measured composition of nuclides i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28) ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23) iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)	Appropriate description due to the selection of nuclides to be measured and assessed
The result of human exposure assessment is 0.00003 (3E-05) to 0.0004 (4E-04) mSv/year. In all cases, the results were much smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value. The assessment in the source term based on the measured value was assessed assuming that nuclides below the detection limits (undetected nuclides) were contained at the detection limits, so the assessment result is considered to be conservative. Attachment IX "Contribution to the undetected nuclides in the source term based on the measured value" shows the contribution of undetected nuclides in the assessment result. Even in the exposure assessment of infant, of which the assessed value of internal exposure is high because the effective dose factor is large, the assessment result of internal exposure is 0.000029 (2.9E-05) mSv/year to 0.00071 (7.1E-04) mSv/year. This result is much lower than the dose limit of 1mSv/year as well as the target dose value of 0.05mSv/year, which is equivalent to the dose constraint.	The result of human exposure assessment is 0.000002 (2E-06) to 0.0002 (2E-05) mSv/year. In all cases, the results were much smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value. The assessment in the source term based on the measured value was assessed assuming that nuclides below the detection limits (undetected nuclides) were contained at the detection limits, so the assessment result is considered to be conservative. Attachment IX "Contribution to the undetected nuclides in the source term based on the measured value" shows the contribution of undetected nuclides in the assessment result. Even in the exposure assessment of infant, of which the assessed value of internal exposure is high because the effective dose factor is large, the assessment result of internal exposure is 0.000001 (1.0E-06) mSv/year to 0.000012 (1.2E-05) mSv/year. This result is much lower than the dose limit of 1mSv/year as well as the target dose value of 0.05mSv/year, which is equivalent to the dose constraint.	
(Omission)	(Omission)	
In terms of the basic concept of radiation protection ³⁸ , which is to make every effort to reduce exposure as low as reasonably achievable while also considering social and economical balance, optimization of radiation protection does not necessarily equal to the minimization of exposure. Radiation protection is optimized to the extent that it does not exceed the dose constraint, so the upper limit of annual discharge amount calculated from "the annual discharge amount of treated water", "Dose constraints", and "Exposure assessment result by the source term" is shown below. For example, if the calculation is performed the annual discharge amount of tritium from the assessment result of the J1-G tank group of which value of the exposure assessment result is the largest among the source terms based on the measured values, the result is as follows considering the dose constraint is 0.05mSv/year and the exposure	In terms of the basic concept of radiation protection ³⁸ , which is to make every effort to reduce exposure as low as reasonably achievable while also considering social and economic balance, optimization of radiation protection does not necessarily equal to the minimization of exposure. Radiation protection is optimized to the extent that it does not exceed the dose constraint, so "the annual discharge amount of treated water", "Dose constraints", and "Exposure assessment result by the source term" are used for the calculation of the allowable upper limit of annual discharge amount. The result of the calculation is summarized in Reference G "Upper limit of annual discharge and optimization assessment result of each nuclide based on the dose constraint". For example, if the calculation is performed the annual discharge amount of tritium from the assessment result of the K4 tank group of which value of the exposure assessment result is the largest among the source terms based on the measured values, the result is as follows considering the dose constraint is 0.05mSv/year and the exposure	
assessment result based on the source term of the <u>J1-G</u> tank group (if the ingestion of seafood is large amount) is <u>4E-04</u> mSv/year:	assessment result based on the source term of the <u>K4</u> tank group (if the ingestion of seafood is large amount) is <u>2E-05</u> mSv/year:	
$2.2E+13(Bq/year) \times 0.05 (mSv/year) \div \frac{0.0004}{0.0004}(mSv/year) = \frac{2.7E+15}{0.0004}(Bq/year) = \frac{2.700}{0.0004}(Bq/year) = \frac{2.700}{0.0004$	$2.2E + 13(Bq/year) \times 0.05 \text{ (mSv/year)} \div \frac{0.00002}{(mSv/year)} = \frac{5.5E + 16}{(Bq/year)} = \frac{55 \text{ PBq/year (55,000}}{(mSv/year))} = \frac{5.5E + 16}{(Bq/year)} = 5.5E + 1$	
As the same calculation, if the calculation is performed using the assessment result of the $\underline{\text{K4}}$ tank group of which value of the exposure assessment result is the smallest, the result is as follows:	As the same calculation, if the calculation is performed using the assessment result of the <u>J1-C</u> tank group of which value of the exposure assessment result is the smallest, the result is as follows:	
$2.2E + 13(Bq/year) \times 0.05 \text{ (mSv/year)} \div \frac{0.00003}{0.00003} \text{(mSv/year)} = \frac{3.6E + 16}{0.00003} \text{(Bq/year)} = \frac{3.6E + 16}{0.00003} \text{(Bq/year)} = \frac{3.6E + 16}{0.00003} \text{(Bq/year)} = \frac{3.6E + 16}{0.00003} \text{(Bg/year)} = 3.$	$2.2E+13(Bq/year)\times0.05 \text{ (mSv/year)} \div \underline{0.000002}(mSv/year) = \underline{5.5E+17}(Bq/year) = \underline{550} \text{ PBq/year } (\underline{550,000} \text{ TBq/year})$	
The actual discharge amount will be determined setting the minimum value of 2,700 TBq (source term: J1-C tank group, seafood ingestion: large amount) as the limit value, which is the lowest value depends on source term and seafood ingestion at a result of optimization of radiation protection. On the other hand, the Basic Policy of the government in April 2021 stipulates "The total annual amount of tritium to be discharged will be at a level below the operational target value10 for tritium discharge of the Fukushima Daiichi NPS before the accident (22 TBq/year)." This is a policy-making decision with consideration of the viewpoint of risk optimization of the whole decommissioning process as well as ALPS treated water, the effect of natural decay of radioactive materials expected to occur during land storage of ALPS treated water, leakage risk and occupational exposure during long-term storage, and social acceptance such as understanding from stakeholders. Based on this circumstance, we set the annual discharge amount of tritium 22 TBq/year (2.2E+13Bq/year) in accordance with above mentioned "TEPCO's Action in response to Government's Policy," and assessed radiological impact.	The actual discharge amount will be determined setting the minimum value of 55 PBq (source term: K4 tank group, seafood ingestion: large amount) as the limit value, which is the lowest value depends on source term and seafood ingestion at a result of optimization of radiation protection. On the other hand, the Basic Policy of the government in April 2021 stipulates "The total annual amount of tritium to be discharged will be at a level below the operational target value10 for tritium discharge of the Fukushima Daiichi NPS before the accident (22 TBq/year)." This is a policy-making decision with consideration of the viewpoint of risk optimization of the whole decommissioning process as well as ALPS treated water, the effect of natural decay of radioactive materials expected to occur during land storage of ALPS treated water, leakage risk and occupational exposure during long-term storage, and social acceptance such as understanding from stakeholders. Based on this circumstance, we set the annual discharge amount of tritium 22 TBq/year (2.2E+13Bq/year) in accordance with above mentioned "TEPCO's Action in response to Government's Policy," and performed radiological environmental impact assessment.	Appropriate description
(Omission)	(Omission)	

Assessed case Inge of se Sea s H External exposure (mSv/year) Beach Fishi Inges	ngestion f seafood as surface Hull During wimming each sand	i. K4 tanl Average 6.5E 4.8E 7.8E	Source k group Large -09 -09	ii. J1-C ta Average 1.71	on measured ank group Large E-08		ank group Large	Assessed	Source term Ingestion of seafood	i. K4 tan	Source	term based of ii. J1-C ta	on measured		ank group Large	
Assessed case Inge of se Sea s Sea s H External exposure (mSv/year) Beacl Fishi Inges	ngestion f seafood ea surface Hull During wimming each sand	Average 6.5E 4.8E 4.5E	Large -09 -09	ii. J1-C ta Average 1.71 1.21	Large	iii. J1-G ta Average	Large		Ingestion of seafood	Average	k group	ii. J1-C ta	nk group	iii. J1-G ta		
Assessed case Inge of se Sea s Sea s H External exposure (mSv/year) Beacl Fishi Inges	ngestion f seafood ea surface Hull During wimming each sand	Average 6.5E 4.8E 4.5E	Large -09 -09	Average 1.71 1.21	Large	Average 4.7E	Large		Ingestion of seafood	Average						
Sea s H External exposure (mSv/year) Beach Fishi Inges	f seafood ea surface Hull During wimming each sand	6.5E 4.8E 4.5E	-09 -09 -09	1.7I 1.2I	E-08	4.7E			of seafood		Large	Average	Large	Average	Large	
External exposure (mSv/year) Beach Fishi Inges	Hull During wimming each sand	4.8E 4.5E	<u>-09</u>	<u>1.2I</u>			E-08			7.65						
External exposure (mSv/year) Beach Fishi	During wimming each sand	4.5E	<u>-09</u>		E-08	3.3E			Sea surface	<u>/.6E</u>	E-10	2.3E	<u>-10</u>	<u>4.8F</u>	E-10	Appropriate description du the selection of nuclides to measured and assessed
exposure (mSv/year) Beach Fishi Inges	wimming each sand			<u>1.21</u>			E-08		Hull	<u>7.2E</u>	E-10	<u>2.2E</u>	<u>-10</u>	<u>4.6E</u>	E-10	
Fishi		7.8E			E-08	<u>3.2F</u>	E-08	External exposure (mSv/year)	During swimming	<u>5.2F</u>	E-10	<u>1.6E</u>	<u>-10</u>	<u>3.2F</u>	E-10	
Inges	shing net		<u>-06</u>	<u>2.11</u>	E-05	<u>5.6E</u>	E-05		Beach sand	<u>9.1E</u>	E-07	<u>2.7E</u>	<u>-07</u>	<u>5.6E</u>	E-07	
-		<u>1.6E</u>	<u>-06</u>	<u>4.3I</u>	<u>E-06</u>	<u>1.2E</u>	<u>E-05</u>		Fishing net	<u>1.8E</u>	E-07	<u>5.3E</u>	<u>-08</u>	<u>1.1E</u>	E-07	
	gestion of water	3.3E	-07	3.11	E-07	3.2E	E-07		Ingestion of water	3.3E	E-07	3.1E	-07	3.1E	E-07	
exposure	nalation of spray	<u>9.3E</u>	<u>-08</u>	<u>2.01</u>	E-07	4.0E	E-07	Internal exposure (mSv/year)	Inhalation of spray	9.1E	E-08	<u>1.9E</u>	<u>-07</u>	3.8E	E-07	
Inges	gestion of seafood	1.5E-05	6.1E-05	2.8E-05	1.1E-04	7.9E-05	3.0E-04		Ingestion of seafood	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	
Total (mSv/year)	ar)	<u>3E-05</u>	<u>7E-05</u>	<u>5E-05</u>	<u>1E-04</u>	<u>1E-04</u>	4E-04		otal v/year)	<u>6E-06</u>	<u>2E-05</u>	<u>2E-06</u>	<u>5E-06</u>	<u>3E-06</u>	<u>1E-05</u>	
		l														

Current										Revis	sed					Reason for Revision	
Table 6-1-22 Results of internal exposures assessment by age							Ta	Table 6-1-22 Results of internal exposures assessment by age									
	Source	Source term based on measured values						Source	Source term based on measu			on measure	ed values				
Assessed	term	i. K4 taı	nk group	ii. J1-C ta	ank group	iii. J1-G ta	ank group	Assessed	term	i. K4 ta	nk group	ii. J1-C ta	ank group	iii. J1-G t	ank group		
case	Ingestio n of seafood	Average	Large	Average	Large	Average	Large	case	Ingestio n of seafood	Average	Large	Average	Large	Average	Large		Aggregation description due to
Internal	Adult	3.3E	E-07	3.1E	E-07	<u>3.2F</u>	E-07	Internal	Adult	3.3E	E-07	3.1E	E-07	<u>3.11</u>	E-07		Appropriate description due to the selection of nuclides to be measured and assessed
exposure from ingestion of water	Child under school age	5.7E	5.7E-07 <u>5.4E-07</u>		5.5E-07		exposure from ingestion of water	Child under school age	5.7E	E-07	<u>5.3E</u>	E-07	<u>5.41</u>	E-07			
(mSv/year)	Infant	-		-		-	-		Infant	-	-	-	-		-		
Internal	Adult	9.3E-08 2.0E-07 4.0E-07		Internal	Adult	<u>9.11</u>	E-08	1.9E	E-07	<u>3.8I</u>	E-07						
exposure from inhalation of spray	Child under school age	<u>6.2E</u>	E-08	1.1E	E-07	<u>2.2F</u>	E-07	exposure from inhalation of spray	Child under school age	<u>6.0E</u>	E-08	3 1.1E-07 <u>2.1E-07</u>					
(mSv/year)	Infant	<u>4.0E</u>	E-08	<u>6.5E</u>	E-08	<u>1.2F</u>	E-07	(mSv/year)	(mSv/year) Infant		3.9E-08 6.3E-08		1.1E-07				
Internal	Adult	1.5E-05	6.1E-05	2.8E-05	1.1E-04	7.9E-05	3.0E-04	Internal exposure from ingestion of seafood (mSv/year)	Adult	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06		
exposure from ingestion of seafood	Child under school age	2.4E-05	9.4E-05	<u>5.1E-05</u>	2.0E-04	1.5E-04	<u>5.6E-04</u>		Child under school age	4.6E-06	<u>2.9E-06</u>	<u>1.1E-06</u>	4.5E-06	2.4E-06	9.9E-06		
(mSv/year)	Infant	2.9E-05	1.1E-04	<u>6.7E-05</u>	2.5E-04	1.9E-04	7.1E-04		Infant	2.9E-06	1.2E-05	1.0E-06	4.5E-06	2.5E-06	1.1E-05		

Current	Revised	Reason for Revision
6-2. Potential exposure assessment	6-2. Potential exposure assessment	
(Omission)	(Omission)	
6-2-1. Assessment method (1) Identification and selection of potential exposure scenarios	6-2-1. Assessment method (1) Identification and selection of potential exposure scenarios	
(Omission)	(Omission)	
•Case 1 Leakage from piping In the case of leakage from piping, the flow rate of ALPS treated water is considered to be the same as in normal conditions, but the water flows into the sea without dilution. As the severest scenario of leakage from piping, selected is the event of leakage of the whole amount of the maximum flow rare in the normal operation (500 m³/day) from near the north breakwater due to piping rupture near the sea. In addition, in reality, leakage is considered to stop on the following day because the flow rate is monitored constantly and a patrol inspection is performed every day, but here it is assumed that leakage was overlooked and continued for 20 days until one tank series for measurement/confirmation of 10,000 m³ became empty.	•Case 1 Leakage from piping In the case of leakage from piping, the flow rate of ALPS treated water is considered to be the same as in normal conditions, but the water flows into the sea without dilution. As the severest scenario of leakage from piping, selected is the event of leakage of the whole amount of the maximum flow rare in the normal operation (500 m³/day) from near the north breakwater due to piping rupture near the sea. In addition, in reality, leakage is considered to stop on the following day because the flow rate is monitored constantly and a patrol inspection is performed every day, but here it is assumed that leakage was overlooked and continued for 20 days until one tank series for measurement/confirmation of 10,000 m³ became empty. In the case of a break in the transfer pipes of ALPS treated water, the water may leak out to the vicinity of the Units 5/6 intakes or the Units 5/6 discharge outlets, depending on the location of the break, however, the Units 5/6 intakes are connected to the Units 5/6 discharge outlets due to the intake of seawater for dilution of ALPS treated water, so it is conservatively assumed that the entire amount of water would directly flow out the vicinity of the Units 5/6 discharge outlets.	Enhancement of description
•Case 2 Leakage from tanks As the severest scenario, selected is the event of leakage of ALPS treated water of 30,000 m³ per day into the sea due to damage of all of the 3 tank groups for measurement/confirmation caused by an enormous earthquake, etc. In reality, it is conceivable that some of ALPS treated water may remain in the tanks and weirs or penetrate into the ground within the site, but it was decided that the whole volume would flow into the sea in this case.	•Case 2 Leakage from tanks As the severest scenario, selected is the event of leakage of ALPS treated water of 30,000 m³ per day into the sea due to damage of all of the 3 tank groups for measurement/confirmation caused by an enormous earthquake, etc. In reality, it is conceivable that some of ALPS treated water may remain in the tanks and weirs or penetrate into the ground within the site, but it was decided that the whole volume would flow into the sea in this case. The location of the outflow into the sea is assumed to be the same as in Case 1, with the entire amount of water discharged directly to the vicinity of the Units 5/6 discharge outlets.	

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Current	Revised	Reason for Revision
(2) Source term (daily discharge amount of each nuclide)	(2) Source term (daily discharge amount of each nuclide)	
Case 1 (Piping rupture)	Case 1 (Piping rupture)	
		1
(Omission)	(Omission)	!

Table 6-2-1 Source term based on the nuclide composition of measured values (K4 tank group) (Case 1)

		gro	oup) (Case 1)	
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	1.9E+05	5.0E+05	9.5E+10	The daily discharge amount was
C-14	1.5E+01		7.5E+06	calculated from the product of the maximum value of the daily
Mn-54	6.7E-03		3.4E+03	discharge volume of water in
<u>Fe-59</u>	1.7E-02		8.5E+03	normal operation, 500 m ³ , and the concentrations of each nuclide
<u>Co-58</u>	8.0E-03		4.0E+03	concentrations of each nuclide
Co-60	4.4E-01		2.2E+05	
Ni-63	2.2E+00		1.1E+06	
<u>Zn-65</u>	1.5E-02		7.5E+03	
<u>Rb-86</u>	1.9E-01		9.5E+04	
<u>Sr-89</u>	<u>1.0E-01</u>		5.0E+04	
Sr-90	2.2E-01		1.1E+05	
Y-90	2.2E-01		1.1E+05	
<u>Y-91</u>	2.2E+00		<u>1.1E+06</u>	
<u>Nb-95</u>	<u>1.0E-02</u>		<u>5.0E+03</u>	
Tc-99	7.0E-01		3.5E+05	
<u>Ru-103</u>	<u>1.0E-02</u>		<u>5.0E+03</u>	
Ru-106	1.6E+00		8.0E+05	
<u>Rh-103m</u>	<u>1.0E-02</u>		<u>5.0E+03</u>	
<u>Rh-106</u>	<u>1.6E+00</u>		<u>8.0E+05</u>	
<u>Ag-110m</u>	<u>5.6E-03</u>		<u>2.8E+03</u>	
Cd-113m	1.8E-02		9.0E+03	
<u>Cd-115m</u>	<u>6.4E-01</u>		3.2E+05	
<u>Sn-119m</u>	<u>1.7E-01</u>		8.5E+04	
<u>Sn-123</u>	1.2E+00		6.0E+05	
<u>Sn-126</u>	2.7E-02		1.4E+04	
<u>Sb-124</u>	9.5E-03		4.8E+03	
Sb-125	3.3E-01		1.7E+05	
<u>Te-123m</u>	9.2E-03		4.6E+03	
Te-125m	3.3E-01		1.7E+05	
<u>Te-127</u>	<u>3.2E-01</u>		<u>1.6E+05</u>	
<u>Te-127m</u>	<u>3.2E-01</u>		<u>1.6E+05</u>	
<u>Te-129</u>	<u>8.1E-02</u>		<u>4.1E+04</u>	
<u>Te-129m</u>	<u>3.2E-01</u>	_	<u>1.6E+05</u>	
I-129	2.1E+00		1.1E+06	

Table 6-2-1 Source term based on the nuclide composition of measured values (K4 tank group) (Case 1)

		gro	oup) (Case 1)		
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	
H-3	1.9E+05	5.0E+05	9.5E+10	The daily discharge amount was	
C-14	1.5E+01		7.5E+06	calculated from the product of the maximum value of the daily	
Mn-54	6.7E-03		3.4E+03	discharge volume of water in	
Co-60	4.4E-01		2.2E+05	normal operation, 500 m ³ , and the concentrations of each nuclide	Appropriate description due to the selection of nuclides to be
Ni-63	2.2E+00		1.1E+06	concentrations of each nuclide	measured and assessed
<u>Se-79</u>	1.5E+00		7.5E+05		
Sr-90	2.2E-01		1.1E+05		
Y-90	2.2E-01		1.1E+05		
Tc-99	7.0E-01		3.5E+05		
Ru-106	1.6E+00		8.0E+05		
Cd-113m	1.8E-02		9.0E+03		
Sb-125	3.3E-01		1.7E+05		
Te-125m	3.3E-01		1.7E+05		
I-129	2.1E+00		1.1E+06		
Cs-134	4.5E-02		2.3E+04		
Cs-137	4.2E-01		2.1E+05		
Ce-144	6.3E-02		3.2E+04		
Pm-147	1.9E-01		9.5E+04		
Sm-151	9.0E-04		4.5E+02		
Eu-154	1.2E-02		6.0E+03		
Eu-155	3.3E-02		1.7E+04		
<u>U-234</u>	<u>6.3E-04</u>		3.2E+02		
<u>U-238</u>	<u>6.3E-04</u>		3.2E+02		
<u>Np-237</u>	<u>6.3E-04</u>		3.2E+02		
Pu-238	6.3E-04		3.2E+02		
Pu-239	6.3E-04		3.2E+02		
Pu-240	6.3E-04		3.2E+02		
Pu-241	2.8E-02	_	1.4E+04		
Am-241	6.3E-04	_	3.2E+02		
Cm-243	6.3E-04		3.2E+02		
Cm-244	6.3E-04		3.2E+02		

		Current	Revised	Reason for Revision
Cs-134	4.5E-02	2.3E+04		
<u>Cs-135</u>	<u>2.5E-06</u>	1.3E+00		Appropriate description due to
<u>Cs-136</u>	3.0E-02	1.5E+04		the selection of nuclides to be measured and assessed
Cs-137	4.2E-01	2.1E+05		measured and assessed
<u>Ba-137m</u>	<u>4.2E-01</u>	2.1E+05		
<u>Ba-140</u>	9.5E-02	4.8E+04		
<u>Ce-141</u>	2.5E-02	1.3E+04		
Ce-144	6.3E-02	3.2E+04		
<u>Pr-144</u>	6.3E-02	3.2E+04		
<u>Pr-144m</u>	6.3E-02	3.2E+04		
<u>Pm-146</u>	9.8E-02	4.9E+04		
Pm-147	1.9E-01	9.5E+04		
<u>Pm-148</u>	5.0E-01	2.5E+05		
<u>Pm-148m</u>	8.4E-03	4.2E+03		
Sm-151	9.0E-04	4.5E+02		
<u>Eu-152</u>	<u>2.8E-02</u>	<u>1.4E+04</u>		
Eu-154	1.2E-02	6.0E+03		
Eu-155	3.3E-02	1.7E+04		
<u>Gd-153</u>	3.2E-02	<u>1.6E+04</u>		
<u>Tb-160</u>	<u>2.8E-02</u>	<u>1.4E+04</u>		
Pu-238	6.3E-04	3.2E+02		
Pu-239	6.3E-04	3.2E+02		
Pu-240	6.3E-04	3.2E+02		
Pu-241	2.8E-02	1.4E+04		
Am-241	6.3E-04	3.2E+02		
<u>Am-242m</u>	3.9E-05	2.0E+01		
<u>Am-243</u>	<u>6.3E-04</u>	3.2E+02		
<u>Cm-242</u>	<u>6.3E-04</u>	3.2E+02		
Cm-243	6.3E-04	3.2E+02		
Cm-244	6.3E-04	3.2E+02		

Current							Reason for Revision			
Table	6-2-2 Source to	erm based on th	ne nuclide compos	sition of measured values (J1-C	Table	e 6-2-2 Source 1	term based on th	ne nuclide compo	sition of measured values (J1-C	
		tank g	group) (Case 1)							
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	
H-3	8.2E+05	5.0E+05	4.1E+11	The daily discharge amount was	H-3	8.2E+05	5.0E+05	4.1E+11	The daily discharge amount was	
C-14	1.8E+01		9.0E+06	calculated from the product of the maximum value of the daily	C-14	1.8E+01		9.0E+06	calculated from the product of the maximum value of the daily	
Mn-54	3.8E-02		1.9E+04	discharge volume of water in	Mn-54	3.8E-02		1.9E+04	discharge volume of water in	Appropriate description due to
<u>Fe-59</u>	8.7E-02		4.4E+04	normal operation, 500 m ³ , and the concentrations of each nuclide	Co-60	3.3E-01		1.7E+05	normal operation, 500 m ³ , and the concentrations of each nuclide	the selection of nuclides to be
<u>Co-58</u>	<u>4.1E-02</u>		2.1E+04	concentrations of each nuclide	Ni-63	8.5E+00		4.3E+06	concentrations of each fulcinde	measured and assessed
Co-60	3.3E-01		1.7E+05		<u>Se-79</u>	<u>1.5E+00</u>		<u>7.5E+05</u>		
Ni-63	8.5E+00		4.3E+06		Sr-90	3.6E-02		1.8E+04		
<u>Zn-65</u>	<u>9.4E-02</u>		<u>4.7E+04</u>		Y-90	3.6E-02		1.8E+04		
<u>Rb-86</u>	<u>5.0E-01</u>		<u>2.5E+05</u>		Tc-99	1.2E+00		6.0E+05		
<u>Sr-89</u>	<u>5.4E-02</u>		<u>2.7E+04</u>		Ru-106	1.4E+00		7.0E+05		
Sr-90	3.6E-02		1.8E+04		Cd-113m	8.5E-02		4.3E+04		
Y-90	3.6E-02		1.8E+04		Sb-125	2.3E-01		1.2E+05		
<u>Y-91</u>	1.7E+01		<u>8.5E+06</u>		Te-125m	2.3E-01		1.2E+05		
<u>Nb-95</u>	<u>5.0E-02</u>		2.5E+04		I-129	1.2E+00		6.0E+05		
Tc-99	1.2E+00		6.0E+05		Cs-134	7.6E-02		3.8E+04		
<u>Ru-103</u>	<u>5.3E-02</u>		2.7E+04		Cs-137	1.9E-01		9.5E+04		
Ru-106	1.4E+00		7.0E+05		Ce-144	5.7E-01		2.9E+05		
<u>Rh-103m</u>	<u>5.3E-02</u>		2.7E+04		Pm-147	8.0E-01		4.0E+05		
<u>Rh-106</u>	1.4E+00		<u>7.0E+05</u>		Sm-151	1.1E-02		5.5E+03		
<u>Ag-110m</u>	<u>4.3E-02</u>	_	2.2E+04		Eu-154	1.1E-01		5.5E+04		
Cd-113m	8.5E-02		4.3E+04		Eu-155	3.4E-01		1.7E+05		
<u>Cd-115m</u>	2.7E+00	_	<u>1.4E+06</u>		<u>U-234</u>	3.3E-02		1.7E+04		
<u>Sn-119m</u>	4.2E+01	_	2.1E+07		<u>U-238</u>	3.3E-02		1.7E+04		
<u>Sn-123</u>	6.6E+00	_	3.3E+06		<u>Np-237</u>	3.3E-02		1.7E+04		
<u>Sn-126</u>	2.9E-01		1.5E+05		Pu-238	3.3E-02		1.7E+04		
<u>Sb-124</u>	9.7E-02	_	4.9E+04		Pu-239	3.3E-02		1.7E+04		
Sb-125	2.3E-01	_	1.2E+05		Pu-240	3.3E-02	_	1.7E+04		
<u>Te-123m</u>	9.2E-02	_	4.6E+04		Pu-241	1.2E+00		6.0E+05		
Te-125m	2.3E-01	_	1.2E+05		Am-241	3.3E-02		1.7E+04		
<u>Te-127</u>	4.7E+00 4.9E+00	_	2.4E+06 2.5E+06		Cm-243	3.3E-02		1.7E+04		
<u>Te-127m</u> <u>Te-129</u>	<u>4.9E+00</u> <u>6.2E-01</u>	_	3.1E+05		Cm-244	3.3E-02		1.7E+04		
<u>Te-129</u> Te-129m	1.4E+00	_	3.1E+03 7.0E+05							
I-129	1.4E+00 1.2E+00	-	6.0E+05							
Cs-134	7.6E-02	1	3.8E+04							
<u>Cs-135</u>	1.2E-06	1	6.0E-01							
<u>Cs-136</u>	4.7E-02	1	2.4E+04							
Cs-137	1.9E-01	-	9.5E+04							
Ba-137m	1.9E-01	-	9.5E+04							
<u>Du 15/111</u>	1.71. ()1		2.0110T							

	Current	Revised	Reason for Revision
<u>Ba-140</u> <u>2.0E-01</u>	1.0E+05		Appropriate description due to
<u>Ce-141</u> <u>2.6E-01</u>	1.3E+05		the selection of nuclides to be
Ce-144 5.7E-01	2.9E+05		measured and assessed
<u>Pr-144</u> <u>5.7E-01</u>	<u>2.9E+05</u>		
<u>Pr-144m</u> <u>5.7E-01</u>	2.9E+05		
<u>Pm-146</u> <u>6.7E-02</u>	3.4E+04		
Pm-147 8.0E-01	4.0E+05		
<u>Pm-148</u> <u>2.3E-01</u>	<u>1.2E+05</u>		
<u>Pm-148m</u> <u>4.8E-02</u>	<u>2.4E+04</u>		
Sm-151 1.1E-02	5.5E+03		
<u>Eu-152</u> <u>2.8E-01</u>	<u>1.4E+05</u>		
Eu-154 1.1E-01	5.5E+04		
Eu-155 3.4E-01	1.7E+05		
<u>Gd-153</u> <u>2.6E-01</u>	<u>1.3E+05</u>		
<u>Tb-160</u> <u>1.4E-01</u>	7.0E+04		
Pu-238 3.3E-02	1.7E+04		
Pu-239 3.3E-02	1.7E+04		
Pu-240 3.3E-02	1.7E+04		
Pu-241 1.2E+00	6.0E+05		
Am-241 3.3E-02	1.7E+04		
<u>Am-242m</u> <u>5.9E-04</u>	3.0E+02		
<u>Am-243</u> <u>3.3E-02</u>	<u>1.7E+04</u>		
<u>Cm-242</u> <u>3.3E-02</u>	<u>1.7E+04</u>		
Cm-243 3.3E-02	1.7E+04		
Cm-244 3.3E-02	1.7E+04		

Current						Reason for Revision					
Table 6-2-3 Source term based on the nuclide composition of measured values (J1-G tank group) (Case 1)						Table 6-2-3 Source term based on the nuclide composition of measured values (J1-G tank group) (Case 1)					
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	_	Remarks		
H-3	2.7E+05	5.0E+05	1.4E+11	The daily discharge amount was	H-3	2.7E+05	5.0E+05	1.4E+11	The daily discharge amount was		
C-14	1.6E+01	3.0E103	8.0E+06	calculated from the product of the	C-14	1.6E+01		8.0E+06	calculated from the product of the maximum value of the daily		
Mn-54	3.8E-02	1	1.9E+04	maximum value of the daily discharge volume of water in	Mn-54	3.8E-02		1.9E+04	discharge volume of water in	Appropriate description due to	
Fe-59	7.2E-02	1	3.6E+04	normal operation, 500 m ³ , and the	Co-60	2.3E-01		1.2E+05	normal operation, 500 m ³ , and the concentrations of each nuclide	the selection of nuclides to be	
<u>Co-58</u>	3.7E-02	1	1.9E+04	concentrations of each nuclide	Ni-63	8.8E+00		4.4E+06		measured and assessed	
Co-60	2.3E-01		1.2E+05		<u>Se-79</u>	<u>1.5E+00</u>		<u>7.5E+05</u>			
Ni-63	8.8E+00		4.4E+06		Sr-90	3.2E-02		1.6E+04			
<u>Zn-65</u>	8.0E-02		4.0E+04		Y-90	3.2E-02	_	1.6E+04			
<u>Rb-86</u>	<u>4.7E-01</u>		2.4E+05		Tc-99	1.3E+00	4	6.5E+05			
<u>Sr-89</u>	4.5E-02		2.3E+04		Ru-106	4.8E-01	_	2.4E+05			
Sr-90	3.2E-02		1.6E+04		Cd-113m	8.6E-02	4	4.3E+04			
Y-90	3.2E-02		1.6E+04		Sb-125	1.4E-01	4	7.0E+04			
<u>Y-91</u>	1.2E+01		6.0E+06		Te-125m	1.4E-01	4	7.0E+04			
<u>Nb-95</u>	4.7E-02		2.4E+04		I-129	3.3E-01	_	1.7E+05			
Tc-99	1.3E+00		6.5E+05		Cs-134 Cs-137	6.7E-02 3.3E-01	_	3.4E+04 1.7E+05			
<u>Ru-103</u>	<u>5.1E-02</u>	_	2.6E+04		Cs-137 Ce-144	5.5E-01	-	2.8E+05			
Ru-106	4.8E-01	_	2.4E+05		Pm-147	7.2E-01		3.6E+05			
<u>Rh-103m</u>	<u>5.1E-02</u>	_	2.6E+04		Sm-151	1.0E-02	-	5.0E+03			
<u>Rh-106</u>	4.8E-01	_	2.4E+05		Eu-154	1.0E-01	-	5.0E+04			
<u>Ag-110m</u>	4.0E-02		2.0E+04		Eu-155	1.8E-01	-	9.0E+04	1		
Cd-113m	8.6E-02	_	4.3E+04		<u>U-234</u>	2.8E-02		1.4E+04			
<u>Cd-115m</u>	2.3E+00 4.0E+01	_	1.2E+06 2.0E+07		<u>U-238</u>	2.8E-02	-	1.4E+04			
<u>Sn-119m</u> <u>Sn-123</u>	6.3E+00	_	3.2E+06		Np-237	2.8E-02		1.4E+04			
<u>Sn-125</u> <u>Sn-126</u>	1.5E-01	+	7.5E+04		Pu-238	2.8E-02		1.4E+04			
Sb-124	8.4E-02	-	4.2E+04		Pu-239	2.8E-02		1.4E+04			
Sb-125	1.4E-01	-	7.0E+04		Pu-240	2.8E-02	1	1.4E+04			
<u>Te-123m</u>	6.7E-02	+	3.4E+04		Pu-241	1.0E+00		5.0E+05			
Te-125m	1.4E-01	1	7.0E+04		Am-241	2.8E-02		1.4E+04			
<u>Te-127</u>	4.3E+00	1	2.2E+06		Cm-243	2.8E-02		1.4E+04			
Te-127m	4.5E+00	1	2.3E+06		Cm-244	2.8E-02		1.4E+04			
<u>Te-129</u>	5.9E-01		3.0E+05						-		
<u>Te-129m</u>	1.2E+00	1	6.0E+05								
I-129	3.3E-01	1	1.7E+05								
Cs-134	6.7E-02	1	3.4E+04								
<u>Cs-135</u>	<u>2.1E-06</u>		1.1E+00								
<u>Cs-136</u>	3.6E-02		1.8E+04								
Cs-137	3.3E-01		1.7E+05								
	raion aball provail				<u> </u>					1	

		Current	Revised Revised	Reason for Revision
<u>Ba-137m</u>	3.3E-01	<u>1.7E+05</u>		Appropriate description due to
<u>Ba-140</u>	1.7E-01	8.5E+04		the selection of nuclides to be measured and assessed
<u>Ce-141</u>	<u>1.2E-01</u>	6.0E+04		measured and assessed
Ce-144	5.5E-01	2.8E+05		
<u>Pr-144</u>	<u>5.5E-01</u>	<u>2.8E+05</u>		
<u>Pr-144m</u>	<u>5.5E-01</u>	<u>2.8E+05</u>		
<u>Pm-146</u>	<u>6.3E-02</u>	3.2E+04		
Pm-147	7.2E-01	3.6E+05		
<u>Pm-148</u>	4.5E-01	2.3E+05		
<u>Pm-148m</u>	<u>4.1E-02</u>	<u>2.1E+04</u>		
Sm-151	1.0E-02	5.0E+03		
<u>Eu-152</u>	<u>1.9E-01</u>	<u>9.5E+04</u>		
Eu-154	1.0E-01	5.0E+04		
Eu-155	1.8E-01	9.0E+04		
<u>Gd-153</u>	1.9E-01	<u>9.5E+04</u>		
<u>Tb-160</u>	<u>1.4E-01</u>	7.0E+04		
Pu-238	2.8E-02	1.4E+04		
Pu-239	2.8E-02	1.4E+04		
Pu-240	2.8E-02	1.4E+04		
Pu-241	1.0E+00	5.0E+05		
Am-241	2.8E-02	1.4E+04		
<u>Am-242m</u>	5.1E-04	2.6E+02		
<u>Am-243</u> <u>Cm-242</u>	2.8E-02 2.8E-02	1.4E+04 1.4E+04		
Cm-243	2.8E-02	1.4E+04		
Cm-244	2.8E-02	1.4E+04		
CIII-244	2.8E-02	1.4ET04		

Current	Revised	Reason for Revision
Case 2 (Tank damage)	Case 2 (Tank damage)	

(Omission)

Table 6-2-4 Source term based on the nuclide composition of measured values (K4 tank group) (Case 2)

		gro	oup) (Case 2)	
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	1.9E+05	3.0E+07	5.7E+12	• It was assumed that all of 3 tank
C-14	1.5E+01		4.5E+08	groups for measurement/confirmation were
Mn-54	6.7E-03		2.0E+05	damaged and whole capacity (30,000
<u>Fe-59</u>	<u>1.7E-02</u>		<u>5.1E+05</u>	m ³) leaked in 1 day • The daily discharge amount was
<u>Co-58</u>	8.0E-03		2.4E+05	calculated from the product of the
Co-60	4.4E-01		1.3E+07	daily discharge volume of water, 30,000 m ³ , and the nuclide
Ni-63	2.2E+00		6.6E+07	concentration
<u>Zn-65</u>	<u>1.5E-02</u>		4.5E+05	
<u>Rb-86</u>	1.9E-01		5.7E+06	
<u>Sr-89</u>	1.0E-01		3.0E+06	
Sr-90	2.2E-01		6.6E+06	
Y-90	2.2E-01		6.6E+06	
<u>Y-91</u>	2.2E+00		6.6E+07	
<u>Nb-95</u>	1.0E-02		3.0E+05	
Tc-99	7.0E-01		2.1E+07	
<u>Ru-103</u>	1.0E-02		3.0E+05	
Ru-106	1.6E+00		4.8E+07	
<u>Rh-103m</u>	1.0E-02		3.0E+05	
<u>Rh-106</u>	1.6E+00		4.8E+07	
<u>Ag-110m</u>	<u>5.6E-03</u>		1.7E+05	
Cd-113m	1.8E-02		5.4E+05	
<u>Cd-115m</u>	<u>6.4E-01</u>		1.9E+07	
<u>Sn-119m</u>	<u>1.7E-01</u>		<u>5.1E+06</u>	
<u>Sn-123</u>	1.2E+00		3.6E+07	
<u>Sn-126</u>	<u>2.7E-02</u>		<u>8.1E+05</u>	
<u>Sb-124</u>	9.5E-03		2.9E+05	
Sb-125	3.3E-01]	9.9E+06	
<u>Te-123m</u>	9.2E-03		2.8E+05	
Te-125m	3.3E-01		9.9E+06	
<u>Te-127</u>	3.2E-01		<u>9.6E+06</u>	
<u>Te-127m</u>	3.2E-01		9.6E+06	
<u>Te-129</u>	<u>8.1E-02</u>	_	2.4E+06	
<u>Te-129m</u>	3.2E-01		9.6E+06	
I-129	2.1E+00		6.3E+07	

Table 6-2-4	Source term based on the nuclide composition of measured values (K4 tank
	group) (Case 2)

		gro	up) (Case 2)	
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	1.9E+05	3.0E+07	5.7E+12	• It was assumed that all of 3 tank
C-14	1.5E+01		4.5E+08	groups for measurement/confirmation were
Mn-54	6.7E-03		2.0E+05	damaged and whole capacity (30,000
Co-60	4.4E-01		1.3E+07	 m³) leaked in 1 day The daily discharge amount was
Ni-63	2.2E+00		6.6E+07	calculated from the product of the
<u>Se-79</u>	1.5E+00		4.5E+07	daily discharge volume of water, 30,000 m ³ , and the nuclide
Sr-90	2.2E-01		6.6E+06	concentration
Y-90	2.2E-01		6.6E+06	
Tc-99	7.0E-01		2.1E+07	
Ru-106	1.6E+00		4.8E+07	
Cd-113m	1.8E-02		5.4E+05	
Sb-125	3.3E-01		9.9E+06	
Te-125m	3.3E-01		9.9E+06	
I-129	2.1E+00		6.3E+07	
Cs-134	4.5E-02		1.4E+06	
Cs-137	4.2E-01		1.3E+07	
Ce-144	6.3E-02		1.9E+06	
Pm-147	1.9E-01		5.7E+06	
Sm-151	9.0E-04		2.7E+04	
Eu-154	1.2E-02		3.6E+05	
Eu-155	3.3E-02		9.9E+05	
<u>U-234</u>	<u>6.3E-04</u>		1.9E+04	
<u>U-238</u>	<u>6.3E-04</u>		<u>1.9E+04</u>	
<u>Np-237</u>	<u>6.3E-04</u>		<u>1.9E+04</u>	
Pu-238	6.3E-04		1.9E+04	
Pu-239	6.3E-04	_	1.9E+04	
Pu-240	6.3E-04	_	1.9E+04	
Pu-241	2.8E-02	_	8.4E+05	
Am-241	6.3E-04	_	1.9E+04	
Cm-243	6.3E-04	-	1.9E+04	
Cm-244	6.3E-04		1.9E+04	

(Omission)

Appropriate description due to the selection of nuclides to be

measured and assessed

		Current	Revised	Reason for Revision
Cs-134	4.5E-02	1.4E+06		
Cs-135	2.5E-06	7.5E+01		Appropriate description due to the selection of nuclides to be
Cs-136	3.0E-02	9.0E+05		measured and assessed
Cs-137	4.2E-01	1.3E+07		
<u>Ba-137m</u>	4.2E-01	1.3E+07		
<u>Ba-140</u>	9.5E-02	2.9E+06		
<u>Ce-141</u>	2.5E-02	7.5E+05		
Ce-144	6.3E-02	1.9E+06		
<u>Pr-144</u>	<u>6.3E-02</u>	<u>1.9E+06</u>		
<u>Pr-144m</u>	<u>6.3E-02</u>	<u>1.9E+06</u>		
<u>Pm-146</u>	9.8E-02	<u>2.9E+06</u>		
Pm-147	1.9E-01	5.7E+06		
<u>Pm-148</u>	<u>5.0E-01</u>	<u>1.5E+07</u>		
<u>Pm-148m</u>	<u>8.4E-03</u>	2.5E+05		
Sm-151	9.0E-04	2.7E+04		
<u>Eu-152</u>	<u>2.8E-02</u>	<u>8.4E+05</u>		
Eu-154	1.2E-02	3.6E+05		
Eu-155	3.3E-02	9.9E+05		
<u>Gd-153</u>	3.2E-02	<u>9.6E+05</u>		
<u>Tb-160</u>	2.8E-02	<u>8.4E+05</u>		
Pu-238	6.3E-04	1.9E+04		
Pu-239	6.3E-04	1.9E+04		
Pu-240	6.3E-04	1.9E+04		
Pu-241	2.8E-02	8.4E+05		
Am-241	6.3E-04	1.9E+04		
Am-242m	3.9E-05	1.2E+03		
Am-243	6.3E-04	1.9E+04		
Cm-242	6.3E-04	1.9E+04		
Cm-243	6.3E-04	1.9E+04		
Cm-244	6.3E-04	1.9E+04		

	Current					Revised				Reason for Revision
Table	Table 6-2-5 Source term based on the nuclide composition of measured values (J1-C				Table 6-2-5 Source term based on the nuclide composition of measured values (J1-C tank group) (Case 2)					
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	
H-3	8.2E+05	3.0E+07	2.5E+13	It was assumed that all of 3 tank	H-3	8.2E+05	3.0E+07	2.5E+13	It was assumed that all of 3 tank	
C-14	1.8E+01	3.01107	5.4E+08	groups for	C-14	1.8E+01		5.4E+08	groups for measurement/confirmation were	
Mn-54	3.8E-02	_	1.1E+06	measurement/confirmation were damaged and whole capacity (30,000	Mn-54	3.8E-02		1.1E+06	damaged and whole capacity (30,000	Appropriate description due to
Fe-59	8.7E-02	_	2.6E+06	m ³) leaked in 1 day	Co-60	3.3E-01		9.9E+06	m ³) leaked in 1 day • The daily discharge amount was	the selection of nuclides to be
<u>Co-58</u>	4.1E-02		1.2E+06	The daily discharge amount was calculated from the product of the	Ni-63	8.5E+00		2.6E+08	calculated from the product of the	measured and assessed
Co-60	3.3E-01		9.9E+06	daily discharge volume of water,	<u>Se-79</u>	1.5E+00	1	4.5E+07	daily discharge volume of water, 30,000 m ³ , and the nuclide	
Ni-63	8.5E+00		2.6E+08	- 30,000 m ³ , and the nuclide concentration	Sr-90	3.6E-02		1.1E+06	concentration	
<u>Zn-65</u>	9.4E-02	_	2.8E+06		Y-90	3.6E-02		1.1E+06	1	
<u>Rb-86</u>	5.0E-01		1.5E+07	1	Tc-99	1.2E+00		3.6E+07	1	
<u>Sr-89</u>	5.4E-02		1.6E+06	1	Ru-106	1.4E+00		4.2E+07	1	
Sr-90	3.6E-02		1.1E+06	1	Cd-113m	8.5E-02	1	2.6E+06	1	
Y-90	3.6E-02		1.1E+06	1	Sb-125	2.3E-01	1	6.9E+06	1	
<u>Y-91</u>	1.7E+01		5.1E+08	1	Te-125m	2.3E-01		6.9E+06	1	
<u>Nb-95</u>	5.0E-02	_	1.5E+06	1	I-129	1.2E+00		3.6E+07		
Tc-99	1.2E+00		3.6E+07	1	Cs-134	7.6E-02		2.3E+06		
<u>Ru-103</u>	<u>5.3E-02</u>		1.6E+06	1	Cs-137	1.9E-01		5.7E+06		
Ru-106	1.4E+00		4.2E+07	1	Ce-144	5.7E-01		1.7E+07	_	
Rh-103m	5.3E-02		1.6E+06	1	Pm-147	8.0E-01		2.4E+07	_	
Rh-106	1.4E+00		4.2E+07	1	Sm-151	1.1E-02		3.3E+05		
<u>Ag-110m</u>	4.3E-02		1.3E+06	1	Eu-154	1.1E-01	_	3.3E+06		
Cd-113m	8.5E-02		2.6E+06	1	Eu-155	3.4E-01	4	1.0E+07	4	
<u>Cd-115m</u>	2.7E+00		8.1E+07	1	<u>U-234</u>	3.3E-02	4	9.9E+05	4	
<u>Sn-119m</u>	4.2E+01		1.3E+09		<u>U-238</u>	3.3E-02	_	9.9E+05	-	
<u>Sn-123</u>	<u>6.6E+00</u>		2.0E+08	1	Np-237 Pu-238	3.3E-02 3.3E-02	_	9.9E+05 9.9E+05	-	
<u>Sn-126</u>	<u>2.9E-01</u>		<u>8.7E+06</u>]	Pu-239	3.3E-02 3.3E-02	-	9.9E+05 9.9E+05	1	
<u>Sb-124</u>	<u>9.7E-02</u>		<u>2.9E+06</u>	<u>]</u>	Pu-240	3.3E-02	-	9.9E+05	1	
Sb-125	2.3E-01		6.9E+06	<u>]</u>	Pu-241	1.2E+00	-	3.6E+07	1	
<u>Te-123m</u>	<u>9.2E-02</u>		2.8E+06	<u>]</u>	Am-241	3.3E-02	1	9.9E+05	1	
Te-125m	2.3E-01		6.9E+06	<u>]</u>	Cm-243	3.3E-02	1	9.9E+05	1	
<u>Te-127</u>	4.7E+00		1.4E+08	<u>]</u>	Cm-244	3.3E-02		9.9E+05	1	
<u>Te-127m</u>	4.9E+00		1.5E+08	<u>]</u>		1				
<u>Te-129</u>	<u>6.2E-01</u>		1.9E+07							
<u>Te-129m</u>	1.4E+00		4.2E+07							
I-129	1.2E+00		3.6E+07	4						
Cs-134	7.6E-02		2.3E+06							
<u>Cs-135</u>	<u>1.2E-06</u>		3.6E+01	4						
<u>Cs-136</u>	<u>4.7E-02</u>		<u>1.4E+06</u>							
31 Y	rgion shall provide									

		Current	Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachm Revised	Reason for Revision
Cs-137	1.9E-01	5.7E+06		
<u>Ba-137m</u>	1.9E-01	<u>5.7E+06</u>		Appropriate description due to
<u>Ba-140</u>	2.0E-01	6.0E+06		the selection of nuclides to be measured and assessed
<u>Ce-141</u>	2.6E-01	7.8E+06		
Ce-144	5.7E-01	1.7E+07		
<u>Pr-144</u>	<u>5.7E-01</u>	<u>1.7E+07</u>		
<u>Pr-144m</u>	<u>5.7E-01</u>	<u>1.7E+07</u>		
<u>Pm-146</u>	<u>6.7E-02</u>	2.0E+06		
Pm-147	8.0E-01	2.4E+07		
<u>Pm-148</u>	2.3E-01	<u>6.9E+06</u>		
<u>Pm-148m</u>	4.8E-02	<u>1.4E+06</u>		
Sm-151	1.1E-02	3.3E+05		
<u>Eu-152</u>	2.8E-01	<u>8.4E+06</u>		
Eu-154	1.1E-01	3.3E+06		
Eu-155	3.4E-01	1.0E+07		
<u>Gd-153</u>	<u>2.6E-01</u>	7.8E+06		
<u>Tb-160</u>	<u>1.4E-01</u>	<u>4.2E+06</u>		
Pu-238	3.3E-02	9.9E+05		
Pu-239	3.3E-02	9.9E+05		
Pu-240	3.3E-02	9.9E+05		
Pu-241	1.2E+00	3.6E+07		
Am-241	3.3E-02	9.9E+05		
<u>Am-242m</u>	<u>5.9E-04</u>	<u>1.8E+04</u>		
<u>Am-243</u>	<u>3.3E-02</u>	<u>9.9E+05</u>		
<u>Cm-242</u>	<u>3.3E-02</u>	<u>9.9E+05</u>		
Cm-243	3.3E-02	9.9E+05		
Cm-244	3.3E-02	9.9E+05		

			Current					Revised		Reason for Revision
Table 6-2-6 Source term based on the nuclide composition of measured values (J1-G						6-2-6 Source t	sition of measured values (J1-G			
tank group) (Case 2)										
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks	
H-3	2.7E+05	3.0E+07	8.1E+12	• It was assumed that all of 3 tank groups for	H-3	2.7E+05	3.0E+07	8.1E+12	• It was assumed that all of 3 tank groups for	
C-14	1.6E+01		4.8E+08	measurement/confirmation were	C-14	1.6E+01		4.8E+08	measurement/confirmation were	
Mn-54	3.8E-02			damaged and whole capacity (30,000	Mn-54	3.8E-02		1.1E+06	damaged and whole capacity (30,000	Appropriate description due to
<u>Fe-59</u>	<u>7.2E-02</u>	-	2.2E+06	m³) leaked in 1 day • The daily discharge amount was	Co-60	2.3E-01		6.9E+06	m ³) leaked in 1 day • The daily discharge amount was	the selection of nuclides to be
<u>Co-58</u>	3.7E-02	-	<u>1.1E+06</u>	calculated from the product of the	Ni-63	8.8E+00	_	2.6E+08	calculated from the product of the	measured and assessed
Co-60	2.3E-01	-		daily discharge volume of water, 30,000 m ³ , and the nuclide	<u>Se-79</u>	1.5E+00	_	4.5E+07	daily discharge volume of water, 30,000 m ³ , and the nuclide	
Ni-63	8.8E+00	-	2.6E+08	concentration	Sr-90	3.2E-02	_	9.6E+05	concentration	
<u>Zn-65</u>	8.0E-02	-	2.4E+06		Y-90	3.2E-02	_	9.6E+05		
<u>Rb-86</u>	4.7E-01	-	1.4E+07		Tc-99	1.3E+00	_	3.9E+07		
<u>Sr-89</u>	4.5E-02	-	1.4E+06		Ru-106	4.8E-01	_	1.4E+07		
Sr-90	3.2E-02	-	9.6E+05		Cd-113m	8.6E-02	_	2.6E+06		
Y-90	3.2E-02	-	9.6E+05		Sb-125	1.4E-01	_	4.2E+06		
<u>Y-91</u>	1.2E+01	-	3.6E+08		Te-125m	1.4E-01	_	4.2E+06		
<u>Nb-95</u>	4.7E-02	-	1.4E+06		I-129	3.3E-01	_	9.9E+06		
Tc-99	1.3E+00	-	3.9E+07		Cs-134	6.7E-02	_	2.0E+06		
<u>Ru-103</u>	5.1E-02	-	1.5E+06		Cs-137	3.3E-01	_	9.9E+06		
Ru-106	4.8E-01	-	1.4E+07		Ce-144	5.5E-01	4	1.7E+07		
Rh-103m Rh-106	5.1E-02 4.8E-01	-	1.5E+06 1.4E+07		Pm-147	7.2E-01	-	2.2E+07		
<u>Ag-110m</u>	4.0E-02	-	1.2E+06		Sm-151 Eu-154	1.0E-02 1.0E-01	_	3.0E+05 3.0E+06		
Cd-113m	8.6E-02	-	2.6E+06		Eu-154 Eu-155	1.0E-01 1.8E-01	_	5.4E+06		
<u>Cd-115m</u>	2.3E+00	-	6.9E+07		<u>U-234</u>	2.8E-02	-	8.4E+05		
<u>Sn-119m</u>	4.0E+01	-	1.2E+09		<u>U-234</u> <u>U-238</u>	2.8E-02	-	8.4E+05		
<u>Sn-123</u>	6.3E+00	-	1.9E+08		<u>Np-237</u>	2.8E-02	-	8.4E+05		
<u>Sn-126</u>	1.5E-01		4.5E+06		Pu-238	2.8E-02	-	8.4E+05		
<u>Sb-124</u>	8.4E-02	-	2.5E+06		Pu-239	2.8E-02	-	8.4E+05		
Sb-125	1.4E-01	-	4.2E+06		Pu-240	2.8E-02		8.4E+05		
<u>Te-123m</u>	6.7E-02	-	2.0E+06		Pu-241	1.0E+00	1	3.0E+07		
Te-125m	1.4E-01	-	4.2E+06		Am-241	2.8E-02		8.4E+05		
Te-127	4.3E+00		1.3E+08		Cm-243	2.8E-02		8.4E+05		
<u>Te-127m</u>	4.5E+00	-	1.4E+08		Cm-244	2.8E-02	1	8.4E+05		
Te-129	5.9E-01	-	3.6E+07				_]			
<u>Te-129m</u>	1.2E+00	-	3.6E+07							
I-129	3.3E-01	1	9.9E+06							
Cs-134	6.7E-02	1	2.0E+06							
<u>Cs-135</u>	2.1E-06	1	6.3E+01							
<u>Cs-136</u>	3.6E-02	1	1.1E+06							
Cs-137	3.3E-01	1	9.9E+06							

		Current	Revised	Reason for Revision
<u>Ba-137m</u>	3.3E-01	<u>9.9E+06</u>		Appropriate description due to
<u>Ba-140</u>	<u>1.7E-01</u>	<u>5.1E+06</u>		the selection of nuclides to be measured and assessed
<u>Ce-141</u>	<u>1.2E-01</u>	3.6E+06		measured and assessed
Ce-144	5.5E-01	1.7E+07		
<u>Pr-144</u>	<u>5.5E-01</u>	<u>1.7E+07</u>		
<u>Pr-144m</u>	<u>5.5E-01</u>	<u>1.7E+07</u>		
<u>Pm-146</u>	<u>6.3E-02</u>	<u>1.9E+06</u>		
Pm-147	7.2E-01	2.2E+07		
<u>Pm-148</u>	4.5E-01	<u>1.4E+07</u>		
<u>Pm-148m</u>	<u>4.1E-02</u>	<u>1.2E+06</u>		
Sm-151	1.0E-02	3.0E+05		
<u>Eu-152</u>	<u>1.9E-01</u>	<u>5.7E+06</u>		
Eu-154	1.0E-01	3.0E+06		
Eu-155	1.8E-01	5.4E+06		
<u>Gd-153</u>	<u>1.9E-01</u>	<u>5.7E+06</u>		
<u>Tb-160</u>	<u>1.4E-01</u>	<u>4.2E+06</u>		
Pu-238	2.8E-02	8.4E+05		
Pu-239	2.8E-02	8.4E+05		
Pu-240	2.8E-02	8.4E+05		
Pu-241	1.0E+00	3.0E+07		
Am-241	2.8E-02	8.4E+05		
<u>Am-242m</u>	<u>5.1E-04</u>	<u>1.5E+04</u>		
<u>Am-243</u>	2.8E-02	<u>8.4E+05</u>		
<u>Cm-242</u>	2.8E-02	<u>8.4E+05</u>		
Cm-243	2.8E-02	8.4E+05		
Cm-244	2.8E-02	8.4E+05		

Current Revised Reason for Revision (3) Modeling of diffusion and transfer, and exposure pathway (3) Modeling of diffusion and transfer, and exposure pathways Appropriate description In the assessment of potential exposure, the location of discharge into the sea changes from 1 km offshore to the In the assessment of potential exposure, the location of discharge into the sea changes from 1 km offshore to the coast, but these discharge destinations are the same sea area and diffusion and advection are assumed as same as coast, but these discharge destinations are the same sea area and diffusion, and advection are assumed as same as those of the normal exposure, so the migration pathways are the same as those of the normal exposure set in 6-1 those for the normal exposure, so the migration pathways are the same as those of the normal exposure set in 6-1-2.(2). Though the same model is also used for simulation, the calculation result based on discharge from near the 2.(2). Though the same model is also used for simulation, the calculation result based on discharge from near the Unit 5/6 discharge outlets was used because it is the leakage from the coast. Units 5/6 discharge outlets was used because it is the leakage from the coast. The location of the Units 5/6 discharge Enhancement of description outlets are shown in Figure 6-2-1. The target regions, sea areas, and migration pathways are the same, so the exposure pathways are the same as those The target regions, sea areas, and migration pathways are the same, so exposure pathways are the same as those of the normal exposure. for the normal exposure. Figures 6-2-2 to 6-2-4 show the comparison results of dispersion simulation results (annual mean concentration) for the different water discharge location. No significant differences in dispersion over a wide area are observed, but in the coastal area near the FDNPS the concentration is higher in the case of discharge from the Units 5/6 discharge outlets. (Not currently listed) An area where no fishing is conducted on a daily basis' Assumed water amount: Approx. 60 billion litter 3.5km north-sou Undersea Location of Units 5/6 discharge outlets Futaba Town Okuma Town : 南江田縣代 Source: Prepared by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (Electronic territory web) https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0 *Areas where common fishery rights are not set s0m0f1 Figure 6-2-1 Discharge location in present plan and the location of Units 5/6 discharge outlets

(Discharge from 1km from the coast) (Discharge from the Units 5/6 discharge outlets)

Figure 6-2-3 comparison of annual mean concentration distribution figures by the difference in discharge location (enlarged diagram)

Current	Revised	Reason for Revision
		Enhancement of description

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)						
Current	Revised	Reason for Revision				
(4) Setting of the representative person For the representative person subject to the potential exposure assessment, the region, sea area, migration pathways, and exposure pathways are the same, so the same <u>characteristics</u> as 6-1-2.(4) <u>are applied</u> . After leakage of ALPS treated water, diffusion <u>dilution</u> proceeds due to tidal currents and the concentration immediately drops, but exposure <u>was assumed to</u> continue for one week even after <u>the end of leakage</u> considering the case that the flow velocity continues to be small for 3 to 4 days. <u>Conservatively, the concentration in the seawater is assumed to continue to be the same during such a period</u> . For each case, the exposure time, etc., was set by a time proportion calculation of the exposure continuation period from the annual operation hours, etc. The set exposure time, etc., are as shown in Table 6-2-7.	(4) Setting of the representative person For the representative person subject to the potential exposure assessment, the region, sea area, migration pathways, and exposure pathways are the same as 6-1-2.(4), and the same living habits are assumed to be maintained in case of the potential exposure. After leakage of ALPS treated water, diffusion proceeds due to tidal currents and the concentration immediately drops, but in this assessment, it is assumed conservatively that the same concentration in the seawater and the exposure will continue for one week even after the outflow ends, considering the case that the flow velocity continues to be small for 3 to 4 days. For each case, the exposure time, etc., was set by a time proportional calculation of the exposure continuation period from the annual operation hours, etc. The set exposure time, etc., are as shown in Table 6-2-7.	Appropriate description				
(Omission)	(Omission)					
The exposure assessment point is near the beach assessment point to the north of the FDNPS used for the normal exposure, and conservatively the concentration in the seawater near the beach assessment point was used for all pathways.	The exposure assessment point is near the beach assessment point to the north of the FDNPS used for the normal exposure, where is the nearest habitable area from the Units 5/6 discharge outlets. In the case of the normal exposure assessed throughout the year, the entire area of 10km×10km surrounding the FDNPS was selected as the assessment area for the exposure pathways related to fishing (sea surface, hulls, fishing nets, and seafood ingestion) because fishing is conducted in a wide area. However, in the case of the potential exposure, because the period of exposure could be short and fishing may be conducted mainly in areas with higher concentrations in seawater, the concentration of radioactive materials in the seawater used in the assessment is the concentration in seawater at the beach assessment point for all pathways.	Enhancement of description				
(Omission)	(Omission)					

Current	Revised	Reason for Revision
6-2-2 Assessment result	6-2-2 Assessment result	

(Omission)

(1) Concentration in the seawater used for the assessment

(Omission)

(1) Concentration in the seawater used for the assessment

Table 6-2-9 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

	compos	ition of nuclides in the	(iii waa gi oup)	
	Case 1 (Pip	oing rupture)	Case 2 (Ta	ank damage)
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	9.5E+10	8.8E+00	5.7E+12	1.4E+03
C-14	7.5E+06	7.0E-04	4.5E+08	1.1E-01
Mn-54	3.4E+03	3.1E-07	2.0E+05	5.0E-05
<u>Fe-59</u>	<u>8.5E+03</u>	<u>7.9E-07</u>	<u>5.1E+05</u>	<u>1.3E-04</u>
<u>Co-58</u>	4.0E+03	3.7E-07	2.4E+05	<u>6.0E-05</u>
Co-60	2.2E+05	2.0E-05	1.3E+07	3.3E-03
Ni-63	1.1E+06	1.0E-04	6.6E+07	1.6E-02
<u>Zn-65</u>	7.5E+03	<u>7.0E-07</u>	<u>4.5E+05</u>	<u>1.1E-04</u>
<u>Rb-86</u>	<u>9.5E+04</u>	<u>8.8E-06</u>	<u>5.7E+06</u>	<u>1.4E-03</u>
<u>Sr-89</u>	<u>5.0E+04</u>	<u>4.6E-06</u>	3.0E+06	<u>7.5E-04</u>
Sr-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
Y-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
<u>Y-91</u>	<u>1.1E+06</u>	<u>1.0E-04</u>	6.6E+07	<u>1.6E-02</u>
<u>Nb-95</u>	<u>5.0E+03</u>	<u>4.6E-07</u>	3.0E+05	<u>7.5E-05</u>
Тс-99	3.5E+05	3.3E-05	2.1E+07	5.2E-03
<u>Ru-103</u>	5.0E+03	4.6E-07	3.0E+05	7.5E-05
Ru-106	8.0E+05	7.4E-05	4.8E+07	1.2E-02
<u>Rh-103m</u>	5.0E+03	4.6E-07	3.0E+05	<u>7.5E-05</u>
<u>Rh-106</u>	<u>8.0E+05</u>	<u>7.4E-05</u>	4.8E+07	<u>1.2E-02</u>
<u>Ag-110m</u>	2.8E+03	<u>2.6E-07</u>	<u>1.7E+05</u>	<u>4.2E-05</u>
Cd-113m	9.0E+03	8.4E-07	5.4E+05	1.3E-04
<u>Cd-115m</u>	3.2E+05	3.0E-05	1.9E+07	<u>4.8E-03</u>
<u>Sn-119m</u>	8.5E+04	7.9E-06	<u>5.1E+06</u>	1.3E-03
<u>Sn-123</u>	6.0E+05	<u>5.6E-05</u>	3.6E+07	9.0E-03
<u>Sn-126</u>	1.4E+04	1.3E-06	<u>8.1E+05</u>	2.0E-04
<u>Sb-124</u>	4.8E+03	4.4E-07	2.9E+05	<u>7.1E-05</u>
Sb-125	1.7E+05	1.5E-05	9.9E+06	2.5E-03
<u>Te-123m</u>	4.6E+03	4.3E-07	2.8E+05	<u>6.9E-05</u>

Table 6-2-9 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

	Case 1 (Pip	oing rupture)	Case 2 (Ta	nnk damage)
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	9.5E+10	8.8E+00	5.7E+12	1.4E+03
C-14	7.5E+06	7.0E-04	4.5E+08	1.1E-01
Mn-54	3.4E+03	3.1E-07	2.0E+05	5.0E-05
Co-60	2.2E+05	2.0E-05	1.3E+07	3.3E-03
Ni-63	1.1E+06	1.0E-04	6.6E+07	1.6E-02
<u>Se-79</u>	7.5E+05	<u>7.0E-05</u>	4.5E+07	1.1E-02
Sr-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
Y-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
Тс-99	3.5E+05	3.3E-05	2.1E+07	5.2E-03
Ru-106	8.0E+05	7.4E-05	4.8E+07	1.2E-02
Cd-113m	9.0E+03	8.4E-07	5.4E+05	1.3E-04
Sb-125	1.7E+05	1.5E-05	9.9E+06	2.5E-03
Te-125m	1.7E+05	1.5E-05	9.9E+06	2.5E-03
I-129	1.1E+06	9.8E-05	6.3E+07	1.6E-02
Cs-134	2.3E+04	2.1E-06	1.4E+06	3.4E-04
Cs-137	2.1E+05	2.0E-05	1.3E+07	3.1E-03
Ce-144	3.2E+04	2.9E-06	1.9E+06	4.7E-04
Pm-147	9.5E+04	8.8E-06	5.7E+06	1.4E-03
Sm-151	4.5E+02	4.2E-08	2.7E+04	6.7E-06
Eu-152	1.4E+04	1.3E-06	8.4E+05	2.1E-04
Eu-154	6.0E+03	5.6E-07	3.6E+05	9.0E-05
Eu-155	1.7E+04	1.5E-06	9.9E+05	2.5E-04
<u>U-234</u>	3.2E+02	<u>2.9E-08</u>	<u>1.9E+04</u>	<u>4.7E-06</u>
<u>U-238</u>	3.2E+02	<u>2.9E-08</u>	<u>1.9E+04</u>	<u>4.7E-06</u>
<u>Np-237</u>	3.2E+02	2.9E-08	<u>1.9E+04</u>	<u>4.7E-06</u>
Pu-238	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-239	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-240	3.2E+02	2.9E-08	1.9E+04	4.7E-06

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision			Revised					Current		
Appropriate description due	2.1E-04	8.4E+05	1.3E-06	1.4E+04	Pu-241	2.5E-03	9.9E+06	1.5E-05	1.7E+05	Te-125m
the selection of nuclides to be measured and assessed	4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-242	2.4E-03	9.6E+06	<u>1.5E-05</u>	1.6E+05	<u>Te-127</u>
	4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-243	2.4E-03	9.6E+06	1.5E-05	1.6E+05	<u>Te-127m</u>
	4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-244	6.0E-04	2.4E+06	3.8E-06	4.1E+04	<u>Te-129</u>
-						2.4E-03	9.6E+06	<u>1.5E-05</u>	1.6E+05	<u>Te-129m</u>
						1.6E-02	6.3E+07	9.8E-05	1.1E+06	I-129
						3.4E-04	1.4E+06	2.1E-06	2.3E+04	Cs-134
						1.9E-08	7.5E+01	<u>1.2E-10</u>	1.3E+00	<u>Cs-135</u>
						2.2E-04	9.0E+05	<u>1.4E-06</u>	1.5E+04	<u>Cs-136</u>
						3.1E-03	1.3E+07	2.0E-05	2.1E+05	Cs-137
						3.1E-03	1.3E+07	2.0E-05	2.1E+05	<u>Ba-137m</u>
						<u>7.1E-04</u>	2.9E+06	<u>4.4E-06</u>	4.8E+04	<u>Ba-140</u>
						1.9E-04	7.5E+05	<u>1.2E-06</u>	1.3E+04	<u>Ce-141</u>
						4.7E-04	1.9E+06	2.9E-06	3.2E+04	Ce-144
						4.7E-04	<u>1.9E+06</u>	<u>2.9E-06</u>	3.2E+04	<u>Pr-144</u>
						<u>4.7E-04</u>	1.9E+06	2.9E-06	3.2E+04	<u>Pr-144m</u>
						7.3E-04	2.9E+06	4.6E-06	4.9E+04	<u>Pm-146</u>
						1.4E-03	5.7E+06	8.8E-06	9.5E+04	Pm-147
						3.7E-03	1.5E+07	2.3E-05	2.5E+05	<u>Pm-148</u>
						<u>6.3E-05</u>	2.5E+05	3.9E-07	4.2E+03	<u>Pm-148m</u>
						6.7E-06	2.7E+04	4.2E-08	4.5E+02	Sm-151
						2.1E-04	8.4E+05	<u>1.3E-06</u>	1.4E+04	<u>Eu-152</u>
						9.0E-05	3.6E+05	5.6E-07	6.0E+03	Eu-154
						2.5E-04	9.9E+05	1.5E-06	1.7E+04	Eu-155
						2.4E-04	9.6E+05	<u>1.5E-06</u>	1.6E+04	<u>Gd-153</u>
						2.1E-04	8.4E+05	<u>1.3E-06</u>	1.4E+04	<u>Tb-160</u>
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Pu-238
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Pu-239
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Pu-240
						2.1E-04	8.4E+05	1.3E-06	1.4E+04	Pu-241
						<u>4.7E-06</u>	<u>1.9E+04</u>	<u>2.9E-08</u>	3.2E+02	<u>Am-241</u>
						2.9E-07	1.2E+03	<u>1.8E-09</u>	2.0E+01	<u>Am-242m</u>
						<u>4.7E-06</u>	1.9E+04	<u>2.9E-08</u>	3.2E+02	<u>Am-243</u>
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-242
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-243
						4.7E-06	1.9E+04	2.9E-08	3.2E+02	Cm-244

Table 6-2-10	Concentration in the seawater used for the assessment (Source term based on the
	composition of nuclides in the J1-C tank group)

Current

	composi	tion of nuclides in the	J1-C tank group)	
	Case 1 (Pip	ping rupture)	Case 2 (Ta	ank damage)
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	4.1E+11	3.8E+01	2.5E+13	6.1E+03
C-14	9.0E+06	8.4E-04	5.4E+08	1.3E-01
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04
<u>Fe-59</u>	4.4E+04	4.0E-06	2.6E+06	<u>6.5E-04</u>
<u>Co-58</u>	2.1E+04	<u>1.9E-06</u>	<u>1.2E+06</u>	3.1E-04
Co-60	1.7E+05	1.5E-05	9.9E+06	2.5E-03
Ni-63	4.3E+06	3.9E-04	2.6E+08	6.3E-02
<u>Zn-65</u>	4.7E+04	4.4E-06	2.8E+06	7.0E-04
<u>Rb-86</u>	2.5E+05	2.3E-05	1.5E+07	3.7E-03
<u>Sr-89</u>	2.7E+04	2.5E-06	1.6E+06	4.0E-04
Sr-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04
Y-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04
<u>Y-91</u>	<u>8.5E+06</u>	<u>7.9E-04</u>	<u>5.1E+08</u>	<u>1.3E-01</u>
<u>Nb-95</u>	2.5E+04	<u>2.3E-06</u>	<u>1.5E+06</u>	3.7E-04
Tc-99	6.0E+05	5.6E-05	3.6E+07	9.0E-03
<u>Ru-103</u>	2.7E+04	<u>2.5E-06</u>	<u>1.6E+06</u>	<u>4.0E-04</u>
Ru-106	7.0E+05	6.5E-05	4.2E+07	1.0E-02
<u>Rh-103m</u>	2.7E+04	<u>2.5E-06</u>	<u>1.6E+06</u>	<u>4.0E-04</u>
<u>Rh-106</u>	7.0E+05	<u>6.5E-05</u>	4.2E+07	<u>1.0E-02</u>
<u>Ag-110m</u>	2.2E+04	<u>2.0E-06</u>	<u>1.3E+06</u>	<u>3.2E-04</u>
Cd-113m	4.3E+04	3.9E-06	2.6E+06	6.3E-04
<u>Cd-115m</u>	<u>1.4E+06</u>	<u>1.3E-04</u>	<u>8.1E+07</u>	<u>2.0E-02</u>
<u>Sn-119m</u>	2.1E+07	2.0E-03	1.3E+09	3.1E-01
<u>Sn-123</u>	3.3E+06	3.1E-04	2.0E+08	4.9E-02
<u>Sn-126</u>	1.5E+05	1.3E-05	8.7E+06	<u>2.2E-03</u>
<u>Sb-124</u>	4.9E+04	<u>4.5E-06</u>	2.9E+06	7.2E-04
Sb-125	1.2E+05	1.1E-05	6.9E+06	1.7E-03
<u>Te-123m</u>	4.6E+04	<u>4.3E-06</u>	2.8E+06	<u>6.9E-04</u>
Te-125m	1.2E+05	1.1E-05	6.9E+06	1.7E-03
<u>Te-127</u>	2.4E+06	2.2E-04	1.4E+08	3.5E-02
<u>Te-127m</u>	2.5E+06	2.3E-04	1.5E+08	3.7E-02
<u>Te-129</u>	3.1E+05	2.9E-05	1.9E+07	4.6E-03

Table 6-2-10 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-C tank group)

Revised

	Case 1 (Pi	ping rupture)	Case 2 (Ta	ank damage)
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	4.1E+11	3.8E+01	2.5E+13	6.1E+03
C-14	9.0E+06	8.4E-04	5.4E+08	1.3E-01
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04
Co-60	1.7E+05	1.5E-05	9.9E+06	2.5E-03
Ni-63	4.3E+06	3.9E-04	2.6E+08	6.3E-02
<u>Se-79</u>	7.5E+05	<u>7.0E-05</u>	4.5E+07	<u>1.1E-02</u>
Sr-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04
Y-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04
Tc-99	6.0E+05	5.6E-05	3.6E+07	9.0E-03
Ru-106	7.0E+05	6.5E-05	4.2E+07	1.0E-02
Cd-113m	4.3E+04	3.9E-06	2.6E+06	6.3E-04
Sb-125	1.2E+05	1.1E-05	6.9E+06	1.7E-03
Te-125m	1.2E+05	1.1E-05	6.9E+06	1.7E-03
I-129	6.0E+05	5.6E-05	3.6E+07	9.0E-03
Cs-134	3.8E+04	3.5E-06	2.3E+06	5.7E-04
Cs-137	9.5E+04	8.8E-06	5.7E+06	1.4E-03
Ce-144	2.9E+05	2.6E-05	1.7E+07	4.3E-03
Pm-147	4.0E+05	3.7E-05	2.4E+07	6.0E-03
Sm-151	5.5E+03	5.1E-07	3.3E+05	8.2E-05
Eu-154	5.5E+04	5.1E-06	3.3E+06	8.2E-04
Eu-155	1.7E+05	1.6E-05	1.0E+07	2.5E-03
<u>U-234</u>	3.2E+02	2.9E-08	1.9E+04	4.7E-06
<u>U-238</u>	3.2E+02	2.9E-08	1.9E+04	4.7E-06
<u>Np-237</u>	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-238	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-239	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-240	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-241	6.0E+05	5.6E-05	3.6E+07	9.0E-03
Am-241	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Cm-243	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Cm-244	1.7E+04	1.5E-06	9.9E+05	2.5E-04

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

		Current			Revised	Reason for Revision
<u>Te-129m</u>	7.0E+05	6.5E-05	4.2E+07	<u>1.0E-02</u>		Appropriate description due t
I-129	6.0E+05	5.6E-05	3.6E+07	9.0E-03		the selection of nuclides to be measured and assessed
Cs-134	3.8E+04	3.5E-06	2.3E+06	5.7E-04		
<u>Cs-135</u>	<u>6.0E-01</u>	<u>5.6E-11</u>	3.6E+01	9.0E-09		
<u>Cs-136</u>	2.4E+04	2.2E-06	1.4E+06	3.5E-04		
Cs-137	9.5E+04	8.8E-06	5.7E+06	1.4E-03		
<u>Ba-137m</u>	9.5E+04	<u>8.8E-06</u>	<u>5.7E+06</u>	1.4E-03		
<u>Ba-140</u>	1.0E+05	9.3E-06	6.0E+06	1.5E-03		
<u>Ce-141</u>	1.3E+05	1.2E-05	7.8E+06	1.9E-03		
Ce-144	2.9E+05	2.6E-05	1.7E+07	4.3E-03		
<u>Pr-144</u>	2.9E+05	2.6E-05	1.7E+07	4.3E-03		
<u>Pr-144m</u>	2.9E+05	2.6E-05	1.7E+07	4.3E-03		
<u>Pm-146</u>	3.4E+04	3.1E-06	2.0E+06	5.0E-04		
Pm-147	4.0E+05	3.7E-05	2.4E+07	6.0E-03		
<u>Pm-148</u>	1.2E+05	1.1E-05	6.9E+06	1.7E-03		
<u>Pm-148m</u>	2.4E+04	2.2E-06	1.4E+06	3.6E-04		
Sm-151	5.5E+03	5.1E-07	3.3E+05	8.2E-05		
<u>Eu-152</u>	1.4E+05	<u>1.3E-05</u>	8.4E+06	<u>2.1E-03</u>		
Eu-154	5.5E+04	5.1E-06	3.3E+06	8.2E-04		
Eu-155	1.7E+05	1.6E-05	1.0E+07	2.5E-03		
<u>Gd-153</u>	1.3E+05	<u>1.2E-05</u>	7.8E+06	<u>1.9E-03</u>		
<u>Tb-160</u>	7.0E+04	<u>6.5E-06</u>	<u>4.2E+06</u>	<u>1.0E-03</u>		
Pu-238	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
Pu-239	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
Pu-240	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
Pu-241 Am-241	6.0E+05 1.7E+04	5.6E-05 1.5E-06	3.6E+07 9.9E+05	9.0E-03 2.5E-04		
Am-242m	3.0E+02	2.7E-08	9.9E+03 1.8E+04	4.4E-06		
Am-243	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
<u>Cm-242</u>	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
Cm-243	1.7E+04	1.5E-06	9.9E+05	2.5E-04		
Cm-244	1.7E+04	1.5E-06	9.9E+05	2.5E-04		

74

Table 6-2-11	Concentration in the seawater used for the assessment (Source term based on the
	composition of nuclides in the J1-G tank group)

Current

composition of nuclides in the J1-G tank group)						
	Case 1 (Pip	ing rupture)	Case 2 (Ta	nk damage)		
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)		
H-3	1.4E+11	1.3E+01	8.1E+12	2.0E+03		
C-14	8.0E+06	7.4E-04	4.8E+08	1.2E-01		
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04		
Fe-59	3.6E+04	3.3E-06	2.2E+06	5.4E-04		
Co-58	1.9E+04	1.7E-06	1.1E+06	2.8E-04		
Co-60	1.2E+05	1.1E-05	6.9E+06	1.7E-03		
Ni-63	4.4E+06	4.1E-04	2.6E+08	6.6E-02		
<u>Zn-65</u>	4.0E+04	<u>3.7E-06</u>	2.4E+06	<u>6.0E-04</u>		
<u>Rb-86</u>	2.4E+05	<u>2.2E-05</u>	1.4E+07	3.5E-03		
<u>Sr-89</u>	2.3E+04	<u>2.1E-06</u>	<u>1.4E+06</u>	3.4E-04		
Sr-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04		
Y-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04		
<u>Y-91</u>	<u>6.0E+06</u>	5.6E-04	3.6E+08	9.0E-02		
<u>Nb-95</u>	2.4E+04	2.2E-06	1.4E+06	3.5E-04		
Tc-99	6.5E+05	6.0E-05	3.9E+07	9.7E-03		
<u>Ru-103</u>	2.6E+04	2.4E-06	1.5E+06	3.8E-04		
Ru-106	2.4E+05	2.2E-05	1.4E+07	3.6E-03		
<u>Rh-103m</u>	2.6E+04	2.4E-06	1.5E+06	3.8E-04		
<u>Rh-106</u>	2.4E+05	2.2E-05	1.4E+07	3.6E-03		
<u>Ag-110m</u>	2.0E+04	1.9E-06	<u>1.2E+06</u>	3.0E-04		
Cd-113m	4.3E+04	4.0E-06	2.6E+06	6.4E-04		
<u>Cd-115m</u>	1.2E+06	1.1E-04	6.9E+07	<u>1.7E-02</u>		
<u>Sn-119m</u>	2.0E+07	1.9E-03	1.2E+09	3.0E-01		
<u>Sn-123</u>	3.2E+06	2.9E-04	1.9E+08	4.7E-02		
<u>Sn-126</u>	7.5E+04	7.0E-06	4.5E+06	<u>1.1E-03</u>		
<u>Sb-124</u>	4.2E+04	3.9E-06	2.5E+06	<u>6.3E-04</u>		
Sb-125	7.0E+04	6.5E-06	4.2E+06	1.0E-03		
<u>Te-123m</u>	3.4E+04	<u>3.1E-06</u>	2.0E+06	<u>5.0E-04</u>		
Te-125m	7.0E+04	6.5E-06	4.2E+06	1.0E-03		
<u>Te-127</u>	2.2E+06	<u>2.0E-04</u>	1.3E+08	3.2E-02		
<u>Te-127m</u>	2.3E+06	2.1E-04	1.4E+08	3.4E-02		

Table 6-2-11 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-G tank group)

Revised

composition of nuclides in the J1-G tank group)						
	Case 1 (Pip	ing rupture)	Case 2 (Ta	ank damage)		
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)		
H-3	1.4E+11	1.3E+01	8.1E+12	2.0E+03		
C-14	8.0E+06	7.4E-04	4.8E+08	1.2E-01		
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04		
Co-60	1.2E+05	1.1E-05	6.9E+06	1.7E-03		
Ni-63	4.4E+06	4.1E-04	2.6E+08	6.6E-02		
<u>Se-79</u>	7.5E+05	<u>7.0E-05</u>	4.5E+07	<u>1.1E-02</u>		
Sr-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04		
Y-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04		
Tc-99	6.5E+05	6.0E-05	3.9E+07	9.7E-03		
Ru-106	2.4E+05	2.2E-05	1.4E+07	3.6E-03		
Cd-113m	4.3E+04	4.0E-06	2.6E+06	6.4E-04		
Sb-125	7.0E+04	6.5E-06	4.2E+06	1.0E-03		
Te-125m	7.0E+04	6.5E-06	4.2E+06	1.0E-03		
I-129	1.7E+05	1.5E-05	9.9E+06	2.5E-03		
Cs-134	3.4E+04	3.1E-06	2.0E+06	5.0E-04		
Cs-137	1.7E+05	1.5E-05	9.9E+06	2.5E-03		
Ce-144	2.8E+05	2.6E-05	1.7E+07	4.1E-03		
Pm-147	3.6E+05	3.3E-05	2.2E+07	5.4E-03		
Sm-151	5.0E+03	4.6E-07	3.0E+05	7.5E-05		
Eu-154	5.0E+04	4.6E-06	3.0E+06	7.5E-04		
Eu-155	9.0E+04	8.4E-06	5.4E+06	1.3E-03		
<u>U-234</u>	<u>1.4E+04</u>	<u>1.3E-06</u>	<u>8.4E+05</u>	<u>2.1E-04</u>		
<u>U-238</u>	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
<u>Np-237</u>	<u>1.4E+04</u>	<u>1.3E-06</u>	<u>8.4E+05</u>	<u>2.1E-04</u>		
Pu-238	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
Pu-239	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
Pu-240	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
Pu-241	5.0E+05	4.6E-05	3.0E+07	7.5E-03		
Am-241	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
Cm-243	1.4E+04	1.3E-06	8.4E+05	2.1E-04		
Cm-244	1.4E+04	1.3E-06	8.4E+05	2.1E-04		

The Japanese version shall prevail.

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

Appropriate description due
the selection of nuclides to l measured and assessed

			C	urrent							Reason for Revision					
Table 6-2-	-12 shows the esult is <u>0.0007</u>	essment result potential exposu 7 (7E-04) mSv to	re result calcul 0.3(3E-01) mS	lated using the Sv, which falls	concentration in below 5mSv, wh	the seawater coich is the stand	alculated in lard at the	Table 6-2 calculated	Exposure asso- 12 to 13 show 1 in (1). The real at the time of a	rater ich is the	Appropriate description due to the selection of nuclides to be measured and assessed					
		Table 6-2-12	Results of th	e potential ex	xposure assessm	ent										
	G	Case	1 (Piping ruptu		Case	2 (Tank damag			C	Case	1 (Piping ruptu	1	Case		-	
Assessed case	Source term	K4 tank group	J1-C tank group	J1-G tank group	K4 tank group	J1-C tank group	J1-G tank group	Assessed case	Source term	K4 tank group	J1-C tank group	J1-G tank group	K4 tank group	J1-C tank group	J1-G tank group	
	Ingestion of seafood	Large	Large	Large	Large	Large	Large		Ingestion of seafood	Large	Large	Large	Large	Large	Large	
	Sea surface	3.5E-08	4.0E-07	3.6E-07	<u>1.7E-06</u>	<u>1.9E-05</u>	1.7E-05		Sea surface	<u>4.1E-09</u>	<u>5.4E-09</u>	3.6E-09	2.0E-07	2.6E-07	1.7E-07	
	Hull	2.5E-08	2.8E-07	2.5E-07	<u>1.2E-06</u>	<u>1.4E-05</u>	1.2E-05		Hull	3.8E-09	<u>5.2E-09</u>	3.5E-09	1.9E-07	2.5E-07	1.7E-07	
External exposure (mSv)	During swimming	3.3E-09	3.8E-08	3.4E-08	<u>1.6E-07</u>	<u>1.8E-06</u>	1.6E-06	External exposure (mSv)	During swimming	3.9E-10	<u>5.0E-10</u>	3.4E-10	1.8E-08	2.4E-08	1.6E-08	
	Beach sand	5.8E-06	6.7E-05	5.9E-05	2.8E-04	3.2E-03	2.8E-03		Beach sand	6.7E-07	8.7E-07	5.9E-07	3.2E-05	4.2E-05	2.8E-05	
	Fishing net	1.8E-05	2.1E-04	1.9E-04	8.9E-04	1.0E-02	9.1E-03		Fishing net	2.0E-06	2.6E-06	1.8E-06	9.8E-05	1.3E-04	8.6E-05	
	Ingestion of water	2.4E-07	9.9E-07	3.3E-07	1.2E-05	4.7E-05	1.6E-05		Ingestion of water	2.4E-07	9.9E-07	3.3E-07	1.2E-05	4.7E-05	1.6E-05	
Internal exposure (mSv)	Inhalation of spray	6.9E-08	6.4E-07	4.2E-07	3.3E-06	3.1E-05	2.0E-05	Internal exposure (mSv)	Inhalation of spray	6.8E-08	6.2E-07	4.0E-07	3.2E-06	3.0E-05	1.9E-05	
	Ingestion of seafood	7.1E-04	<u>5.4E-03</u>	4.9E-03	3.4E-02	2.6E-01	2.4E-01		Ingestion of seafood	<u>2.4E-04</u>	2.3E-04	1.5E-04	<u>1.1E-02</u>	<u>1.1E-02</u>	7.1E-03	
	otal nSv)	<u>7E-04</u>	<u>6E-03</u>	<u>5E-03</u>	<u>4E-02</u>	<u>3E-01</u>	<u>2E-01</u>		Cotal mSv)	<u>2E-04</u>	<u>2E-04</u>	<u>2E-04</u>	<u>1E-02</u>	<u>1E-02</u>	<u>7E-03</u>	
																1

Current			Reason for Revision						
(Not currently listed)		<u>Tabl</u>	le 6-2-13 R	esults of the	internal expo	sure assessmen	t by age		
		Source	Case	1 (Piping rupti	<u>ure)</u>	Case	2 (Tank dama	ge)	Enhancement of description
	Assessed case	term	K4 tank group	J1-C tank group	J1-G tank group	K4 tank group	J1-C tank group	J1-G tank group	
		Ingestion of seafood	<u>Large</u>	<u>Large</u>	<u>Large</u>	<u>Large</u>	<u>Large</u>	Large	
	<u>Internal</u>	<u>Adult</u>	2.4E-07	9.9E-07	3.3E-07	<u>1.2E-05</u>	<u>4.7E-05</u>	<u>1.6E-05</u>	
	exposure by ingestion of water		4.2E-07	<u>1.7E-06</u>	<u>5.7E-07</u>	2.0E-05	<u>8.1E-05</u>	2.7E-05	
	water (mSv)	<u>Infant</u>	=	=	=	=	=	=	
	Internal	Adult	<u>6.8E-08</u>	6.2E-07	4.0E-07	3.2E-06	3.0E-05	1.9E-05	
	exposure by inhalation of spray	Child	<u>4.5E-08</u>	3.5E-07	<u>2.2E-07</u>	<u>2.1E-06</u>	<u>1.7E-05</u>	1.0E-05	
	of spray (mSv)	<u>Infant</u>	<u>2.9E-08</u>	2.0E-07	<u>1.2E-07</u>	<u>1.4E-06</u>	<u>9.7E-06</u>	<u>5.5E-06</u>	
	Internal	<u>Adult</u>	<u>2.4E-04</u>	2.3E-04	<u>1.5E-04</u>	1.1E-02	<u>1.1E-02</u>	7.1E-03	
	exposure by ingestion of seafood		<u>2.3E-04</u>	<u>2.3E-04</u>	<u>1.6E-04</u>	<u>1.1E-02</u>	<u>1.1E-02</u>	7.8E-03	
	(mSv)	<u>Infant</u>	1.4E-04	2.3E-04	1.8E-04	6.7E-03	<u>1.1E-02</u>	8.7E-03	
	<u> </u>								

Current	Revised	Reason for Revision
7. Assessment regarding environmental protection	7. Assessment regarding environmental protection	
(Omission)	(Omission)	
7-2. Assessment method	7-2. Assessment method	
(Omission)	(Omission)	
7-2-3. Setting of exposure pathways	7-2-3. Setting of exposure pathways	
(Omission)	(Omission)	
The internal and external exposure dose conversion factors to plants and animals are excerpted from ICRP Publication 136 "Dose Coefficients for Non-human Biota Environmentally Exposed to Radiation" (ICRP,2017) [29] (hereinafter called "ICRP pub.136") and the BiotaDC program of ICRP [30] (See Tables 7-2-1 and 7-2-2). Only the dose conversion factor of Sn-126 could not be calculated by BiotaDC, so conservatively the values of Ru-106 and Ag-110m are used for the internal and external exposure dose conversion factors, respectively.	The internal and external exposure dose conversion factors to plants and animals are excerpted from ICRP Publication 136 "Dose Coefficients for Non-human Biota Environmentally Exposed to Radiation" (ICRP,2017) [29] (hereinafter called "ICRP pub.136") and the BiotaDC program of ICRP [30] (See Tables 7-2-1 and 7-2-2).	Appropriate description due to the selection of nuclides to be
The concentration ratios of plants and animals and the seawater are excerpted from ICRP Publication 114 "Environmental Protection: Transfer Parameters for Reference Animals and Plants" (ICRP,2009) [31] (hereinafter called "ICRP pub.114") and IAEA Technical report series No.479 "Handbook of Parameter Values for the Prediction of Radionuclide Transfer to Wildlife" (hereinafter called "TRS-479"). For the elements not shown here, the concentration factors of TRS-422 [25] are excerpted (See Table 7-2-3). For the concentration distribution coefficients of the seawater and seabed sediment, those specified in 2.3.OCEAN MARGIN Kds of TRS-422 are used (See Table 7-2-4).	The concentration ratios of plants and animals and the seawater are excerpted from ICRP Publication 114 "Environmental Protection: Transfer Parameters for Reference Animals and Plants" (ICRP,2009) [31] (hereinafter called "ICRP pub.114") and IAEA Technical report series No.479 "Handbook of Parameter Values for the Prediction of Radionuclide Transfer to Wildlife" (hereinafter called "TRS-479") (See Table 7-2-3). For the concentration distribution coefficients of the seawater and seabed sediment, those specified in 2.3.OCEAN MARGIN Kds of TRS-422 [26] are used (See Table 7-2-4).	Appropriate description for addition of references and due to the selection of nuclides to be measured and assessed
(Omission)	(Omission)	

Current	Revised	Reason for Revision
7-2-5. Dose assessment	7-2-5. Dose assessment	

(Omission)

 Table 7-2-1
 Internal exposure conversion factor to marine plants and animals

(ICRP Pub.136 and others are shown in remarks)

	(ICRP Pub.136 and others are shown in remarks)												
	Target	_	sure dose con nGy/day)/(Bq/		Remarks								
	nuclide	Flatfish	Crab	Brown seaweed	T.C.I.M.I.D.								
1	H-3	7.9E-08	7.9E-08	7.9E-08									
2	C-14	7.0E-07	7.0E-07	7.0E-07									
3	Mn-54	1.1E-06	1.4E-06	9.4E-07									
<u>4</u>	<u>Fe-59</u>	2.9E-06	3.4E-06	2.0E-06	Calculated from BiotaDC								
<u>5</u>	<u>Co-58</u>	1.6E-06	2.1E-06	1.5E-06									
<u>6</u>	Co-60	3.8E-06	5.0E-06	3.6E-06									
<u>7</u>	Ni-63	2.4E-07	2.4E-07	2.4E-07									
<u>8</u>	<u>Zn-65</u>	<u>7.7E-07</u>	1.0E-06	<u>7.0E-07</u>									
9	<u>Rb-86</u>	8.8E-06	9.1E-06	6.9E-06	Calculated from BiotaDC								
<u>10</u>	<u>Sr-89</u>	7.7E-06	7.9E-06	<u>7.7E-06</u>									
<u>11</u>	Sr-90	1.4E-05	1.5E-05	1.4E-05									
<u>12</u>	Y-90	_	_	_	Contained in the parent nuclide Sr-90								
<u>13</u>	<u>Y-91</u>	8.0E-06	<u>8.1E-06</u>	<u>6.4E-06</u>	Calculated from BiotaDC								
<u>14</u>	<u>Nb-95</u>	1.5E-06	<u>1.9E-06</u>	<u>1.4E-06</u>									
<u>15</u>	Tc-99	1.4E-06	1.4E-06	1.4E-06									
<u>16</u>	<u>Ru-103</u>	<u>2.1E-06</u>	2.3E-06	2.0E-06									
<u>17</u>	Ru-106	1.7E-05	1.9E-05	1.7E-05									
<u>18</u>	<u>Rh-103m</u>	=	Ш	=	Contained in the parent nuclide Ru-103								
<u>19</u>	<u>Rh-106</u>	=	Ш	=	Contained in the parent nuclide Ru-106								
<u>20</u>	<u>Ag-110m</u>	<u>4.3E-06</u>	<u>5.5E-06</u>	<u>4.1E-06</u>	Calculated from BiotaDC								
<u>21</u>	Cd-113m	2.5E-06	2.5E-06	2.4E-06	Calculated from BiotaDC								
<u>22</u>	<u>Cd-115m</u>	8.0E-06	8.2E-06	<u>6.4E-06</u>	Calculated from BiotaDC								
<u>23</u>	<u>Sn-119m</u>	1.2E-06	1.2E-06	<u>1.1E-06</u>	Calculated from BiotaDC								
<u>24</u>	<u>Sn-123</u>	7.0E-06	7.1E-06	<u>5.8E-06</u>	Calculated from BiotaDC								
<u>25</u>	<u>Sn-126</u>	1.7E-05	1.9E-05	1.7E-05	The value of Ru-106 is used because no value is given to this nuclide in the source								
<u>26</u>	Sb-124	7.0E-06	7.9E-06	6.7E-06									
<u>27</u>	Sb-125	2.0E-06	2.2E-06	1.9E-06									
<u>28</u>	<u>Te-123m</u>	1.6E-06	1.7E-06	1.4E-06	Calculated from BiotaDC								
<u>29</u>	Te-125m	1.7E-06	1.8E-06	1.6E-06	Calculated from BiotaDC								
<u>30</u>	<u>Te-127</u>	3.1E-06	3.1E-06	2.9E-06	Calculated from BiotaDC								
Ь		<u> </u>		L	I .								

Table 7-2-1 Internal exposure conversion factor to marine plants and animals

	1		(ICRP Pub.	136 and others ar	e shown in remarks)
	Target		osure dose conv nGy/day)/(Bq/l		Remarks
	nuclide	Flatfish	Crab	Brown seaweed	
1	H-3	7.9E-08	7.9E-08	7.9E-08	
2	C-14	7.0E-07	7.0E-07	7.0E-07	
3	Mn-54	1.1E-06	1.4E-06	9.4E-07	
<u>4</u>	Co-60	3.8E-06	5.0E-06	3.6E-06	
<u>5</u>	Ni-63	2.4E-07	2.4E-07	2.4E-07	
<u>6</u>	<u>Se-79</u>	<u>7.2E-07</u>	<u>7.2E-07</u>	<u>7.2E-07</u>	_
<u>7</u>	Sr-90	1.4E-05	1.5E-05	1.4E-05	
<u>8</u>	Y-90	_	_	_	Contained in the parent nuclide Sr-90
<u>9</u>	Tc-99	1.4E-06	1.4E-06	1.4E-06	
<u>10</u>	Ru-106	1.7E-05	1.9E-05	1.7E-05	
<u>11</u>	Cd-113m	2.5E-06	2.5E-06	2.4E-06	Calculated from BiotaDC
<u>12</u>	Sb-125	2.0E-06	2.2E-06	1.9E-06	
<u>13</u>	Te-125m	1.7E-06	1.8E-06	1.6E-06	Calculated from BiotaDC
<u>14</u>	I-129	1.0E-06	1.1E-06	1.0E-06	
<u>15</u>	Cs-134	4.1E-06	4.8E-06	3.8E-06	
<u>16</u>	Cs-137	4.1E-06	4.3E-06	4.1E-06	
<u>17</u>	Ce-144	1.6E-05	1.7E-05	1.6E-05	
<u>18</u>	Pm-147	8.6E-07	8.6E-07	8.5E-07	Calculated from BiotaDC
<u>19</u>	Sm-151	2.8E-07	2.8E-07	2.8E-07	Calculated from BiotaDC
<u>20</u>	Eu-154	5.0E-06	5.8E-06	5.0E-06	
<u>21</u>	Eu-155	1.0E-06	1.0E-06	9.8E-07	
<u>22</u>	<u>U-234</u>	6.7E-05	<u>6.7E-05</u>	6.7E-05	_
<u>23</u>	<u>U-238</u>	6.0E-05	6.0E-05	6.0E-05	_
<u>24</u>	<u>Np-237</u>	<u>6.7E-05</u>	<u>6.7E-05</u>	<u>6.7E-05</u>	_
<u>25</u>	Pu-238	7.7E-05	7.7E-05	7.7E-05	
<u>26</u>	Pu-239	7.2E-05	7.2E-05	7.2E-05	
<u>27</u>	Pu-240	7.2E-05	7.2E-05	7.2E-05	
<u>28</u>	Pu-241	7.4E-08	7.4E-08	7.4E-08	
<u>29</u>	Am-241	7.7E-05	7.7E-05	7.7E-05	
<u>30</u>	Cm-243	8.4E-05	8.4E-05	8.4E-05	

The Japanese version shall prevail.

(Omission)

Appropriate description due to the selection of nuclides to be

measured and assessed

1 1.72 1.7			Compari	Current	t amendments in the implementation Plai	Torruna	mina Danem	Reason for Revision				
30 Tel 20	31 <u>Te-127m</u>	4.2E-06	4.2E-06	4.0E-06	Calculated from BiotaDC	31	Cm-244	8.2E-05	8.2E-05	8.2E-05		Appropriate description due to
1129	<u>32</u> <u>Te-129</u>	=	=	=	Contained in the parent nuclide Te-129m		•	-	1	'		
	33 <u>Te-129m</u>	<u>8.4E-06</u>	8.6E-06	8.2E-06								
20	<u>34</u> I-129	1.0E-06	1.1E-06	1.0E-06								
	35 Cs-134	4.1E-06	4.8E-06	3.8E-06								
28	<u>36</u> <u>Cs-135</u>	1.2E-06	<u>1.2E-06</u>	1.2E-06								
Ba 137m	<u>37</u> <u>Cs-136</u>	4.3E-06	5.3E-06	4.1E-06								
10	38 Cs-137	4.1E-06	4.3E-06	4.1E-06								
1	<u>39</u> <u>Ba-137m</u>	=	=	Ш	Contained in the parent nuclide Cs-137							
Calculated from BiombC Calculated from Bio	40 <u>Ba-140</u>	1.4E-05	1.5E-05	1.4E-05								
13	41 <u>Ce-141</u>	2.4E-06	2.6E-06	2.4E-06								
44 Pc-144m	42 Ce-144	1.6E-05	1.7E-05	1.6E-05								
Section Part Part	<u>43</u> <u>Pr-144</u>	=	=		Contained in the parent nuclide Ce-144							
According Acco	44 <u>Pr-144m</u>	=	=	=	Contained in the parent nuclide Ce-144							
17	45 <u>Pm-146</u>	2.3E-06	2.6E-06	<u>1.5E-06</u>	<u>Calculated from BiotaDC</u>							
18	46 Pm-147	8.6E-07	8.6E-07	8.5E-07	Calculated from BiotaDC							
49 Sm-151 2.8F-07 2.8F-07 2.8F-07 2.8F-07 Calculated from BiotaDC 50 Eu-152 3.1F-06 3.6F-06 2.9F-06 1 51 Eu-154 5.0F-06 5.8E-06 5.0F-06 1 52 Eu-155 1.0F-06 1.0F-06 9.8E-07 Calculated from BiotaDC 53 Gd-153 8.5E-07 2.2E-07 7.0E-07 Calculated from BiotaDC 54 Tb-160 4.8E-06 3.7E-06 Calculated from BiotaDC 55 Pu-238 7.7E-05 7.7E-05 7.2E-05 56 Pu-239 7.2E-05 7.2E-05 7.2E-05 52 Pu-240 7.2F-05 7.2F-05 7.2F-05 58 Pu-241 7.4F-08 7.4F-08 7.4F-08 59 Am-241 7.7E-05 7.7E-05 7.0E-05 60 Am-242m 3.6E-06 3.6E-06 3.6E-06 3.6E-06 61 Am-243 7.0E-05 7.8E-05 Calculated from BiotaDC <t< td=""><td><u>47</u> <u>Pm-148</u></td><td><u>9.9E-06</u></td><td><u>1.1E-05</u></td><td><u>7.3E-06</u></td><td><u>Calculated from BiotaDC</u></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	<u>47</u> <u>Pm-148</u>	<u>9.9E-06</u>	<u>1.1E-05</u>	<u>7.3E-06</u>	<u>Calculated from BiotaDC</u>							
50 Eu-152 3.1E-06 3.6E-06 2.9E-06 51 Eu-154 5.0E-06 5.8E-06 5.0E-06 52 Eu-155 1.0E-06 1.0E-06 9.8E-07 53 Gd-153 8.5E-07 9.2E-07 7.0E-07 Calculated from BiotaDC 54 Th-160 4.8E-06 5.4E-06 3.7E-05 Calculated from BiotaDC 55 Pu-238 7.7E-05 7.7E-05 7.7E-05 56 Pu-239 7.2E-05 7.2E-05 7.2E-05 57 Pu-240 7.2E-05 7.2E-05 7.2E-05 58 Pu-241 7.4E-08 7.4E-08 59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.6E-06 2.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.4E-05 8.4E-05	48 <u>Pm-148m</u>	<u>5.2E-06</u>	<u>6.1E-06</u>	3.3E-06	<u>Calculated from BiotaDC</u>							
51 Eu-154 5.0F-06 5.8E-06 5.0F-06 5.0F-06 5.0F-06 5.0F-06 9.8E-07 5.0F-06 9.8E-07 5.0F-06 9.8E-07 5.0F-06 9.8E-07 7.0F-07 Calculated from BiotaDC 5.0F-06 5.2F-06 3.7E-06 Calculated from BiotaDC 5.0F-06 5.2F-06 3.7E-05 7.7E-05 7.7E-05 7.7E-05 7.7E-05 7.2E-05 7.2E-05 <td>49 Sm-151</td> <td>2.8E-07</td> <td>2.8E-07</td> <td>2.8E-07</td> <td>Calculated from BiotaDC</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	49 Sm-151	2.8E-07	2.8E-07	2.8E-07	Calculated from BiotaDC							
52 Eu-155 1.0E-06 1.9E-06 9.8E-07 53 Gd-153 8.5E-07 9.2E-07 7.0E-07 Calculated from BiotaDC 54 Tb-160 4.8E-06 5.4E-06 3.7E-06 Calculated from BiotaDC 55 Pu-238 7.7E-05 7.7E-05 7.7E-05 56 Pu-239 7.2E-05 7.2E-05 7.2E-05 57 Pu-240 7.2E-05 7.2E-05 7.2E-05 58 Pu-241 7.4E-08 7.4E-08 7.4E-08 59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.9E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>50</u> <u>Eu-152</u>	3.1E-06	3.6E-06	2.9E-06								
53 Gd-153 8.5E-07 9.2E-07 7.0E-07 Calculated from BiotaDC 54 Tb-160 4.8E-06 5.4E-06 3.7E-06 Calculated from BiotaDC 55 Pu-238 7.7E-05 7.7E-05 7.7E-05 7.2E-05 56 Pu-239 7.2E-05 7.2E-05 7.2E-05 7.2E-05 57 Pu-240 7.2E-05 7.2E-05 7.2E-05 7.2E-05 58 Pu-241 7.4E-08 7.4E-08 7.7E-05 7.7E-05 59 Am-241 7.7E-05 7.7E-05 7.7E-05 6.0 Am-242m 3.6E-06 3.6E-06 Calculated from BiotaDC 6.0 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 6.0 Calculated from BiotaDC 6.0 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.6E-05 8.4E-05	<u>51</u> Eu-154	5.0E-06	5.8E-06	5.0E-06								
54 Tb-160 4_8E-06 5_4E-06 3_7E-06 Calculated from BiotaDC 55 Pu-238 7.7E-05 7.7E-05 7.7E-05 7.2E-05	<u>52</u> Eu-155	1.0E-06	1.0E-06	9.8E-07								
55 Pu-238 7.7E-05 7.7E-05 7.7E-05 56 Pu-239 7.2E-05 7.2E-05 7.2E-05 57 Pu-240 7.2E-05 7.2E-05 7.2E-05 58 Pu-241 7.4E-08 7.4E-08 7.4E-08 59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>53</u> <u>Gd-153</u>	<u>8.5E-07</u>	9.2E-07	<u>7.0E-07</u>	<u>Calculated from BiotaDC</u>							
56 Pu-239 7.2E-05 7.2E-08 7.4E-08 7.4E-08 7.4E-08 7.4E-08 7.7E-05 7.7E-05 7.7E-05 7.7E-05 7.7E-05 7.7E-05 7.2E-05 7.2E-05 7.2E-05 7.2E-05 7.2E-08 8.2E-06 8.2E-06 8.2E-06 8.2E-05 8.2E	<u>54</u> <u>Tb-160</u>	4.8E-06	<u>5.4E-06</u>	3.7E-06	<u>Calculated from BiotaDC</u>							
57 Pu-240 7.2E-05 7.2E-05 7.2E-05 58 Pu-241 7.4E-08 7.4E-08 7.4E-08 59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>55</u> Pu-238	7.7E-05	7.7E-05	7.7E-05								
58 Pu-241 7.4E-08 7.4E-08 7.4E-08 59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>56</u> Pu-239	7.2E-05	7.2E-05	7.2E-05								
59 Am-241 7.7E-05 7.7E-05 7.7E-05 60 Am-242m 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>57</u> Pu-240	7.2E-05	7.2E-05	7.2E-05								
60 Am-242m 3.6E-06 3.4E-06 Calculated from BiotaDC 61 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>58</u> Pu-241	7.4E-08	7.4E-08	7.4E-08								
61 Am-243 7.9E-05 7.8E-05 Calculated from BiotaDC 62 Cm-242 8.6E-05 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05 8.4E-05	<u>59</u> Am-241	7.7E-05	7.7E-05	7.7E-05								
62 Cm-242 8.6E-05 8.6E-05 63 Cm-243 8.4E-05 8.4E-05	60 <u>Am-242m</u>	3.6E-06	3.6E-06	3.4E-06	Calculated from BiotaDC							
63 Cm-243 8.4E-05 8.4E-05	<u>61</u> <u>Am-243</u>	7.9E-05	7.9E-05	7.8E-05	Calculated from BiotaDC							
	62 <u>Cm-242</u>	8.6E-05	8.6E-05	8.6E-05								
64 Cm-244 8.2E-05 8.2E-05 8.2E-05	<u>63</u> Cm-243	8.4E-05	8.4E-05	8.4E-05								
	64 Cm-244	8.2E-05	8.2E-05	8.2E-05								

				Curren	t	Revised Reason for Revision							
	Table 7	-2-2 Exter	rnal exposur	e conversion	n factor to marine plants and animals		Table 7	-2-2 Exte	rnal exposur	e conversion	n factor to marine plants and animals		
			(ICRP Pub.1	136 and others a	re shown in remarks)				(ICRP Pub.1	36 and others a	re shown in remarks)		
		External ex	xposure dose	conversion				External exposure dose conversion					
	Target	((me	factor Gy/day)/(Bq/l	kg))	Remarks		Target	((m	factor (Gy/day)/(Bq/l	kg))	Remarks		
	nuclide	Flatfish	Crab	Brown			nuclide	Flatfish	Crab	Brown			
1	H-3	1.9E-14	2.4E-16	seaweed 2.4E-16		1	H-3	1.9E-14	2.4E-16	seaweed 2.4E-16			
2	C-14	4.3E-10	5.3E-10	5.3E-10		2	C-14	4.3E-10	5.3E-10	5.3E-10			
3	Mn-54	1.1E-05	1.0E-05	1.1E-05		3	Mn-54	1.1E-05	1.0E-05	1.1E-05			
4	<u>Fe-59</u>	1.5E-05	1.5E-05	1.6E-05	Calculated from BiotaDC	4	Co-60	3.1E-05	3.1E-05	3.4E-05		Appropriate description due to the selection of nuclides to be	
<u>5</u>	<u>Co-58</u>	1.2E-05	1.2E-05	1.2E-05		<u>5</u>	Ni-63	2.6E-11	4.1E-11	4.1E-11		measured and assessed	
<u>6</u>	Co-60	3.1E-05	3.1E-05	3.4E-05		<u>6</u>	<u>Se-79</u>	4.8E-10	<u>5.8E-10</u>	6.2E-10	_		
<u>7</u>	Ni-63	2.6E-11	4.1E-11	4.1E-11		<u>7</u>	Sr-90	1.2E-06	5.5E-07	1.2E-06			
<u>8</u>	<u>Zn-65</u>	<u>7.4E-06</u>	7.2E-06	7.4E-06		8	Y-90	_	_	_	Contained in the parent nuclide Sr-90		
9	<u>Rb-86</u>	1.7E-06	1.4E-06	3.7E-06	Calculated from BiotaDC	9	Tc-99	3.1E-09	3.4E-09	3.6E-09			
<u>10</u>	<u>Sr-89</u>	3.6E-07	2.0E-07	4.1E-07		<u>10</u>	Ru-106	5.3E-06	3.8E-06	5.3E-06			
<u>11</u>	Sr-90	1.2E-06	5.5E-07	1.2E-06		<u>11</u>	Cd-113m	1.7E-08	1.6E-08	1.4E-07	Calculated from BiotaDC		
<u>12</u>	Y-90	_			Contained in the parent nuclide Sr-90	<u>12</u>	Sb-125	5.5E-06	5.3E-06	5.5E-06			
<u>13</u>	<u>Y-91</u>	<u>4.4E-07</u>	2.5E-07	<u>2.0E-06</u>	Calculated from BiotaDC	<u>13</u>	Te-125m	2.9E-07	2.4E-07	4.3E-07	Calculated from BiotaDC		
<u>14</u>	<u>Nb-95</u>	<u>9.6E-06</u>	<u>9.4E-06</u>	9.8E-06		<u>14</u>	I-129	2.2E-07	1.9E-07	2.4E-07			
<u>15</u>	Tc-99	3.1E-09	3.4E-09	3.6E-09		<u>15</u>	Cs-134	2.0E-05	1.9E-05	2.0E-05			
<u>16</u>	<u>Ru-103</u>	<u>6.2E-06</u>	<u>6.0E-06</u>	<u>6.2E-06</u>		<u>16</u>	Cs-137	7.2E-06	7.0E-06	7.2E-06			
<u>17</u>	Ru-106	5.3E-06	3.8E-06	5.3E-06		<u>17</u>	Ce-144	2.6E-06	1.5E-06	2.6E-06			
<u>18</u>	<u>Rh-103m</u>	=			Contained in the parent nuclide Ru-103	<u>18</u>	Pm-147	9.9E-10	1.1E-09	1.0E-08	Calculated from BiotaDC		
<u>19</u>	<u>Rh-106m</u>	=		=	Contained in the parent nuclide Ru-106	<u>19</u>	Sm-151	7.7E-11	8.4E-11	7.6E-10	Calculated from BiotaDC		
<u>20</u>	<u>Ag-110m</u>	3.6E-05	3.4E-05	3.6E-05		<u>20</u>	Eu-154	1.6E-05	1.5E-05	1.6E-05			
<u>21</u>	Cd-113m	1.7E-08	1.6E-08	1.4E-07	Calculated from BiotaDC	<u>21</u>	Eu-155	7.4E-07	7.0E-07	7.4E-07			
<u>22</u>	<u>Cd-115m</u>	8.2E-07	6.2E-07	2.4E-06	Calculated from BiotaDC	<u>22</u>	<u>U-234</u>	4.8E-09	<u>4.1E-09</u>	<u>5.5E-09</u>	_		
23	<u>Sn-119m</u>	1.0E-07	8.0E-08	1.7E-07	Calculated from BiotaDC	<u>23</u>	<u>U-238</u>	3.1E-09	<u>2.6E-09</u>	3.6E-09	_		
<u>24</u>	<u>Sn-123</u>	3.7E-07	2.5E-07	1.6E-06	Calculated from BiotaDC The value of Ag-110m is used because no	<u>24</u>	<u>Np-237</u>	3.1E-07	2.9E-07	3.1E-07	_		
<u>25</u>	<u>Sn-126</u>	3.6E-05	3.4E-05	3.6E-05	value is given to this nuclide in the source	<u>25</u>	Pu-238	4.6E-09	3.8E-09	5.5E-09			
<u>26</u>	<u>Sb-124</u>	<u>2.4E-05</u>	2.3E-05	2.4E-05		<u>26</u>	Pu-239	2.6E-09	2.3E-09	3.1E-09			
<u>27</u>	Sb-125	5.5E-06	5.3E-06	5.5E-06		<u>27</u>	Pu-240	4.3E-09	3.6E-09	5.3E-09			
<u>28</u>	<u>Te-123m</u>	1.8E-06	<u>1.7E-06</u>	2.0E-06	Calculated from BiotaDC	<u>28</u>	Pu-241	1.9E-11	1.9E-11	2.0E-11			
<u>29</u>	Te-125m	2.9E-07	2.4E-07	4.3E-07	Calculated from BiotaDC	<u>29</u>	Am-241	2.9E-07	2.6E-07	2.9E-07			
<u>30</u>	<u>Te-127</u>	8.9E-08	8.3E-08	2.9E-07	Calculated from BiotaDC	30	Cm-243	1.6E-06	1.5E-06	1.6E-06			
<u>31</u>	<u>Te-127m</u>	1.8E-07	1.6E-07	4.2E-07	Calculated from BiotaDC	31	Cm-244	4.8E-09	3.8E-09	5.5E-09			
<u>32</u>	Te-129	=			Contained in the parent nuclide Te-129m								

			Сотрин	Current	•	Revised	Reason for Revision
<u>33</u>	<u>Te-129m</u>	1.2E-06	1.1E-06	1.3E-06			Appropriate description due to
<u>34</u>	I-129	2.2E-07	1.9E-07	2.4E-07			the selection of nuclides to be measured and assessed
<u>35</u>	Cs-134	2.0E-05	1.9E-05	2.0E-05			
<u>36</u>	<u>Cs-135</u>	2.2E-09	2.6E-09	2.6E-09			
<u>37</u>	<u>Cs-136</u>	2.6E-05	2.6E-05	2.6E-05			
<u>38</u>	Cs-137	7.2E-06	7.0E-06	7.2E-06			
<u>39</u>	<u>Ba-137m</u>	=	=	=	Contained in the parent nuclide Cs-137		
<u>40</u>	<u>Ba-140</u>	3.1E-05	3.1E-05	3.4E-05			
<u>41</u>	<u>Ce-141</u>	9.6E-07	9.1E-07	9.8E-07			
<u>42</u>	Ce-144	2.6E-06	1.5E-06	2.6E-06			
<u>43</u>	<u>Pr-144</u>	=	=	=	Contained in the parent nuclide Ce-144		
<u>44</u>	<u>Pr-144m</u>	=	=	=	Contained in the parent nuclide Ce-144		
<u>45</u>	<u>Pm-146</u>	<u>9.5E-06</u>	<u>9.1E-06</u>	1.0E-05	Calculated from BiotaDC		
<u>46</u>	Pm-147	9.9E-10	1.1E-09	1.0E-08	Calculated from BiotaDC		
<u>47</u>	<u>Pm-148</u>	<u>8.1E-06</u>	<u>7.5E-06</u>	<u>1.1E-05</u>	Calculated from BiotaDC		
<u>48</u>	<u>Pm-148m</u>	2.5E-05	2.4E-05	2.7E-05	<u>Calculated from BiotaDC</u>		
<u>49</u>	Sm-151	7.7E-11	8.4E-11	7.6E-10	Calculated from BiotaDC		
<u>50</u>	<u>Eu-152</u>	1.5E-05	<u>1.4E-05</u>	<u>1.5E-05</u>			
<u>51</u>	Eu-154	1.6E-05	1.5E-05	1.6E-05			
<u>52</u>	Eu-155	7.4E-07	7.0E-07	7.4E-07			
<u>53</u>	<u>Gd-153</u>	<u>1.2E-06</u>	<u>1.1E-06</u>	<u>1.4E-06</u>	Calculated from BiotaDC		
<u>54</u>	<u>Tb-160</u>	1.4E-05	<u>1.4E-05</u>	<u>1.5E-05</u>	Calculated from BiotaDC		
<u>55</u>	Pu-238	4.6E-09	3.8E-09	5.5E-09			
<u>56</u>	Pu-239	2.6E-09	2.3E-09	3.1E-09			
<u>57</u>	Pu-240	4.3E-09	3.6E-09	5.3E-09			
<u>58</u>	Pu-241	1.9E-11	1.9E-11	2.0E-11			
<u>59</u>	Am-241	2.9E-07	2.6E-07	2.9E-07			
<u>60</u>	<u>Am-242m</u>	2.4E-07	2.3E-07	<u>4.2E-07</u>	<u>Calculated from BiotaDC</u>		
<u>61</u>	<u>Am-243</u>	2.9E-06	2.8E-06	3.2E-06	Calculated from BiotaDC		
<u>62</u>	<u>Cm-242</u>	<u>5.3E-09</u>	<u>4.3E-09</u>	<u>6.2E-09</u>			
<u>63</u>	Cm-243	1.6E-06	1.5E-06	1.6E-06			
<u>64</u>	Cm-244	4.8E-09	3.8E-09	5.5E-09			

				Curren	ıt			Reason for Revision				
		Table 7-2-3	Concent	ration ratio	to marine plants and animals			Table 7-2-3	Concent	ration ratio	to marine plants and animals	
		(IC			s, shown in remarks)			(Ie			s, shown in remarks)	
	Target	Concentration	on ratio ((Bq/kg-	-f.w)/(Bq/L))	Remarks		Target	Concentration	on ratio ((Bq/kg	-f.w)/(Bq/L))	Remarks	
	nuclide	Flatfish	Crab	Brown seaweed			nuclide	Flatfish	Crab	Brown seaweed		
1	H-3	1.0E+00	1.0E+00	3.7E-01	Excerpted from ICRP Pub.114	1	H-3	1.0E+00	1.0E+00	3.7E-01	Excerpted from ICRP Pub.114	
2	C-14	1.2E+04	1.0E+04	8.0E+03	Excerpted from ICRP Pub.114	2	C-14	1.2E+04	1.0E+04	8.0E+03	Excerpted from ICRP Pub.114	
3	Mn-54	2.6E+03	4.5E+04	1.1E+04	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)	3	Mn-54	2.6E+03	4.5E+04	1.1E+04	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)	
<u>4</u>	<u>Fe-59</u>	3.0E+04	5.0E+05	2.0E+04	The concentration factor of TRS-422 is excerpted because it is not shown in ICRP Pub.114 or TRS-	4	Co-60	1.1E+04	5.5E+03	1.7E+03	Excerpted from TRS-479 Excerpted from TRS-479 (crab)	Appropriate description due to
<u>5</u>	<u>Co-58</u>	1.1E+04	5.5E+03	1.7E+03	Excerpted from TRS-479	<u>5</u>	Ni-63	2.7E+02	6.4E+03	2.0E+03	Excerpted from ICRP Pub.114 (fish and crab brown seaweed)	the selection of nuclides to be measured and assessed
<u>6</u>	Co-60	1.1E+04	5.5E+03	1.7E+03	Excerpted from TRS-479	<u>6</u>	<u>Se-79</u>	1.0E+04	1.0E+04	4.3E+02	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)	
7	Ni-63	2.7E+02	6.4E+03	2.0E+03	Excerpted from TRS-479	7	Sr-90	4.4E+01	1.5E+02	4.3E+01	Excerpted from TRS-479 (crab and brown seaweed) Excerpted from ICRP Pub.114 (fish)	
<u>8</u>	<u>Zn-65</u>	2.5E+04	3.0E+05	1.3E+04	Excerpted from TRS-479 (fish) Excerpted from ICRP Pub.114 (crab and brown	<u>8</u>	Y-90	-	-	-	Assessed with the parent nuclide Sr-90.	
9	<u>Rb-86</u>	1.2E+02	6.3E+01	9.6E+01	<u>seaweed)</u> The value of congener Cs is used	9	Тс-99	8.0E+01	1.8E+04	5.3E+04	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)	
<u>10</u>	Sr-89	4.4E+01	1.5E+02	4.3E+01	Excerpted from TRS-479	<u>10</u>	Ru-106	2.9E+01	1.6E+03	1.2E+03	Excerpted from TRS-479	
11	Sr-90	4.4E+01	1.5E+02	4.3E+01	Excerpted from TRS-479	<u>11</u>	Cd-113m	2.9E+04	1.3E+05	1.6E+03	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)	
<u>12</u>	Y-90	-	-	-	Assessed with the parent nuclide Sr-90.	12	Sb-125	6.0E+02	4.7E+02	1.5E+03	Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and brown	
<u>13</u>	<u>Y-91</u>	2.0E+01	1.0E+03	1.0E+03	The concentration factor of TRS-422 is excerpted because it is not shown in ICRP Pub.114 or TRS-	13	To 125m	1.0E+03	1.0E+03	1.0E+04	seaweed)	
10	<u> </u>	<u> 2.02 01</u>	1.02+05	1.02103	479	 	Te-125m				Excerpted from ICRP Pub.114 Excerpted from ICRP Pub.114 (fish)	
<u>14</u>	<u>Nb-95</u>	3.0E+01	8.8E+02	4.9E+02	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)	14	I-129	9.0E+00	8.8E+03	4.2E+03	Excerpted from TRS-479 (crab and brown seaweed)	
<u>15</u>	Tc-99	8.0E+01	1.8E+04	5.3E+04	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)	15 16	Cs-134 Cs-137	1.2E+02 1.2E+02	6.3E+01 6.3E+01	9.6E+01 9.6E+01	Excerpted from TRS-479 Excerpted from TRS-479	
<u>16</u>	<u>Ru-103</u>	2.9E+01	1.6E+03	1.2E+03	Excerpted from TRS-479	17	Ce-144	3.9E+02	2.2E+03	2.1E+03	Excerpted from TRS-479	
<u>17</u>	Ru-106	2.9E+01	1.6E+03	1.2E+03	Excerpted from TRS-479							
<u>18</u>	<u>Rh-103m</u>	=	Ξ	Ξ	Assessed with the parent nuclide Ru-103	<u>18</u>	Pm-147	7.3E+02	2.4E+04	5.9E+03	Excerpted from ICRP Pub.114	
<u>19</u>	<u>Rh-106</u>	<u>=</u>	Ξ	=	Assessed with the parent nuclide Ru-106 Excerpted from TRS-479 (fish and brown seaweed)	10	G 4.74	5.25 .02	2.47.04	7.07.02		
<u>20</u>	<u>Ag-110m</u>	1.1E+04	2.0E+05	3.9E+03	Excerpted from ICRP Pub.114 (crab)	19	Sm-151	7.3E+02	2.4E+04	5.9E+03	Excerpted from ICRP Pub.114	
<u>21</u>	Cd-113m	2.9E+04	1.3E+05	1.6E+03	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed) Excerpted from TRS-479 (fish and crab)	<u>20</u>	Eu-154	7.3E+02	2.4E+04	1.4E+03	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)	
<u>22</u>	<u>Cd-115m</u>	2.9E+04	1.3E+05	1.6E+03	Excerpted from ICRP Pub.114 (brown seaweed)	<u>21</u>	Eu-155	7.3E+02	2.4E+04	1.4E+03	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)	
<u>23</u>	<u>Sn-119m</u>	5.0E+05	5.0E+05	2.0E+05	The concentration factor of TRS-422 is excerpted because it is not shown in ICRP Pub.114 or TRS-	<u>22</u>	<u>U-234</u>	<u>8.8E+00</u>	3.5E+01	<u>8.3E+01</u>	Excerpted from TRS-479	
					The concentration factor of TRS-422 is excerpted	<u>23</u>	<u>U-238</u>	8.8E+00	3.5E+01	8.3E+01	Excerpted from TRS-479	
<u>24</u>	<u>Sn-123</u>	5.0E+05	<u>5.0E+05</u>	2.0E+05	because it is not shown in ICRP Pub.114 or TRS- 479	24	<u>Np-237</u>	2.1E+01	4.3E+02	5.4E+01	Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and brown seaweed)	
<u>25</u>	<u>Sn-126</u>	5.0E+05	5.0E+05	2.0E+05	The concentration factor of TRS-422 is excerpted because it is not shown in ICRP Pub.114 or TRS-	<u>25</u>	Pu-238	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479	
					479 Excerpted from ICRP Pub.114 (fish and brown	<u>26</u>	Pu-239	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479	
<u>26</u>	<u>Sb-124</u>	6.0E+02	4.7E+02	1.5E+03	seaweed)	<u>27</u>	Pu-240	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479	
					Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and brown	<u>28</u>	Pu-241	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479	
<u>27</u>	Sb-125	6.0E+02	4.7E+02	1.5E+03	seaweed) Excerpted from TRS-479 (crab)	<u>29</u>	Am-241	3.2E+02	9.9E+03	4.3E+02	Excerpted from ICRP Pub.114 Excerpted from TRS-479 (crab and brown seaweed)	
					Excepted from 11x3-4/7 (clau)	<u>30</u>	Cm-243	1.9E+02	3.2E+04	1.2E+04	Excerpted from IRS-4/9 (crab and brown seaweed) Excerpted from ICRP Pub.114 (fish)	

			Compan	Current	t amendments in the implementation Plan for	T GIK	Revised						Reason for Revision
<u>28</u>	<u>Te-123m</u>	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114		<u>31</u>	Cm-244	1.9E+02	3.2E+04	1.2E+04	Excerpted from TRS-479 (crab and brown seaweed)	Appropriate description due to
<u>29</u>	Te-125m	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114	L	<u>J1</u>	CIII-244	1.7L102	3.2L104	1.2L+0+	Excerpted from ICRP Pub.114 (fish)	the selection of nuclides to be
<u>30</u>	<u>Te-127</u>	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114								measured and assessed
<u>31</u>	<u>Te-127m</u>	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114								
<u>32</u>	<u>Te-129</u>	_	_		Assessed with the parent nuclide Te-129m								
<u>33</u>	<u>Te-129m</u>	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114								
<u>34</u>	I-129	9.0E+00	8.8E+03	4.2E+03	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)								
<u>35</u>	Cs-134	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479								
<u>36</u>	<u>Cs-135</u>	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479								
<u>37</u>	<u>Cs-136</u>	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479								
<u>38</u>	Cs-137	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479								
<u>39</u>	<u>Ba-137m</u>	Ξ	Ξ	П	Assessed with the parent nuclide Cs-137								
<u>40</u>	<u>Ba-140</u>	9.6E+00	8.0E+02	1.6E+03	Excerpted from ICRP Pub.114								
<u>41</u>	<u>Ce-141</u>	3.9E+02	2.2E+03	2.1E+03	Excerpted from TRS-479								
<u>42</u>	Ce-144	3.9E+02	2.2E+03	2.1E+03	Excerpted from TRS-479								
<u>43</u>	<u>Pr-144</u>	=	Ξ	Ξ	Assessed with the parent nuclide Ce-144								
<u>44</u>	<u>Pr-144m</u>	=	=	Ξ	Assessed with the parent nuclide Ce-144								
<u>45</u>	<u>Pm-146</u>	7.3E+02	2.4E+04	5.9E+03	The value of congener Eu is used (fish and crab) The value of congener La is used (brown seaweed)								
<u>46</u>	Pm-147	7.3E+02	2.4E+04	5.9E+03	The value of congener Eu is used (fish and crab) The value of congener La is used (brown seaweed)								
<u>47</u>	Pm-148	7.3E+02	2.4E+04	5.9E+03	The value of congener Eu is used (fish and crab)								
					The value of congener La is used (brown seaweed) The value of congener Eu is used (fish and crab)								
<u>48</u>	<u>Pm-148m</u>	7.3E+02	2.4E+04	5.9E+03	The value of congener La is used (brown seaweed)								
<u>49</u>	Sm-151	7.3E+02	2.4E+04	5.9E+03	The value of congener Eu is used (fish and crab) The value of congener La is used (brown seaweed)								
<u>50</u>	<u>Eu-152</u>	7.3E+02	2.4E+04	1.4E+03	Excerpted from ICRP Pub.114 (fish and crab) Excerpted from TRS-479 (brown seaweed)								
<u>51</u>	Eu-154	7.3E+02	2.4E+04	1.4E+03	Excerpted from ICRP Pub.114 (fish and crab) Excerpted from TRS-479 (brown seaweed)								
<u>52</u>	Eu-155	7.3E+02	2.4E+04	1.4E+03	Excerpted from ICRP Pub.114 (fish and crab) Excerpted from TRS-479 (brown seaweed)								
<u>53</u>	<u>Gd-153</u>	7.3E+02	2.4E+04	5.9E+03	The value of congener Eu is used (fish and crab) The value of congener La is used (brown seaweed)								
<u>54</u>	<u>Tb-160</u>	6.0E+01	4.0E+03	2.0E+03	The concentration factor of TRS-422 is excerpted because it is not shown in ICRP Pub.114 or TRS-479								
<u>55</u>	Pu-238	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479								
<u>56</u>	Pu-239	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479								
<u>57</u>	Pu-240	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479								
<u>58</u>	Pu-241	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479								
<u>59</u>	Am-241	3.2E+02	9.9E+03	4.3E+02	Excerpted from TRS-479								
<u>60</u>	<u>Am-242m</u>	3.2E+02	9.9E+03	4.3E+02	Excerpted from TRS-479								
<u>61</u>	<u>Am-243</u>	3.2E+02	9.9E+03	4.3E+02	Excerpted from TRS-479								
<u>62</u>	<u>Cm-242</u>	1.9E+02	3.2E+04	1.2E+04	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)								
<u>63</u>	Cm-243	1.9E+02	3.2E+04	1.2E+04	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)								
<u>64</u>	Cm-244	1.9E+02	3.2E+04	1.2E+04	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)								

		Current			Reason for Revision				
	Table 7-2-4	Concentration distribution coefficient of the seawater and seabed sediment		Table 7-2-4					
		(TRS-422 and others are shown in remarks)			(Excerpted from TRS-422)	Appropriate description due to			
	Target nuclide	Concentration distribution coefficient ((Bq/kg)/(Bq/L))		Target nuclide	Concentration distribution coefficient ((Bq/kg)/(Bq/L)) Remarks	the selection of nuclides to be measured and assessed			
1	H-3	1.0E+00	1	H-3	1.0E+00				
2	C-14	1.0E+03	2	C-14	1.0E+03				
3	Mn-54	2.0E+06	3	Mn-54	2.0E+06				
<u>4</u>	<u>Fe-59</u>	3.0E+08	4	Co-60	3.0E+05				
<u>5</u>	<u>Co-58</u>	3.0E+05	<u>5</u>	Ni-63	2.0E+04				
<u>6</u>	Co-60	3.0E+05	<u>6</u>	<u>Se-79</u>	3.00E+03				
<u>7</u>	Ni-63	2.0E+04	7	Sr-90	8.0E+00				
<u>8</u>	<u>Zn-65</u>	7.0E+04	<u>8</u>	Y-90	- Assessed with the parent nuclide Sr-90				
9	<u>Rb-86</u>	4.0E+03 The value of congener Cs is used because no value is given to this nuclide in the source	9	Tc-99	1.0E+02				
<u>10</u>	<u>Sr-89</u>	8.0E+00	<u>10</u>	Ru-106	4.0E+04				
<u>11</u>	Sr-90	8.0E+00	<u>11</u>	Cd-113m	3.0E+04				
<u>12</u>	Y-90	- Assessed with the parent nuclide Sr-90	<u>12</u>	Sb-125	2.0E+03				
<u>13</u>	<u>Y-91</u>	9.0E+05	<u>13</u>	Te-125m	1.0E+03				
14	Nb-95	8.0E+05	<u>14</u>	I-129	7.0E+01				
<u>15</u>	Tc-99	1.0E+02	<u>15</u>	Cs-134	4.0E+03				
<u>16</u>	<u>Ru-103</u>	4.0E+04	<u>16</u>	Cs-137	4.0E+03				
<u>17</u>	Ru-106	4.0E+04	<u>17</u>	Ce-144	3.0E+06				
<u>18</u>	Rh-103m	<u>-</u> <u>Assessed with the parent nuclide Ru-103</u>	<u>18</u>	Pm-147	2.0E+06				
<u>19</u>	<u>Rh-106</u>	<u>-</u> <u>Assessed with the parent nuclide Ru-106</u>	<u>19</u>	Sm-151	3.0E+06				
<u>20</u>	<u>Ag-110m</u>	1.0E+04	<u>20</u>	Eu-154	2.0E+06				
<u>21</u>	Cd-113m	3.0E+04	<u>21</u>	Eu-155	2.0E+06				
<u>22</u>	<u>Cd-115m</u>	3.0E+04	22	<u>U-234</u>	1.00E+03				
<u>23</u>	<u>Sn-119m</u>	<u>4.0E+06</u>	23	<u>U-238</u>	1.00E+03				
<u>24</u>	<u>Sn-123</u>	<u>4.0E+06</u>	24	Np-237 Pu-238	1.00E+03 1.0E+05				
<u>25</u>	<u>Sn-126</u>	<u>4.0E+06</u>	<u>25</u>	Pu-239	1.0E+05				
<u>26</u>	<u>Sb-124</u>	2.0E+03	26 27	Pu-240	1.0E+05 1.0E+05				
<u>27</u>	Sb-125	2.0E+03	28	Pu-241	1.0E+05				
<u>28</u>	<u>Te-123m</u>	1.0E+03	<u>29</u>	Am-241	2.0E+06				
<u>29</u>	Te-125m	1.0E+03	30	Cm-243	2.0E+06				
<u>30</u>	<u>Te-127</u>	1.0E+03	31	Cm-244	2.0E+06				
<u>31</u>	<u>Te-127m</u>	1.0E+03		Cm 211	2.02100				
<u>32</u>	<u>Te-129</u>	<u>-</u> <u>Assessed with the parent nuclide Te-129m</u>							
<u>33</u>	<u>Te-129m</u>	1.0E+03							
<u>34</u>	I-129	7.0E+01							
<u>35</u>	Cs-134	4.0E+03							
<u>36</u>	<u>Cs-135</u>	4.0E+03							
<u>37</u>	<u>Cs-136</u>	4.0E+03							
<u>38</u>	Cs-137	4.0E+03							
<u>39</u>	<u>Ba-137m</u>	<u>-</u> <u>Assessed with the parent nuclide Cs-137</u>							

2.0E+03 3.0E+06			
3.0E+06			Appropriate description due to
			Appropriate description due to the selection of nuclides to be
3.0E+06			measured and assessed
Ξ.	Assessed with the parent nuclide Ce-144		
	Assessed with the parent nuclide Ce-144		
1.0E+05			
2.0E+06			
2.0E+06			
	1.0E+05 1.0E+05 1.0E+05 2.0E+06 2.0E+06 2.0E+06 2.0E+06 2.0E+06	2.0E+06 2.0E+06 2.0E+06 2.0E+06 3.0E+06 3.0E+06 2.0E+06 2.0E+06 2.0E+06 2.0E+06 1.0E+05 1.0E+05 1.0E+05 1.0E+05 2.0E+06 2.0E+06 2.0E+06 2.0E+06 2.0E+06	2.0E+06 2.0E+06 2.0E+06 3.0E+06 3.0E+06 2.0E+06 2.0E+06 2.0E+06 2.0E+06 2.0E+06 1.0E+05 1.0E+05 1.0E+05 2.0E+06

87

Current	Revised
7-3. Assessment result	7-3. Assessment result
(Omission)	(Omission)
7-3-1. Concentration in the seawater used for the assessment	7-3-1. Concentration in the seawater used for the assessment
(Omission)	(Omission)

Table 7-3-2 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

	T T	ichdes in the K4 tank group)
Target	Annual discharge	Concentration in the seawater used for the assessment (within 10 km × 10 km)
nuclide	amount (Bq)	Average concentration of the bottom layer (Bq/L)
H-3	2.2E+13	6.0E-02
C-14	1.7E+09	4.7E-06
Mn-54	7.8E+05	2.1E-09
<u>Fe-59</u>	2.0E+06	<u>5.4E-09</u>
<u>Co-58</u>	9.3E+05	<u>2.5E-09</u>
Co-60	5.1E+07	1.4E-07
Ni-63	2.5E+08	6.9E-07
<u>Zn-65</u>	1.7E+06	<u>4.7E-09</u>
<u>Rb-86</u>	2.2E+07	<u>6.0E-08</u>
<u>Sr-89</u>	1.2E+07	3.2E-08
Sr-90	2.5E+07	6.9E-08
Y-90	2.5E+07	6.9E-08
<u>Y-91</u>	2.5E+08	<u>6.9E-07</u>
<u>Nb-95</u>	1.2E+06	<u>3.2E-09</u>
Tc-99	8.1E+07	2.2E-07
<u>Ru-103</u>	1.2E+06	3.2E-09
Ru-106	1.9E+08	5.1E-07
<u>Rh-103m</u>	1.2E+06	<u>3.2E-09</u>
<u>Rh-106</u>	1.9E+08	<u>5.1E-07</u>
<u>Ag-110m</u>	6.5E+05	<u>1.8E-09</u>
Cd-113m	2.1E+06	5.7E-09
<u>Cd-115m</u>	7.4E+07	<u>2.0E-07</u>
<u>Sn-119m</u>	2.0E+07	<u>5.4E-08</u>
<u>Sn-123</u>	1.4E+08	3.8E-07
<u>Sn-126</u>	3.1E+06	<u>8.5E-09</u>
<u>Sb-124</u>	1.1E+06	3.0E-09
Sb-125	3.8E+07	1.0E-07
<u>Te-123m</u>	<u>1.1E+06</u>	<u>2.9E-09</u>

Concentration in the seawater used for the assessment (Source term based on the **Table 7-3-2** composition of nuclides in the K4 tank group)

	Tobition of ite	chues in the K4 tank group)
Target	Annual discharge	Concentration in the seawater used for the assessment (within 10 km × 10 km)
nuclide	amount (Bq)	Average concentration of the bottom layer (Bq/L)
H-3	2.2E+13	6.0E-02
C-14	1.7E+09	4.7E-06
Mn-54	7.8E+05	2.1E-09
Co-60	5.1E+07	1.4E-07
Ni-63	2.5E+08	6.9E-07
<u>Se-79</u>	1.7E+08	<u>4.7E-07</u>
Sr-90	2.5E+07	6.9E-08
Y-90	2.5E+07	6.9E-08
Tc-99	8.1E+07	2.2E-07
Ru-106	1.9E+08	5.1E-07
Cd-113m	2.1E+06	5.7E-09
Sb-125	3.8E+07	1.0E-07
Te-125m	3.8E+07	1.0E-07
I-129	2.4E+08	6.6E-07
Cs-134	5.2E+06	1.4E-08
Cs-137	4.9E+07	1.3E-07
Ce-144	7.3E+06	2.0E-08
Pm-147	2.2E+07	6.0E-08
Sm-151	1.0E+05	2.8E-10
Eu-154	1.4E+06	3.8E-09
Eu-155	3.8E+06	1.0E-08
<u>U-234</u>	7.3E+04	<u>2.0E-10</u>
<u>U-238</u>	7.3E+04	<u>2.0E-10</u>
<u>Np-237</u>	7.3E+04	<u>2.0E-10</u>
Pu-238	7.3E+04	2.0E-10
Pu-239	7.3E+04	2.0E-10
Pu-240	7.3E+04	2.0E-10
Pu-241	3.2E+06	8.8E-09
Am-241	7.3E+04	2.0E-10

The Japanese version shall prevail.

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

Current	R	evised Reason for Revisi
Te-125m 3.8E+07 1.0E-07	Cm-243 7.3E+04	2.0E-10
Te-127 3.7E+07 1.0E-07	Cm-244 7.3E+04	2.0E-10 Appropriate description d the selection of nuclides t
Te-127m 3.7E+07 1.0E-07	Target exposure assessment	Environmental protection measured and assessed
<u>Te-129</u> 9.4E+06 2.6E-08		
<u>Te-129m</u> 3.7E+07 1.0E-07		
I-129 2.4E+08 6.6E-07		
Cs-134 5.2E+06 1.4E-08		
<u>Cs-136</u> <u>3.5E+06</u> <u>9.5E-09</u>		
Cs-137 4.9E+07 1.3E-07		
<u>Ba-137m</u> <u>4.9E+07</u> <u>1.3E-07</u>		
<u>Ba-140</u> <u>1.1E+07</u> <u>3.0E-08</u>		
<u>Ce-141</u> <u>2.9E+06</u> <u>7.9E-09</u>		
Ce-144 7.3E+06 2.0E-08		
<u>Pr-144</u> 7.3E+06 2.0E-08		
<u>Pr-144m</u> 7.3E+06 2.0E-08		
<u>Pm-146</u> <u>1.1E+07</u> <u>3.1E-08</u>		
Pm-147 2.2E+07 6.0E-08		
<u>Pm-148</u> <u>5.8E+07</u> <u>1.6E-07</u>		
<u>Pm-148m</u> 9.7E+05 2.7E-09		
Sm-151 1.0E+05 2.8E-10		
<u>Eu-152</u> <u>3.2E+06</u> <u>8.8E-09</u>		
Eu-154 1.4E+06 3.8E-09		
Eu-155 3.8E+06 1.0E-08		
<u>Gd-153</u> <u>3.7E+06</u> <u>1.0E-08</u>		
<u>Tb-160</u> <u>3.2E+06</u> <u>8.8E-09</u>		
Pu-238 7.3E+04 2.0E-10		
Pu-239 7.3E+04 2.0E-10		
Pu-240 7.3E+04 2.0E-10		
Pu-241 3.2E+06 8.8E-09		
Am-241 7.3E+04 2.0E-10		
<u>Am-242m</u> <u>4.5E+03</u> <u>1.2E-11</u>		
<u>Am-243</u> 7.3E+04 2.0E-10		
<u>Cm-242</u> 7.3E+04 2.0E-10		
Cm-243 7.3E+04 2.0E-10		
Cm-244 7.3E+04 2.0E-10		
Target exposure assessment Environmental pr	on	

88

	Current							Reason for Revision	
Table 7-3-3	3-3 Concentration in the seawater used for the assessment (Source term based on the Tab				3 Concentration in the seawater used for the assessment (Source term based on th				
	comp	osition of nu	clides in the J1-C tank group)		comp	position of nu	clides in the J1-C tank group)		
	Target nuclide	Annual discharge amount (Bq)	Concentration in the seawater used for the assessment (within 10 km × 10 km) Average concentration of the bottom layer (Bq/L)		Target nuclide	Annual discharge amount (Bq)	Concentration in the seawater used for the assessment (within 10 km × 10 km) Average concentration of the bottom layer (Bq/L)		
	H-3	2.2E+13	6.0E-02		H-3	2.2E+13	6.0E-02		
	C-14	4.8E+08	1.3E-06		C-14	4.8E+08	1.3E-06		
	Mn-54	1.0E+06	2.8E-09		Mn-54	1.0E+06	2.8E-09		
	<u>Fe-59</u>	2.3E+06	<u>6.4E-09</u>		Co-60	8.9E+06	2.4E-08		Appropriate description due to the selection of nuclides to be
	<u>Co-58</u>	1.1E+06	<u>3.0E-09</u>		Ni-63	2.3E+08	6.2E-07		measured and assessed
	Co-60	8.9E+06	2.4E-08		<u>Se-79</u>	4.0E+07	1.1E-07		
	Ni-63	2.3E+08	6.2E-07		Sr-90	9.7E+05	2.6E-09		
	<u>Zn-65</u>	2.5E+06	<u>6.9E-09</u>		Y-90	9.7E+05	2.6E-09		
	<u>Rb-86</u>	1.3E+07	<u>3.7E-08</u>		Tc-99	3.2E+07	8.8E-08		
	<u>Sr-89</u>	<u>1.4E+06</u>	<u>4.0E-09</u>		Ru-106	3.8E+07	1.0E-07		
	Sr-90	9.7E+05	2.6E-09		Cd-113m	2.3E+06	6.2E-09		
	Y-90	9.7E+05	2.6E-09		Sb-125	6.2E+06	1.7E-08		
	<u>Y-91</u>	4.6E+08	<u>1.2E-06</u>		Te-125m	6.2E+06	1.7E-08		
	<u>Nb-95</u>	1.3E+06	<u>3.7E-09</u>		I-129	3.2E+07	8.8E-08		
	Тс-99	3.2E+07	8.8E-08		Cs-134	2.0E+06	5.6E-09		
	<u>Ru-103</u>	1.4E+06	<u>3.9E-09</u>		Cs-137	5.1E+06	1.4E-08		
	Ru-106	3.8E+07	1.0E-07		Ce-144	1.5E+07	4.2E-08		
	<u>Rh-103m</u>	1.4E+06	<u>3.9E-09</u>		Pm-147	2.1E+07	5.9E-08		
	<u>Rh-106</u>	3.8E+07	<u>1.0E-07</u>		Sm-151	3.0E+05	8.0E-10		
	<u>Ag-110m</u>	<u>1.2E+06</u>	<u>3.1E-09</u>		Eu-154	3.0E+06	8.0E-09		
	Cd-113m	2.3E+06	6.2E-09		Eu-155	9.1E+06	2.5E-08		
	<u>Cd-115m</u>	7.2E+07	<u>2.0E-07</u>		<u>U-234</u>	<u>8.9E+05</u>	<u>2.4E-09</u>		
	<u>Sn-119m</u>	1.1E+09	<u>3.1E-06</u>		<u>U-238</u>	8.9E+05	2.4E-09		
	<u>Sn-123</u>	1.8E+08	<u>4.8E-07</u>		<u>Np-237</u>	8.9E+05	2.4E-09		
	<u>Sn-126</u>	7.8E+06	<u>2.1E-08</u>		Pu-238	8.9E+05	2.4E-09		
	<u>Sb-124</u>	2.6E+06	<u>7.1E-09</u>		Pu-239	8.9E+05	2.4E-09		
	Sb-125	6.2E+06	1.7E-08		Pu-240	8.9E+05	2.4E-09		
	<u>Te-123m</u>	2.5E+06	<u>6.7E-09</u>		Pu-241	3.2E+07	8.8E-08		
	Te-125m	6.2E+06	1.7E-08		Am-241	8.9E+05	2.4E-09		
	<u>Te-127</u>	1.3E+08	<u>3.4E-07</u>		Cm-243	8.9E+05	2.4E-09		
	<u>Te-127m</u>	1.3E+08	<u>3.6E-07</u>		Cm-244	8.9E+05	2.4E-09		
T .	<u>Te-129</u>	1.7E+07	<u>4.5E-08</u>		Target exposi	ure assessment	Environmental protection		

Current		Current	Revised	Reason for Revision
<u>Te-129m</u>	3.8E+07	1.0E-07		Appropriate description due
I-129	3.2E+07	8.8E-08		the selection of nuclides to l measured and assessed
Cs-134	2.0E+06	5.6E-09		
<u>Cs-135</u>	3.2E+01	8.8E-14		
<u>Cs-136</u>	1.3E+06	3.4E-09		
Cs-137	5.1E+06	1.4E-08		
<u>Ba-137m</u>	5.1E+06	<u>1.4E-08</u>		
<u>Ba-140</u>	5.4E+06	1.5E-08		
<u>Ce-141</u>	7.0E+06	<u>1.9E-08</u>		
Ce-144	1.5E+07	4.2E-08		
<u>Pr-144</u>	1.5E+07	4.2E-08		
<u>Pr-144m</u>	1.5E+07	<u>4.2E-08</u>		
<u>Pm-146</u>	1.8E+06	<u>4.9E-09</u>		
Pm-147	2.1E+07	5.9E-08		
<u>Pm-148</u>	6.2E+06	<u>1.7E-08</u>		
<u>Pm-148m</u>	1.3E+06	3.5E-09		
Sm-151	3.0E+05	8.0E-10		
<u>Eu-152</u>	7.5E+06	2.0E-08		
Eu-154	3.0E+06	8.0E-09		
Eu-155	9.1E+06	2.5E-08		
<u>Gd-153</u>	7.0E+06	<u>1.9E-08</u>		
<u>Tb-160</u>	3.8E+06	<u>1.0E-08</u>		
Pu-238	8.9E+05	2.4E-09		
Pu-239	8.9E+05	2.4E-09		
Pu-240	8.9E+05	2.4E-09		
Pu-241	3.2E+07	8.8E-08		
Am-241	8.9E+05	2.4E-09		
<u>Am-242m</u>	1.6E+04	<u>4.3E-11</u>		
<u>Am-243</u>	8.9E+05	<u>2.4E-09</u>		
<u>Cm-242</u>	8.9E+05	<u>2.4E-09</u>		
Cm-243	8.9E+05	2.4E-09		
Cm-244	8.9E+05	2.4E-09		
Target exposi	ire assessment	Environmental protection		

		Compariso	n Table of amendments in the Imple	mentation Plan for Fu	ukushima Daiichi	Nuclear Power	Station as S	pecified Nuclear Facility (Reference, A	Attachment-2)	
	Current							Reason for Revision		
Table 7-3-4	Concentration	in the seawa	ter used for the assessment (Source to	erm based on the	Table 7-3-4	Concentration	in the seawa	ter used for the assessment (Source ter	m based on the	
	comp	osition of nu	clides in the J1-G tank group)			comp	osition of nu	clides in the J1-G tank group)		
		A 1	Concentration in the seawater used for				A 1	Concentration in the seawater used for		
	Target	Annual discharge	the assessment (within 10 km × 10 km)			Target	Annual discharge	the assessment (within 10 km × 10 km)		
	nuclide	amount	Average concentration of the bottom			nuclide	amount	Average concentration of the bottom		
		(Bq)	layer (Bq/L)				(Bq)	layer (Bq/L)		
	H-3	2.2E+13	6.0E-02			H-3	2.2E+13	6.0E-02		
	C-14	1.3E+09	3.6E-06			C-14	1.3E+09	3.6E-06		
	Mn-54	3.1E+06	8.4E-09			Mn-54	3.1E+06	8.4E-09		Appropriate description due to
	<u>Fe-59</u>	5.9E+06	1.6E-08			Co-60	1.9E+07	5.1E-08		the selection of nuclides to be
	<u>Co-58</u>	3.0E+06	8.2E-09			Ni-63	7.2E+08	2.0E-06		measured and assessed
	Co-60	1.9E+07	5.1E-08]		<u>Se-79</u>	1.2E+08	3.3E-07		
	Ni-63	7.2E+08	2.0E-06			Sr-90	2.6E+06	7.1E-09		
	<u>Zn-65</u>	6.5E+06	1.8E-08			Y-90	2.6E+06	7.1E-09		
	<u>Rb-86</u>	3.8E+07	1.0E-07			Tc-99	1.1E+08	2.9E-07		
	<u>Sr-89</u>	3.7E+06	1.0E-08			Ru-106	3.9E+07	1.1E-07		
	Sr-90	2.6E+06	7.1E-09			Cd-113m	7.0E+06	1.9E-08		
	Y-90	2.6E+06	7.1E-09			Sb-125	1.1E+07	3.1E-08		
	<u>Y-91</u>	9.8E+08	<u>2.7E-06</u>			Te-125m	1.1E+07	3.1E-08		
	<u>Nb-95</u>	3.8E+06	1.0E-08			I-129	2.7E+07	7.3E-08		
	Тс-99	1.1E+08	2.9E-07			Cs-134	5.5E+06	1.5E-08		
	<u>Ru-103</u>	4.2E+06	<u>1.1E-08</u>			Cs-137	2.7E+07	7.3E-08		
	Ru-106	3.9E+07	1.1E-07			Ce-144	4.5E+07	1.2E-07		
	<u>Rh-103m</u>	4.2E+06	<u>1.1E-08</u>			Pm-147	5.9E+07	1.6E-07		
	<u>Rh-106</u>	3.9E+07	<u>1.1E-07</u>			Sm-151	8.1E+05	2.2E-09		
	<u>Ag-110m</u>	3.3E+06	<u>8.9E-09</u>			Eu-154	8.1E+06	2.2E-08		
	Cd-113m	7.0E+06	1.9E-08			Eu-155	1.5E+07	4.0E-08		
	<u>Cd-115m</u>	1.9E+08	<u>5.1E-07</u>			<u>U-234</u>	2.3E+06	<u>6.2E-09</u>		
	<u>Sn-119m</u>	3.3E+09	<u>8.9E-06</u>			<u>U-238</u>	2.3E+06	<u>6.2E-09</u>		
	<u>Sn-123</u>	5.1E+08	<u>1.4E-06</u>			<u>Np-237</u>	2.3E+06	6.2E-09		
	<u>Sn-126</u>	1.2E+07	3.3E-08			Pu-238	2.3E+06	6.2E-09		
	<u>Sb-124</u>	6.8E+06	<u>1.9E-08</u>			Pu-239	2.3E+06	6.2E-09		
	Sb-125	1.1E+07	3.1E-08			Pu-240	2.3E+06	6.2E-09		
	<u>Te-123m</u>	5.5E+06	<u>1.5E-08</u>]		Pu-241	8.1E+07	2.2E-07		
	Te-125m	1.1E+07	3.1E-08			Am-241	2.3E+06	6.2E-09		
	<u>Te-127</u>	3.5E+08	9.6E-07			Cm-243	2.3E+06	6.2E-09		
	<u>Te-127m</u>	3.7E+08	1.0E-06			Cm-244	2.3E+06	6.2E-09		

C	Current	Revised	Reason for Revision
<u>Te-129</u> <u>4.8E+07</u>	<u>1.3E-07</u>	Target exposure assessment Environmental protection	Appropriate description due
<u>Te-129m</u> 9.8E+07	2.7E-07		the selection of nuclides to b measured and assessed
I-129 2.7E+07	7.3E-08		
Cs-134 5.5E+06	1.5E-08		
<u>Cs-135</u> <u>1.7E+02</u>	4.7E-13		
<u>Cs-136</u> <u>2.9E+06</u>	8.0E-09		
Cs-137 2.7E+07	7.3E-08		
<u>Ba-137m</u> <u>2.7E+07</u>	7.3E-08		
<u>Ba-140</u> <u>1.4E+07</u>	3.8E-08		
<u>Ce-141</u> 9.8E+06	<u>2.7E-08</u>		
Ce-144 4.5E+07	1.2E-07		
<u>Pr-144</u> <u>4.5E+07</u>	<u>1.2E-07</u>		
<u>Pr-144m</u> 4.5E+07	1.2E-07		
<u>Pm-146</u> <u>5.1E+06</u>	1.4E-08		
Pm-147 5.9E+07	1.6E-07		
<u>Pm-148</u> <u>3.7E+07</u>	1.0E-07		
<u>Pm-148m</u> <u>3.3E+06</u>	9.1E-09		
Sm-151 8.1E+05	2.2E-09		
<u>Eu-152</u> <u>1.5E+07</u>	4.2E-08		
Eu-154 8.1E+06	2.2E-08		
Eu-155 1.5E+07	4.0E-08		
<u>Cd-153</u> <u>1.5E+07</u>	4.2E-08		
<u>Tb-160</u> <u>1.1E+07</u>	3.1E-08		
Pu-238 2.3E+06	6.2E-09		
Pu-239 2.3E+06	6.2E-09		
Pu-240 2.3E+06	6.2E-09		
Pu-241 8.1E+07	2.2E-07		
Am-241 2.3E+06	6.2E-09		
<u>Am-242m</u> <u>4.2E+04</u>	1.1E-10		
<u>Am-243</u> 2.3E+06	<u>6.2E-09</u>		
<u>Cm-242</u> 2.3E+06	<u>6.2E-09</u>		
Cm-243 2.3E+06	6.2E-09		
Cm-244 2.3E+06	6.2E-09		
Target exposure assessment	Environmental protection		

Current								Revis	sed		Reason for Revision
Table 7-3-5 shows the	3-2. Exposure assessment result ble 7-3-5 shows the result of the exposure assessment of reference plants and animals. All results are low dose es that are lower than 1/10,000 of the minimum limit value of the derived consideration reference level. Table 7-3-5 Assessment result regarding environmental protection			Table	7-3-2. Exposure assessment result Table 7-3-5 shows the result of the exposure assessment of reference plants and animals. All results are low dose rates that are lower than 1/100,000 of the minimum limit value of the derived consideration reference level.					Appropriate description due to the selection of nuclides to be	
Tal	ole 7-3-5	Assessment result reg	garding environmenta	l protection		Tahl	e 7-3-5	Assessment result r	egarding environmen	tal protection	measured and assessed
A 22222		Source	e term based on measured	l values		1401			e term based on measured		
Assesse	ed case	i. K4 tank group	ii. J1-C tank group	iii. J1-G tank group		Assesse	ed case	i. K4 tank group	ii. J1-C tank group	iii. J1-G tank group	
	Flatfish	<u>2E-05</u>	<u>2E-05</u>	<u>6E-05</u>			Flatfish	9E-07	<u>5E-07</u>	<u>1E-06</u>	
Exposure (mGy/day)	Crab	<u>2E-05</u>	2E-05	6E-05		Exposure (mGy/day)	Crab	9E-07	4E-07	<u>1E-06</u>	
	Brown seaweed	<u>2E-05</u>	<u>2E-05</u>	<u>6E-05</u>			Brown seaweed	<u>1E-06</u>	5E-07	<u>1E-06</u>	
	eration referer 10 mGy/day	nce level (DCRL) [29] Crab: 10-100 mG	y/day Brown sea	weed: 1-10 mGy/day			eration refere 10 mGy/day	nce level (DCRL) [29] Crab: 10-100 mG	y/day Brown sea	weed: 1-10 mGy/day	
(Omission)					(Omis	sion)					

8. Discussion about the uncertainty of the assessment 8. Discussion about the uncertainty of the assessment Appropriate description due	Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)							
Ornesion) Appropriate description of the source term As 1. Cincertainty included in the selection of the source term The following treas are compiled of uncertainty of the source term. As 1. Cincertainty included in the selection of the source term. As 1. Cincertainty included in the selection of the source term. As 1. Cincertainty included in the selection of the source term. As 1. Cincertainty of the composition of macidic (epistumic uncertainty) (Omission) (Onission) (Omission) (Onission) (Omission) (Onission) (Current	Revised	Reason for Revision					
(Omission) (Omission) (Omission) (St. L. Incertainty included in the selection of the source term the following series are examples of uncertainty of the composition of melide (epistensie uncertainty) (Omission) (St. L. Incertainty of the composition of melide (epistensie uncertainty) (Omission) (St. L. Incertainty of the composition of melide (epistensie uncertainty) (Omission) (St. L. Incertainty of the composition of melide (epistensie uncertainty) (Omission) (St. L. Incertainty of the composition of melide (epistensie uncertainty) (Omission) (Omission) (Omission) (St. L. Incertainty of the composition of melide (epistensie uncertainty) (Omission) (Omission) (Omission) (Omission) (Omission) (Incertainty of the composition of melide (epistensie uncertainty) (Omission) (Omission) (Omission) (Omission) (Omission) (Incertainty of the composition of melide (epistensie uncertainty) (Omission) (Omission) (Omission) (Omission) (Omission) (Omission) (Omission) (Incertainty of the composition of melide (epistensie uncertainty) (Omission) (O	8. Discussion about the uncertainty of the assessment	8. Discussion about the uncertainty of the assessment						
The following steams are examples of uncertainty of the source term. \$1-1. Uncertainty of the composition of mulide (epistemie uncertainty) (Omassien) Among the exposure assessment value by three source terms, there is about a five-fined difference; between the source terms based on the K4 and 11-G and groups, Since the difference in the tritium concentration is not large, the difference in the tritium concentration of the critical and the composition of mulide at their manning that the composition of mulides the concentrative) assuming that undexteed mulides including about 14-Hz. In the composition of mulides the concentrative assuming that undexteed mulides including about 14-Hz. In the composition of mulides are included at their measured while. To the manneause of the uncertainty of the source term is due to the undexteed mulides and the concentration of the source term is considered to be the difference in the terms of the source term is considered to be the difference in the terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits of the composition of mulides in the three terms of the ratios to regulatory concentrations limits	(Omission)	(Omission)	the selection of nuclides to be					
Omission) Consistion Consist								
Among the exposure assessment value by three source terms, there is about a five-fold difference in the tritium concentration is not large, this difference is mainly caused by the difference in the composition of nucleids, but the assessment is desirable to the composition of nucleids, but the assessment is desirable to the control is the following the control is the sum of the ratios of exposure assessment while the following the control is the composition of nucleids are included as their minimum limit valued by the fine source terms, beside on the fine source terms, beside on the fine source terms, because the step in the composition of nucleids are included as their minimum limit values of the composition of the undertexed nucleids as allowing the control is the sum of the ratios to regulatory concentrations limits of the composition of nucleids of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the control is the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the LD for the sum of the ratios to regulatory concentrations limits of the composition of the nucleis of the latest the sum of the ratios to regulatory concentrations limits of the composition of mucleis of the nucleis of the latest	8-1-1. Uncertainty of the composition of nuclide (epistemic uncertainty)	8-1-1. Uncertainty of the composition of nuclide (epistemic uncertainty)						
source terms bised on the K4 and J1-G unk groups. Since the difference in the tritum concentration is not large, this difference is misinty caused by the difference with the composition of the source term is about a limit difference in the sum of the uncertainty of the source term is decided at their immunitum limit values of the uncertainty of the source term is decided at their immunitum limit values of the uncertainty of the source term is source term is uncertainty of the source term is considered to be the difference in the telection limit. The color hand, the sum of the ratios to regulatory concentrations limits of the composition of muclides in the incidence of the J1-G unk group with the highest exposure assessment value between the source terms, there is about the source term is decided at their immunitum limit value in discharge of the lim	(Omission)	(Omission)						
The compositions of nuclides of the three tank groups used for the setting of the source term includes uncertainty of analysis. To verify the impact of the uncertainty of analysis on the exposure assessment value, we applied the expanded uncertainty calculated from the analysis result of the J1-C tank group with a high exposure assessment value for the normal exposure assessment. Table 8-1 shows the composition of nuclides considering expanded uncertainty in the composition of nuclides of the <u>J1-G</u> tank group. Table 8-2 shows the concentration in the seawater used for the set source term and assessment. Table 8-3 shows the exposure assessment result. The exposure assessment result of the source term considering the uncertainty of analysis is about 1.5 times larger than that not considering the uncertainty of the exposure assessment result of the source term considering the uncertainty of the exposure assessment tresult of the source term considering the uncertainty of the exposure assessment result. 8-1-3. Summary of the uncertainty of the source term, the difference due to the composition of nuclides of the tank group is about ±5-fold centering on the source term based on the J1-G group, the uncertainty of tritium concentration is	source terms based on the K4 and J1-G tank groups. Since the difference in the tritium concentration is not large, this difference is mainly caused by the difference in the composition of nuclides, but the assessment is designed conservatively assuming that undetected nuclides including short-half-life radionuclides are included at their minimum limit values of detection and 70% or more of the uncertainty of the source term is due to the undetected nuclides as shown in Attachment IX "Contribution to the undetected nuclides in the source term based on the measured value," so the main cause of the uncertainty of the source term is considered to be the difference in the detection limit. On the other hand, the sum of the ratios to regulatory concentrations limits of the composition of nuclides in the three tanks is about 0.3 and the sum of the ratios to regulatory concentrations limits of the composition of the nuclides of the J1-G tank group with the highest exposure assessment value is 0.22. The limit value in discharge control is the sum of the ratios to regulatory concentrations limits of less than 1, so if ALPS treated water in which the sum of the ratios to regulatory concentrations limits is close to 1, exposure may become 4 to 5 times larger. If the tritium concentration in ALPS treated water is low, the discharge volume of water instead increases, so there is uncertainty due to the tritium concentration that exposure increases due to an increase in the discharge amount of nuclides other than tritium, but the discharge volume of water is limited to up to 500 m ³ /day and the annual discharge volume of water is 1.5E+08L (capacity factor: 80%), which is just 1.25 times larger than that of the K4 tank group (annual discharge volume of water: 1.2E+08L) and about 2 times larger than the J1-G tank group (annual discharge	exposure assessment became smaller. Among the exposure assessment value by three source terms, there is about a four-fold difference between the source terms based on the K4 tank group and J1-C tank group, which could be occurred due to the fact that the volume of ALPS treated water discharged based on K4 tank group is about four times larger than J1-C tank group due to the difference in tririum concentration of each tank group. On the other hand, the difference in the exposure assessment values between the source terms based on the K4 tank group and J1-G tank group, where the difference in tritium concentrations is small, is about two-fold. Since the difference in the tritium concentration is not large, this difference is mainly caused by the difference in the composition of nuclides, but the difference caused by the composition of nuclides is small. The sum of the ratios to regulatory concentrations limits of the composition of nuclides of the K4 tank group with the highest exposure assessment value is 0.28. The limit value in discharge control is the sum of the ratios to regulatory concentrations limits of less than 1, so if ALPS treated water in which the sum of the ratios to regulatory concentrations limits is close to 1, exposure may become 3 to 4 times larger. If the tritium concentration in ALPS treated water is low, the discharge volume of water instead increases, so there is uncertainty due to the tritium concentration that exposure increases due to an increase in the discharge amount of nuclides other than tritium, but the discharge volume of water is limited to up to 500 m³/day due to the capacity of facility and the annual discharge volume of water is, even if the tritium concentration is low, maximum 1.5E+08L (capacity factor: 80%), which is just 1.25 times larger than that of the K4 tank group (annual discharge volume of						
	The compositions of nuclides of the three tank groups used for the setting of the source term includes uncertainty of analysis. To verify the impact of the uncertainty of analysis on the exposure assessment value, we applied the expanded uncertainty calculated from the analysis result of the J1-C tank group to the measurement result of the J1-G tank group with a high exposure assessment value for the normal exposure assessment. Table 8-1 shows the composition of nuclides considering expanded uncertainty in the composition of nuclides of the J1-G tank group. Table 8-2 shows the concentration in the seawater used for the set source term and assessment. Table 8-3 shows the exposure assessment result. The exposure assessment result of the source term considering the uncertainty of analysis is about 1.5 times larger than that not considering the uncertainty, so the uncertainty of the exposure assessment due to the uncertainty of the analysis is considered to be less than 2 times greater. 8-1-3. Summary of the uncertainty of the source term As for the uncertainty of the source term, the difference due to the composition of nuclides of the tank group is about ±5-fold centering on the source term based on the J1-G group and the uncertainty of analysis is considered to	The compositions of nuclides of the three tank groups used for the setting of the source term includes uncertainty of analysis. To verify the impact of the uncertainty of analysis on the exposure assessment value, we applied the expanded uncertainty calculated from the analysis result of the J1-C tank group to the measurement result of the K4 tank group with a high exposure assessment value for the normal exposure assessment. Table 8-1 shows the composition of nuclides considering expanded uncertainty in the composition of nuclides of the K4 tank group. Table 8-2 shows the concentration in the seawater used for the set source term and assessment. Table 8-3 shows the exposure assessment result. The exposure assessment result of the source term considering the uncertainty of analysis is about 1.5 times larger than that not considering the uncertainty, so the uncertainty of the exposure assessment due to the uncertainty of the analysis is considered to be less than 2 times greater. 8-1-3. Summary of the uncertainty of the source term As for the uncertainty of the source term, the difference due to the composition of nuclides of the tank group is about ±2-fold centering on the source term based on the J1-G group, the uncertainty of tritium concentration is						

		Current					Reason for Revision			
Table 8-1 Co	mposition of nucl	ides considering the u	uncertainty of detection	on for the composition of	Table 8-1 Con	mposition of nuc	lides considering the u	ıncertainty of detection	on for the composition of	A
		nuclides of the <u>J1-G</u>					nuclides of the <u>K4</u> t			Appropriate description due to the selection of nuclides to be
Target nuclide	Regulatory concentration limit (Bq/L)	Composition of nuclides of the J1-G tank group (Bq/L)	Composition of nuclides of the J1-G tank group considering expanded uncertainty (Bq/L)	Ratio to regulatory concentration limit	Target nuclide	Regulatory concentration limit (Bq/L)	Composition of nuclides of the <u>K4</u> tank group (Bq/L)	Composition of nuclides of the K4 tank group considering expanded uncertainty (Bq/L)	Ratio to regulatory concentration limit	measured and assessed
H-3	6.0E+04	2.7E+05	2.7E+05	-	H-3	6.0E+04	2.7E+05	2.7E+05	-	
C-14	2.0E+03	1.6E+01	2.0E+01	1.0E-02	C-14	2.0E+03	1.6E+01	2.0E+01	1.0E-02	
Mn-54	1.0E+03	3.8E-02	6.4E-02	6.4E-05	Mn-54	1.0E+03	3.8E-02	6.4E-02	6.4E-05	
<u>Fe-59</u>	4.0E+02	7.2E-02	<u>1.2E-01</u>	3.0E-04	Co-60	2.0E+02	2.3E-01	2.7E-01	1.4E-03	
<u>Co-58</u>	1.0E+03	3.7E-02	<u>6.2E-02</u>	<u>6.2E-05</u>	Ni-63	6.0E+03	8.8E+00	9.2E+00	1.5E-03	
Co-60	2.0E+02	2.3E-01	2.7E-01	1.4E-03	<u>Se-79</u>	2.0E+02	1.5E+00	1.6E+00	7.8E-03	
Ni-63	6.0E+03	8.8E+00	9.2E+00	1.5E-03	Sr-90	3.0E+01	3.2E-02	4.2E-02	1.4E-03	
<u>Zn-65</u>	2.0E+02	<u>8.0E-02</u>	<u>1.3E-01</u>	<u>6.7E-04</u>	Y-90	3.0E+02	3.2E-02	4.2E-02	1.4E-04	
<u>Rb-86</u>	3.0E+02	<u>4.7E-01</u>	7.9E-01	2.6E-03	Tc-99	1.0E+03	1.3E+00	1.3E+00	1.3E-03	
<u>Sr-89</u>	3.0E+02	4.5E-02	<u>5.3E-02</u>	<u>1.8E-04</u>	Ru-106	1.0E+02	4.8E-01	6.1E-01	6.1E-03	
Sr-90	3.0E+01	3.2E-02	4.2E-02	1.4E-03	Cd-113m	4.0E+01	8.6E-02	9.0E-02	2.2E-03	
Y-90	3.0E+02	3.2E-02	4.2E-02	1.4E-04	Sb-125	8.0E+02	1.4E-01	2.0E-01	2.5E-04	
<u>Y-91</u>	3.0E+02	1.2E+01	2.0E+01	<u>6.6E-02</u>	Te-125m	9.0E+02	1.4E-01	2.0E-01	2.2E-04	
<u>Nb-95</u>	1.0E+03	<u>4.7E-02</u>	<u>7.9E-02</u>	<u>7.9E-05</u>	I-129	9.0E+00	3.3E-01	3.8E-01	4.2E-02	
Tc-99	1.0E+03	1.3E+00	1.3E+00	1.3E-03	Cs-134	6.0E+01	6.7E-02	1.1E-01	1.9E-03	
<u>Ru-103</u>	1.0E+03	<u>5.1E-02</u>	<u>8.6E-02</u>	<u>8.6E-05</u>	Cs-137	9.0E+01	3.3E-01	4.0E-01	4.5E-03	
Ru-106	1.0E+02	4.8E-01	6.1E-01	6.1E-03	Ce-144	2.0E+02	5.5E-01	9.4E-01	4.7E-03	
<u>Rh-103m</u>	2.0E+05	<u>5.1E-02</u>	<u>8.6E-02</u>	<u>4.3E-07</u>	Pm-147	3.0E+03	7.2E-01	1.2E+00	4.1E-04	
<u>Rh-106</u>	3.0E+05	4.8E-01	<u>6.1E-01</u>	<u>2.0E-06</u>	Sm-151	8.0E+03	1.0E-02	1.7E-02	2.1E-06	
<u>Ag-110m</u>	3.0E+02	4.0E-02	<u>6.7E-02</u>	2.2E-04	Eu-154	4.0E+02	1.0E-01	1.7E-01	4.3E-04	
Cd-113m	4.0E+01	8.6E-02	9.0E-02	2.2E-03	Eu-155	3.0E+03	1.8E-01	3.0E-01	1.0E-04	
<u>Cd-115m</u>	3.0E+02	2.3E+00	4.5E+00	<u>1.5E-02</u>	<u>U-234</u>	2.0E+01	<u>6.3E-04</u>	<u>7.5E-04</u>	3.8E-05	
<u>Sn-119m</u>	2.0E+03	4.0E+01	6.7E+01	3.4E-02	<u>U-238</u>	2.0E+01	<u>6.3E-04</u>	<u>7.5E-04</u>	3.8E-05	
<u>Sn-123</u>	4.0E+02	<u>6.3E+00</u>	1.1E+01	2.6E-02	<u>Np-237</u>	9.0E+00	<u>6.3E-04</u>	<u>7.5E-04</u>	<u>8.4E-05</u>	
<u>Sn-126</u>	2.0E+02	<u>1.5E-01</u>	<u>2.5E-01</u>	<u>1.3E-03</u>	Pu-238	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
<u>Sb-124</u>	3.0E+02	<u>8.4E-02</u>	<u>1.4E-01</u>	<u>4.7E-04</u>	Pu-239	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
Sb-125	8.0E+02	1.4E-01	2.0E-01	2.5E-04	Pu-240	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
<u>Te-123m</u>	6.0E+02	<u>6.7E-02</u>	<u>1.1E-01</u>	<u>1.9E-04</u>	Pu-241	2.0E+02	1.0E+00	1.2E+00	6.0E-03	
Te-125m	9.0E+02	1.4E-01	2.0E-01	2.2E-04	Am-241	5.0E+00	2.8E-02	3.3E-02	6.7E-03	
<u>Te-127</u>	5.0E+03	4.3E+00	7.5E+00	<u>1.5E-03</u>	Cm-243	6.0E+00	2.8E-02	3.3E-02	5.6E-03	
<u>Te-127m</u>	3.0E+02	4.5E+00	7.9E+00	<u>2.6E-02</u>	Cm-244	7.0E+00	2.8E-02	3.3E-02	4.8E-03	
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<u>Te-129</u>	1.0E+04	<u>5.9E-01</u>	1.0E+00	<u>1.0E-04</u>	Sum of the ratios to regulatory concentrations limits 3.2E-	Appropriate description due to
<u>Te-129m</u>	3.0E+02	1.2E+00	2.1E+00	7.1E-03		the selection of nuclides to be measured and assessed
I-129	9.0E+00	3.3E-01	3.8E-01	4.2E-02		
Cs-134	6.0E+01	6.7E-02	1.1E-01	1.9E-03		
<u>Cs-135</u>	6.0E+02	2.1E-06	2.6E-06	4.3E-09		
<u>Cs-136</u>	3.0E+02	3.6E-02	<u>6.1E-02</u>	2.0E-04		
Cs-137	9.0E+01	3.3E-01	4.0E-01	4.5E-03		
<u>Ba-137m</u>	8.0E+05	3.3E-01	4.0E-01	<u>5.0E-07</u>		
<u>Ba-140</u>	3.0E+02	<u>1.7E-01</u>	2.9E-01	9.6E-04		
<u>Ce-141</u>	1.0E+03	<u>1.2E-01</u>	2.0E-01	2.0E-04		
Ce-144	2.0E+02	5.5E-01	9.4E-01	4.7E-03		
Pr-144	2.0E+04	5.5E-01	9.4E-01	4.7E-05		
Pr-144m	4.0E+04	5.5E-01	9.4E-01	2.3E-05		
Pm-146	9.0E+02	6.3E-02	1.1E-01	1.2E-04		
Pm-147	3.0E+03	7.2E-01	1.2E+00	4.1E-04		
<u>Pm-148</u>	3.0E+02	4.5E-01	<u>7.6E-01</u>	<u>2.5E-03</u>		
<u>Pm-148m</u>	5.0E+02	<u>4.1E-02</u>	6.9E-02	<u>1.4E-04</u>		
Sm-151	8.0E+03	1.0E-02	1.7E-02	2.1E-06		
<u>Eu-152</u>	6.0E+02	<u>1.9E-01</u>	3.2E-01	<u>5.3E-04</u>		
Eu-154	4.0E+02	1.0E-01	1.7E-01	4.3E-04		
Eu-155	3.0E+03	1.8E-01	3.0E-01	1.0E-04		
<u>Gd-153</u>	3.0E+03	<u>1.9E-01</u>	3.2E-01	<u>1.1E-04</u>		
<u>Tb-160</u>	5.0E+02	<u>1.4E-01</u>	2.4E-01	<u>4.7E-04</u>		
Pu-238	4.0E+00	2.8E-02	3.3E-02	8.4E-03		
Pu-239	4.0E+00	2.8E-02	3.3E-02	8.4E-03		
Pu-240	4.0E+00	2.8E-02	3.3E-02	8.4E-03		
Pu-241	2.0E+02	1.0E+00	1.2E+00	6.0E-03		
Am-241	5.0E+00	2.8E-02	3.3E-02	6.7E-03		
<u>Am-242m</u>	5.0E+00	<u>5.1E-04</u>	<u>6.1E-04</u>	<u>1.2E-04</u>		
<u>Am-243</u>	5.0E+00	2.8E-02	3.3E-02	<u>6.7E-03</u>		
<u>Cm-242</u>	6.0E+01	2.8E-02	3.3E-02	<u>5.6E-04</u>		
Cm-243	6.0E+00	2.8E-02	3.3E-02	5.6E-03		
Cm-244	7.0E+00	2.8E-02	3.3E-02	4.8E-03		
S	Sum of the ratios to re	egulatory concentrations	limits	3.2E-01		

		Curr	rent			Reason for Revision						
Table 8-2	Concentrati	on in the seawater us	ed for the assessment	(Source term based on	Table 8-2	Table 8-2 Concentration in the seawater used for the assessment (Source term based on						
the compos	sition of nucli	des in the <u>J1-G</u> tank g	group reflecting the u	ncertainty of detection)	the comp	osition of nucl	lides in the <u>K4</u> tank gr	oup reflecting the un	certainty of detection)	Appropriate description due to the selection of nuclides to be		
	Source term (annual	Concentration in t	he seawater used for the	assessment (Bq/L)		Source term (annual	Concentration in t	he seawater used for the	assessment (Bq/L)	measured and assessed		
Target nuclide	discharge amount) (Bq)	Within $10 \times 10 \text{ km}$ Average of all layers	Within 10 × 10 km Average of the top layers	Beach assessment point Average of all layers	Target nuclide	discharge amount) (Bq)	Within 10 × 10 km Average of all layers	Within 10×10 km Average of the top layers	Beach assessment point Average of all layers			
H-3	2.2E+13	5.6E-02	1.2E-01	9.0E-01	H-3	2.2E+13	5.6E-02	1.2E-01	9.0E-01			
C-14	6.1E+08	1.5E-06	3.3E-06	2.5E-05	C-14	6.1E+08	1.5E-06	3.3E-06	2.5E-05			
Mn-54	1.7E+06	4.4E-09	9.4E-09	7.0E-08	Mn-54	1.7E+06	4.4E-09	9.4E-09	7.0E-08			
<u>Fe-59</u>	3.9E+06	<u>1.0E-08</u>	<u>2.1E-08</u>	<u>1.6E-07</u>	Co-60	1.0E+07	2.7E-08	5.7E-08	4.3E-07			
<u>Co-58</u>	<u>1.9E+06</u>	<u>4.7E-09</u>	1.0E-08	<u>7.6E-08</u>	Ni-63	2.4E+08	6.1E-07	1.3E-06	9.7E-06			
Co-60	1.0E+07	2.7E-08	5.7E-08	4.3E-07	<u>Se-79</u>	1.8E+08	<u>4.6E-07</u>	<u>9.9E-07</u>	<u>7.3E-06</u>			
Ni-63	2.4E+08	6.1E-07	1.3E-06	9.7E-06	Sr-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08			
<u>Zn-65</u>	<u>4.2E+06</u>	<u>1.1E-08</u>	<u>2.3E-08</u>	<u>1.7E-07</u>	Y-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08			
<u>Rb-86</u>	2.3E+07	<u>5.7E-08</u>	<u>1.2E-07</u>	9.2E-07	Tc-99	3.3E+07	8.3E-08	1.8E-07	1.3E-06			
<u>Sr-89</u>	<u>1.7E+06</u>	<u>4.4E-09</u>	<u>9.3E-09</u>	<u>7.0E-08</u>	Ru-106	4.7E+07	1.2E-07	2.6E-07	1.9E-06			
Sr-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08	Cd-113m	2.4E+06	6.1E-09	1.3E-08	9.7E-08			
Y-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08	Sb-125	8.9E+06	2.3E-08	4.8E-08	3.6E-07			
<u>Y-91</u>	<u>7.5E+08</u>	<u>1.9E-06</u>	<u>4.1E-06</u>	<u>3.1E-05</u>	Te-125m	8.9E+06	2.3E-08	4.8E-08	3.6E-07			
<u>Nb-95</u>	<u>2.3E+06</u>	<u>5.7E-09</u>	<u>1.2E-08</u>	<u>9.2E-08</u>	I-129	3.7E+07	9.4E-08	2.0E-07	1.5E-06			
Tc-99	3.3E+07	8.3E-08	1.8E-07	1.3E-06	Cs-134	3.4E+06	8.7E-09	1.9E-08	1.4E-07			
<u>Ru-103</u>	2.4E+06	<u>6.1E-09</u>	1.3E-08	9.8E-08	Cs-137	6.2E+06	1.6E-08	3.4E-08	2.5E-07			
Ru-106	4.7E+07	1.2E-07	2.6E-07	1.9E-06	Ce-144	2.6E+07	6.6E-08	1.4E-07	1.1E-06			
<u>Rh-103m</u>	<u>2.4E+06</u>	<u>6.1E-09</u>	<u>1.3E-08</u>	9.8E-08	Pm-147	3.6E+07	9.3E-08	2.0E-07	1.5E-06			
<u>Rh-106</u>	<u>4.7E+07</u>	<u>1.2E-07</u>	<u>2.6E-07</u>	<u>1.9E-06</u>	Sm-151	5.0E+05	1.3E-09	2.7E-09	2.1E-08			
<u>Ag-110m</u>	<u>1.9E+06</u>	<u>4.9E-09</u>	<u>1.1E-08</u>	<u>7.9E-08</u>	Eu-154	5.0E+06	1.3E-08	2.7E-08	2.1E-07			
Cd-113m	2.4E+06	6.1E-09	1.3E-08	9.7E-08	Eu-155	1.5E+07	3.9E-08	8.3E-08	6.3E-07			
<u>Cd-115m</u>	1.4E+08	<u>3.6E-07</u>	7.8E-07	<u>5.8E-06</u>	<u>U-234</u>	8.7E+04	<u>2.2E-10</u>	<u>4.8E-10</u>	<u>3.5E-09</u>			
<u>Sn-119m</u>	<u>1.9E+09</u>	<u>4.8E-06</u>	<u>1.0E-05</u>	<u>7.8E-05</u>	<u>U-238</u>	8.7E+04	<u>2.2E-10</u>	<u>4.8E-10</u>	3.5E-09			
<u>Sn-123</u>	3.0E+08	<u>7.6E-07</u>	<u>1.6E-06</u>	<u>1.2E-05</u>	<u>Np-237</u>	<u>8.7E+04</u>	<u>2.2E-10</u>	<u>4.8E-10</u>	3.5E-09			
<u>Sn-126</u>	1.3E+07	<u>3.3E-08</u>	<u>7.2E-08</u>	<u>5.4E-07</u>	Pu-238	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
<u>Sb-124</u>	4.4E+06	<u>1.1E-08</u>	2.4E-08	<u>1.8E-07</u>	Pu-239	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Sb-125	8.9E+06	2.3E-08	4.8E-08	3.6E-07	Pu-240	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
<u>Te-123m</u>	4.2E+06	<u>1.1E-08</u>	2.3E-08	<u>1.7E-07</u>	Pu-241	3.8E+07	9.8E-08	2.1E-07	1.6E-06			
Te-125m	8.9E+06	2.3E-08	4.8E-08	3.6E-07	Am-241	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
<u>Te-127</u>	2.2E+08	<u>5.6E-07</u>	<u>1.2E-06</u>	<u>9.0E-06</u>	Cm-243	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
<u>Te-127m</u>	2.3E+08	<u>5.8E-07</u>	<u>1.3E-06</u>	9.4E-06	Cm-244	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
<u>Te-129</u>	6.7E+07	1.7E-07	3.7E-07	<u>2.7E-06</u>								
ne Iananese versior	a shall proved											

		Curr	rent	•		Rev	ised		Reason for Revision
<u>Te-129m</u>	6.7E+07	1.7E-07	3.7E-07	2.7E-06	The state of the s	- a.i.	-	During swimming From beach sand	Appropriate description due to the selection of nuclides to be
I-129	3.7E+07	9.4E-08	2.0E-07	1.5E-06	Target exposure assessment	From fishing nets Ingestion of seafood	From sea surface From hulls	Ingestion of seawater Inhalation of seawater	measured and assessed
Cs-134	3.4E+06	8.7E-09	1.9E-08	1.4E-07				spray	
<u>Cs-135</u>	3.9E+01	<u>1.0E-13</u>	<u>2.1E-13</u>	<u>1.6E-12</u>					
<u>Cs-136</u>	2.1E+06	<u>5.4E-09</u>	<u>1.2E-08</u>	<u>8.7E-08</u>					
Cs-137	6.2E+06	1.6E-08	3.4E-08	2.5E-07					
<u>Ba-137m</u>	6.2E+06	<u>1.6E-08</u>	3.4E-08	2.5E-07					
<u>Ba-140</u>	9.1E+06	<u>2.3E-08</u>	<u>5.0E-08</u>	3.7E-07					
<u>Ce-141</u>	1.2E+07	3.0E-08	<u>6.4E-08</u>	<u>4.8E-07</u>					
Ce-144	2.6E+07	6.6E-08	1.4E-07	1.1E-06					
<u>Pr-144</u>	2.6E+07	<u>6.6E-08</u>	<u>1.4E-07</u>	<u>1.1E-06</u>					
<u>Pr-144m</u>	2.6E+07	<u>6.6E-08</u>	<u>1.4E-07</u>	<u>1.1E-06</u>					
<u>Pm-146</u>	3.0E+06	<u>7.6E-09</u>	<u>1.6E-08</u>	<u>1.2E-07</u>					
Pm-147	3.6E+07	9.3E-08	2.0E-07	1.5E-06					
<u>Pm-148</u>	1.0E+07	<u>2.7E-08</u>	<u>5.7E-08</u>	<u>4.3E-07</u>					
<u>Pm-148m</u>	2.2E+06	<u>5.5E-09</u>	<u>1.2E-08</u>	<u>8.9E-08</u>					
Sm-151	5.0E+05	1.3E-09	2.7E-09	2.1E-08					
<u>Eu-152</u>	1.3E+07	3.2E-08	<u>6.9E-08</u>	<u>5.2E-07</u>					
Eu-154	5.0E+06	1.3E-08	2.7E-08	2.1E-07					
Eu-155	1.5E+07	3.9E-08	8.3E-08	6.3E-07					
<u>Gd-153</u>	1.2E+07	3.0E-08	<u>6.4E-08</u>	4.8E-07					
<u>Tb-160</u>	<u>6.4E+06</u>	<u>1.6E-08</u>	3.5E-08	2.6E-07					
Pu-238	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
Pu-239	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
Pu-240	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
Pu-241	3.8E+07	9.8E-08	2.1E-07	1.6E-06					
Am-241	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
<u>Am-242m</u>	1.9E+04	<u>4.8E-11</u>	<u>1.0E-10</u>	<u>7.7E-10</u>					
<u>Am-243</u>	<u>1.1E+06</u>	<u>2.7E-09</u>	<u>5.8E-09</u>	4.3E-08					
<u>Cm-242</u>	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
Cm-243	1.1E+06	2.7E-09	5.8E-09	4.3E-08					
Cm-244 Target exp		2.7E-09 From fishing nets Ingestion of seafood	5.8E-09 From sea surface From hulls	4.3E-08 During swimming From beach sand Ingestion of seawater Inhalation of seawater spray					

98

	Current										Revised							Reason for Revision	
Table 8-3	-				-				G tank group	Table 8-	=				_			in the <u>K4</u> tank group	the selection of nuclides to be
	reflectin			of detection							reflectin			of detection	-			·	measured and assessed
	Source term			e term based				(2) Sour	ring the		Source term		. ,	e term based				(2) Source term considering the uncertainty of	
Assessed case		i. K4 ta	nk group	ii. J1-C ta	ank group	iii. J1-G t	ank group	uncerta analysis		Assessed		i. K4 ta	nk group	ii. J1-C ta	ank group	iii. J1-G t	tank group	analysis (<u>K4</u>)	
	Ingestion of seafood	Average	Large	Average	Large	Average	Large	Average	Large		Ingestion of seafood	Average	Large	Average	Large	Average	Large	Average Large	
	Sea surface	<u>6.5I</u>	E-09	<u>1.7</u> E	E-08	<u>4.71</u>	E-08	<u>8.0I</u>	E-08		Sea surface	<u>7.61</u>	E-10	2.3E	E-10	4.8	E-10	9.6E-10	
External	Hull	<u>4.8I</u>	E-09	<u>1.2F</u>	E-08	<u>3.3I</u>	E-08	<u>5.6I</u>	E-08		Hull	7.2E	E-10	2.2F	E-10	4.6	E-10	9.0E-10	
External exposure (mSv/year)	During swimming	<u>4.51</u>	E-09	1.2F	E-08	<u>3.21</u>	E-08	<u>5.6I</u>	E-08	External exposure (mSv/year)	During swimming	<u>5.2F</u>	E-10	<u>1.6E</u>	E-10	3.2	<u>E-10</u>	6.6E-10	
	Beach sand	<u>7.8F</u>	E-06	<u>2.1F</u>	E-05	<u>5.6I</u>	E-05	<u>9.71</u>	E-05		Beach sand	<u>9.11</u>	E-07	2.7E	E-07	5.6	E-07	<u>1.1E-06</u>	
	Fishing net	<u>1.6F</u>	E-06	4.3I	E-06	<u>1.2I</u>	E-05	<u>2.0I</u>	E-05		Fishing net	<u>1.8F</u>	E-07	<u>5.3E</u>	E-08	1.1	<u>E-07</u>	2.2E-07	
Internal	Ingestion of water	3.3I	E-07	3.1F	E-07	<u>3.2I</u>	E-07	3.31	E-07	Internal	Ingestion of water	3.3E	E-07	3.1E	E-07	3.1	E-07	3.3E-07	
exposure (mSv/year)	Inhalation of spray	<u>9.3I</u>	E-08	2.0E	E-07	<u>4.0I</u>	E-07	<u>4.8I</u>	E-07	Internal exposure (mSv/year)	Inhalation of spray	<u>9.11</u>	E-08	<u>1.9E</u>	E-07	3.8	<u>E-07</u>	9.5E-08	
	Ingestion of seafood	1.5E-05	6.1E-05	2.8E-05	1.1E-04	7.9E-05	3.0E-04	1.3E-04	5.0E-04		Ingestion of seafood	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	5.5E-06 2.4E-05	
	otal /year)	<u>3E-05</u>	<u>7E-05</u>	<u>5E-05</u>	<u>1E-04</u>	<u>1E-04</u>	<u>4E-04</u>	<u>2E-04</u>	<u>6E-04</u>		otal //year)	<u>6E-06</u>	<u>2E-05</u>	<u>2E-06</u>	<u>5E-06</u>	<u>3E-06</u>	<u>1E-05</u>	7E-06 3E-05	

				Current			•					•	evised					Reason for Revision
Table 8-4	Results of	internal	exposures	s assessment by a	ge based or	the comp	osition of nuclides in				-		• 0		_			
J1-G	tank gro	up reflect		ncertainty of dete			ea: 10 km × 10 km) (2) Source term	J1-G	tank gro	up reflect		ncertainty e term base		•		1	$\times 10 \text{ km}$)	
	Source term	; V4 to	nk group	ii. J1-C tank grou		tank group	considering the uncertainty of		Source term	; VA+c	ank group		ank group			conside	ering the	
Assessed case	Ingestion	1. K4 ta	iik group	II. J1-C talk grou) III. 31-0	lank group	analysis (J1-G)	Assessed case	Ingestion		ilik group	11. J1-C t	ank group	111. 31-01	alik group		s (J1-G)	
	of seafood	Average	Large	Average Large	Average	Large	Average Large		of seafood	Average	Large	Average	Large	Average	Large	Average	Large	
Internal	Adult	3.31	E-07	3.1E-07	3.2	<u>E-07</u>	3.2E-07	Internal	Adult	3.3	E-07	3.11	E-07	3.1	<u>E-07</u>	3.3	<u>E-07</u>	Appropriate description due to the selection of nuclides to be
exposure from ingestion of water	Child under school age	5.71	E-07	<u>5.4E-07</u>	<u>5.5</u>	<u>E-07</u>	5.7E-07	exposure from ingestion of water	Child under school age	5.7	E-07	5.31	E-07	5.4	E-07	5.7	E-07	measured and assessed
(mSv/year)	Infant		-	-		-	-	(mSv/year)	Infant		-		-		-		-	
Internal	Adult	<u>9.3I</u>	E-08	2.0E-07	4.0	E-07	4.7E-07	Internal	Adult	9.1	E-08	1.91	E-07	3.8	E-07	9.5	E-08	
exposure from inhalation of spray	Child under school age	<u>6.21</u>	E-08	1.1E-07	2.2	<u>E-07</u>	2.5E-07	exposure from inhalation of spray	Child under school age	6.0	E-08	1.11	E-07	2.1	E-07	6.3	<u>E-08</u>	
(mSv/year)	Infant	<u>4.0I</u>	E-08	<u>6.5E-08</u>	1.2	<u>E-07</u>	1.3E-07	(mSv/year)	Infant	3.93	E-08	6.31	E-08	<u>1.1</u>	E-07	4.0	<u>E-08</u>	
Internal	Adult	1.5E-05	6.1E-05	2.8E-05 1.1E-0	4 7.9E-05	3.0E-04	1.3E-04 5.0E-04	Internal	Adult	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	5.5E-06	2.4E-05	
exposure from ingestion of seafood	Child under school age	2.4E-05	9.4E-05	5.1E-05 2.0E-0	1.5E-04	5.6E-04	2.4E-04 9.4E-04	exposure from ingestion of seafood	Child under school age	4.6E-06	2.0E-05	1.1E-06	4.5E-06	2.4E-06	9.9E-06	5.3E-06	2.3E-05	
(mSv/year)	Infant	2.9E-05	1.1E-04	6.7E-05 2.5E-0	1.9E-04	7.1E-04	3.2E-04 1.2E-03	(mSv/year)		2.9E-06	1.2E-05	1.0E-06	4.5E-06	2.5E-06	1.1E-05	3.3E-06	1.4E-05	

		Current			Revised	Reason for Revision
8-2. Uncertain	inty of modeling of diffusion and	transfer in the environment	8-2. Uncertai	inty of modeling of diffusion and	transfer in the environment	
(Omission)			(Omission)			
8-2-3. Uncer	tainty in the selection of migration	on pathways (epistemic uncertainty)	8-2-3. Uncer	tainty in the selection of migration	on pathways (epistemic uncertainty)	
(Omission)			(Omission)			
method of Environment was 20 to 20 contribution much from the shows the de	TECDOC-1759 (using the external Protection Agency), so the explor or more times larger. Howev of external exposure is smaller that of this report. Attachment XI	gration factors, the migration to sandy beaches can be assessed by the rnal exposure dose conversion factor of FGR15 issued by U.S. posure from sandy beaches was calculated and the result of this reporter, it turned out that as the contribution to the overall exposure, the han internal exposure and the total exposure value does not differ so "Conservativeness of the external exposure dose conversion factor" ng the external exposure dose conversion factor of FGR15 issued by	method of T Environment was about 8 t external expo of this report	TECDOC-1759 (using the external Protection Agency), so the experimes larger. However, it turned cosure is smaller than internal experiment XI "Conservative ment result using the external experiment.	gration factors, the migration to sandy beaches can be assessed by the small exposure dose conversion factor of FGR15 issued by U.S. posure from sandy beaches was calculated and the result of this report that as the contribution to the overall exposure, the contribution of the observed and the total exposure value does not differ so much from the ess of the external exposure dose conversion factor" shows the detail posure dose conversion factor of FGR15 issued by U.S. Environments	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)			(Omission)			
8-4. Uncertain	inty in the selection of the repres	entative person	8-4. Uncertai	inty in the selection of the repres	entative person	
(Omission)			(Omission)			
8-4-3. Uncer	tainty depending on the range of	the sea area to be assessed (epistemic uncertainty)	8-4-3. Uncer	tainty depending on the range of	the sea area to be assessed (epistemic uncertainty)	
(Omission)			(Omission)			
within 5 km conditions. T	\times 5 km and 20 km \times 10 km in add The exposure assessment result of	ange to be assessed, we calculated the annual average concentration ition to $10 \text{ km} \times 10 \text{ km}$ and assessed exposure of human under normal $20 \text{ km} \times 10 \text{ km}$ is about 20% lower than that of $10 \text{ km} \times 10 \text{ km}$, but the as about 3 times higher than that of $10 \text{ km} \times 10 \text{ km}$.	within 5 km conditions. T	imes 5 km and 20 km $ imes$ 10 km in add	range to be assessed, we calculated the annual average concentration lition to $10 \text{ km} \times 10 \text{ km}$ and assessed exposure of human under normal f $20 \text{ km} \times 10 \text{ km}$ has small difference to that of $10 \text{ km} \times 10 \text{ km}$. That on at of $10 \text{ km} \times 10 \text{ km}$.	al
	y about uncertainty			ry about uncertainty		
(Omission)			(Omission)			
	T.11 0 T G		Table 8-5	Summary of uncertain	ity in this assessment	
		mary of uncertainty in this assessment	Item	Details of uncertainty	Assessment of uncertainty	
Selection of the source terms	Details of uncertainty The composition of nuclides of ALPS treated water is unknown until secondary treatment and measurement is completed, so it has epistemic uncertainty.	Assessment of uncertainty The exposure assessment result of the K4 tank group with a low detection limit in the source term based on the measured value is about 1/5 of the J1-G tank group with the highest one. On the other hand, the sum of ratios to regulatory concentration limit of the J1-G tank group is 0.22. If the sum of the ratios to regulatory concentration limit is 1 with the same nuclide ratio, exposure will be about 5 times greater.	Selection of the source terms	The composition of nuclides of ALPS treated water is unknown until secondary treatment and measurement is completed, so it has epistemic uncertainty.	The exposure assessment result of the K4 tank group with the highest sum of the ratios to regulatory concentration limits in the source term based on the measured value is about 2-fold of the J1-G tank group with the lowest one. On the other hand, the sum of ratios to regulatory concentration limit of the K4 tank group is 0.28. If the sum of the ratios to regulatory concentration limit is 1 with the same nuclide ratio, exposure will be about 3 to 4 times greater.	
	The measured value incudes aleatory uncertainty based on uncertainty of analysis.	The impact of uncertainty of analysis seems to be less than double.		The measured value incudes aleatory uncertainty based on uncertainty of analysis.	The impact of uncertainty of analysis seems to be less than double.	
Modeling of diffusion and transfer in the environment	The meteorological and oceanographic data has annual variations and includes aleatory uncertainty. The diffusion simulation model has epistemic uncertainty in the model itself.	We calculated the average concentration of $10~\rm km \times 10~\rm km$ of 7 years and found a difference of about 20%. In the comparison with the measured value, the parts with high concentrations match well, so uncertainty is assumed to be less than two times greater in the calculation of the average calculation of $10~\rm km \times 10~\rm km$.	Modeling of diffusion and transfer in the environment	The meteorological and oceanographic data has annual variations and includes aleatory uncertainty. The diffusion simulation model has epistemic uncertainty in the model itself.	We calculated the average concentration of $10~\text{km}\times10~\text{km}$ of 7 years and found a difference of about 20%. In the comparison with the measured value, the parts with high concentrations match well, so uncertainty is assumed to be less than two times greater in the calculation of the average calculation of $10~\text{km}\times10~\text{km}$.	
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exposure althways Exposure althways exposure assessment from ingestion of a garding exposure assessment from ingestion of a great garding and ways at the garding exposure assessment at the pathways. Exposure althways exposure assessment from ingestion of a great at the garding exposure assessment from a great garding exposure assessment from ingestion of a great at the garding exposure assessment form and the pathways of an crover all liberature and the garding exposure from ingestion of a great at the garding exposure from ingestion of a great garding exposure assessment in the pathways Exposure assessment from ingestion of a great garding exposure assessment in the pathways Exposure assessment from ingestion of a great garding exposure assessment in the pathways Exposure assessment from ingestion of a great garding exposure assessment from ingestion of seafood includes epistemic uncertainties because the selected migration and group exposure pathways do not cover all the pathways. There are epistemic uncertainties because the impact of internal exposure from ingestion of seafood is great.		Сотр	arison Table of amendments in the Implementation Plan Current	Torrakasiiiia De	men reactour 1 over station	Revised	Reason for Revision
for the internal exposure assessment from ingestion of sead of includes epistemic uncertainty due to insufficiency of data. There are epistemic uncertainties because the selected migration and the pathways of not cover all the pathways of the distribution coefficient, maximum and minimum values could be assumed to be a factor of 10 higher and lower than the recommended value. There are epistemic uncertainties because the selected migration and the pathways of not cover all the pathways of not cover all the pathways. There are around the FDNPS is undergoing econstruction, so we used it is hard that from densetic precedent case. As a result, it for the ingestion of seafood within affects the internal exposure from ingestion of seafood is great. The area around the FDNPS is undergoing econstruction, so we used it is half data from densetic precedent case. As a result, it follows the range of the appropriate area is the sa area to be assessed. The food injection of a seafood seafood within affects the internal exposure room and involved and and also includes epistemic uncertainty about the range of the appropriate area is the sa area to be assessed. The same around the FDNPS in the assessment to the seasoned. The area around the FDNPS in the assessment to the seasoned. The area around the FDNPS in the assessment to the proportion of the distribution coefficient, maximum and minimum values could be asserted to a flower than the recommended value in the necessary of the internal exposure assessment may administrate the internal exposure assessment than the recommended value and and the exposure pathways by the method of TECDOC-1799 and added pathways with higher exposure assessments than the exposure pathways. However, the total value did not change because the inpact of internal exposure than the exposure time is shorter than that of the Rokkasho representative percentative percen	For the migration pathways	exposure, differences in elements are not considered, so the dose conversion factor of external exposure has epistemic uncertainty which does not	(using the external exposure dose conversion factor of FGR15) and it turned out that the result of the radiological impact assessment report was 20 to 200 or more times higher. Even so, the effect of external exposure on exposure is smaller than that of internal exposures, and the total exposure value does not differ so much	migration	exposure, differences in elements are not considered, so the dose conversion factor of external exposure has epistemic uncertainty which does not	(using the external exposure dose conversion factor of FGR15) and it turned out that the result of the radiological environmental impact assessment report was 8 to 9 times. Even so, the effect of external exposure on exposure is smaller than that of internal exposures, and the total exposure value does not differ so much	
because the selected migration and those of the selected pathways with higher exposure assessments than those of the selected pathways. However, the total value did not change because the impact of internal exposure from ingestion of seafood is great. The area around the FDNPS is undergoing reconstruction, so we used life habit data from domestic precedent cases. As a result, it includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes epistemic uncertainty. It includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes epistemic uncertainty. It includes epistemic uncertainty. It includes epistemic uncertainty. It includes epistemic uncertainty. It includes epistemic uncertainty with the range of the appropriate area as the sea area to be assessed. It includes epistemic uncertainty with the range of the appropriate area as the sea area to be assessed. It includes epistemic uncertainty with the range of the appropriate area as the sea area to be assessed. It includes epistemic uncertainty with the range of the appropriate area as the sea area to be assessed. It includes epistemic uncertainty which is smaller, and 20 km × 10 km, which is magnetic to perform histing only within the range of 5 km × 5 km and the assessment than those of the Received pathways. Who were the total value did not change because t		for the internal exposure assessment from ingestion of seafood includes epistemic uncertainty due to	minimum CFs are one order of magnitude above and below the recommended value in the case of existence of reliable data for element—organism combination, and for the distribution coefficient, maximum and minimum values could be assumed to be a factor of 10 higher and lower		for the internal exposure assessment from ingestion of seafood includes epistemic uncertainty due to	minimum CFs are one order of magnitude above and below the recommended value in the case of existence of reliable data for element—organism combination, and for the distribution coefficient, maximum and minimum values could be assumed to be a factor of 10 higher and lower	
undergoing reconstruction, so we used life habit data from domestic precedent cases. As a result, it includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes epistemic uncertainty about the range of the appropriate area as the sea area to be assessed. It includes epistemic uncertainty about the range of 20 km × 20 km. Actually, it is unrealistic to perform fishing only within the range of 5 km × 5 km and the assessment in this report assumes that all ingested fish are caught in the range of 20 km × 20 km. Actually, it is unrealistic to perform fishing only within the range of 15 km × 5 km and the assessment in this report assumes that all ingested fish are caught in the area or out the FDNPS, so it is	Exposure pathways	because the selected migration and exposure pathways do not cover all	TECDOC-1759 and added pathways with higher exposure assessments than those of the selected pathways. However, the total value did not change		because the selected migration and exposure pathways do not cover all	TECDOC-1759 and added pathways with higher exposure assessments than those of the selected pathways. However, the total value did not change	
about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of the appropriate area as the sea area to be assessed. about the range of 5 km × 10 km and it turned out that the exposure is about three times greater in the range of 5 km × 20 km. Actually, it is unrealistic to perform fishing only within the range of 5 km × 20 km. Actually, it is unrealistic to perform fishing only within the range of 5 km × 5 km and the assessment in this report assumes that all ingested fish are caught in the area around the FDNPS, so it is	Selection of a representative person	undergoing reconstruction, so we used life habit data from domestic precedent cases. As a result, it includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes	reprocessing plant, but it is smaller than internal exposure from ingestion of seafood and does not affect the exposure assessment result. For the ingestion of seafood which affects the internal exposure result, nation-wide statistical data aggregated by age is used and about 10% different from the data of Tohoku, but in the report, all ingested fish are assumed to have been caught in the area around the FDNPS in the assessment, so there is considered to be not uncertainty which may lead to	representative	undergoing reconstruction, so we used life habit data from domestic precedent cases. As a result, it includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes	reprocessing plant, but it is smaller than internal exposure from ingestion of seafood and does not affect the exposure assessment result. For the ingestion of seafood which affects the internal exposure result, nation-wide statistical data aggregated by age is used and about 10% different from the data of Tohoku, but in the report, all ingested fish are assumed to have been caught in the area around the FDNPS in the assessment, so there is considered to be not uncertainty which may lead to	
the assessed sea area.		about the range of the appropriate area	larger, than $10 \text{ km} \times 10 \text{ km}$ and it turned out that the exposure is about three times greater in the range of $5 \text{ km} \times 5 \text{ km}$ and not much different in the range of $20 \text{ km} \times 20 \text{ km}$. Actually, it is unrealistic to perform fishing only within the range of $5 \text{ km} \times 5 \text{ km}$ and the assessment in this report assumes that all ingested fish are caught in the area around the FDNPS, so it is considered to be unnecessary to consider uncertainty due to the setting of		about the range of the appropriate area	larger, than $10 \text{ km} \times 10 \text{ km}$ and it turned out that the exposure is about three times greater in the range of $5 \text{ km} \times 5 \text{ km}$ and not much different in the range of $20 \text{ km} \times 20 \text{ km}$. Actually, it is unrealistic to perform fishing only within the range of $5 \text{ km} \times 5 \text{ km}$ and the assessment in this report assumes that all ingested fish are caught in the area around the FDNPS, so it is considered to be unnecessary to consider uncertainty due to the setting of	

	Currer	nt				Revise	ed		Reason for Revision
9. Monitoring to be perform	ned in response to discharge of A	LPS treated water into the	e sea	Ì	9. Monitoring to be performed	ed in response to discharge of A	LPS treated water into the	sea	
(Omission)				((Omission)				
9-1. Analytical capability in	the Fukushima Daiichi Nuclear	Power Station		9	9-1. Analytical capability in	the Fukushima Daiichi Nuclear	Power Station		
(Omission)				((Omission)				
9-1-1. Analytical capability	in terms of facilities			ç	9-1-1. Analytical capability i	in terms of facilities			
(Omission)				((Omission)				
Table 9-2 Analyzers in	the chemical analysis buildin	ng (including those plan	ned to be expanded in the	е ,	Table 9-2 Analyzers in	the chemical analysis buildir	ng (including those plan	ned to be expanded in the	
Tubic > 2 Timary 2015 in	future		neu to se enpanaea m me		Tuble > 2 Timuly 2015 III	future	· · · ·	neu to se empunueu m the	
Sample handled	Analyzer	Target nuclides to be measured	Number of units deployed		Sample handled	Analyzer	Target nuclides to be measured	Number of units deployed	
	Ge semiconductor detector	γ-ray emitting nuclides (e.g. Cs -134.137)	12			Ge semiconductor detector	γ-ray emitting nuclides (e.g. Cs -134.137)	12	
	Automatic α-measuring device	Total α	2			Automatic α-measuring device	Total α	2	
Monitoring samples:	Low back gas flow counter	Total β, Sr -90	5		Monitoring samples:	Low back gas flow counter	Total β, Sr -90	5	
seawater, etc. Drainage sample:	β-nuclide analysis equipment	Sr-90	2		seawater, etc. Drainage sample:	β-nuclide analysis equipment	Sr-90	2	
Groundwater bypass and sub-drain	Low background liquid scintillation counter	Tritium, C -14 Cd-113 m, Ni-63	(Three more to be expanded)		Groundwater bypass and sub-drain	Low background liquid scintillation counter	Tritium, C -14 Cd-113 m, Ni-63	(Three more to be expanded)	
ALPS outlet water: last stage	Inductively coupled plasma mass spectrometer (ICP-MS)	I-129, Tc-99	2		ALPS outlet water: last stage	Inductively coupled plasma mass spectrometer (ICP-MS)	I-129, Tc-99	2	
etc.	(======================================	Tritium	(To be expanded)		etc.	Noble gas mass spectrometer (He-MS)	Tritium	(To be expanded)	
	High purity Ge semiconductor detector for low energy photons (LEPS)	Low-energy γ-ray emitting nuclide (including Sn-126)	(To be expanded)			High purity Ge semiconductor detector for low energy photons (LEPS)	Low-energy γ-ray emitting nuclide (including Fe-55)	2 (To be expanded)	Appropriate description due to the selection of nuclides to be measured and assessed
9-1-2. Analytical capabil	lity in terms of competence				9-1-2. Analytical capabil	ity in terms of competence			incustred and assessed
(Omission)	, 01 00				(Omission)	1			
(Omission)									
	uclide (including Cs134/Cs137 ute: Perry Johnson Laboratory A			1 4	⁴⁶ Analytical tests of radion sludge" (Certification institu	uclide (including Cs134/Cs137 te: Perry Johnson Laboratory A	and H-3) in public water ccreditation Inc., Certifica	s, wastewater, soil, ash and te: <u>L22-389</u>)	Appropriate description for
(Omission)				((Omission)				change of the date

Comparison Table of amendments in the Implementation Plan for Fu	ıkushıma Danchi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)
Current	Revised

9-2-1. Source monitoring

Source monitoring is monitoring of the source term (annual discharge amount (total amount) of each nuclide contained in the ALPS treated water, which is diluted and discharged into the sea). In this analysis, we collect samples after homogenization of ALPS treated water every time the measurement/confirmation facility is fully filled with ALPS treated water, and all nuclides to be measured in ALPS treated water (tritium, C-14, and 62 nuclides subject to removal by ALPS) are analyzed and assessed⁴⁷. From the analysis results, we verified that

- The sum of the ratios to regulatory concentrations limits⁴⁸ of the concentrations of <u>63</u> nuclides excluding tritium falls below 1, which is the regulatory standard
- This is the basis for the determination of the flow rate of the ALPS treated amount to be diluted and discharged based on the measured tritium concentration to surely make the concentration after dilution less than 1,500Bq/L, which is the concentration specified in the fundamental policy of the government.

(Omission)

Table 9-5 Measurement and assessment methods of each nuclide

	18	ble 9-5	Measurement and assessment methods of each nuclide
No.	Nuclide	Radiation type	Measurement or assessment method
1	Mn-54	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>2</u>	Fe-59	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>3</u>	Co-58	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
4	Co-60	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>5</u>	Ni-63	В	Isolated by resin, mixed with a scintillator, and counted by a low back liquid scintillation counter.
<u>6</u>	Zn-65	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
7	Rb-86	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>8</u>	Sr-89	β	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish
<u>9</u>	Sr-90	В	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish
<u>10</u>	Y-90	β	[Evaluation value] Concentration assessment as radioactive equilibrium with Sr-90
<u>11</u>	Y-91	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>12</u>	Nb-95	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>13</u>	Tc-99	β	Samples are diluted with dilute nitric acid and counted with the inductively coupled plasma mass spectrometry (ICP-MS).
<u>14</u>	Ru-103	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>15</u>	Ru-106	В	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
<u>16</u>	Rh-103m	βγ	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-103
<u>17</u>	Rh-106	γ	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-106
<u>18</u>	Ag-110m	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
19	Cd-113m	γ	Isolated by ion exchange, mixed with a scintillator, and counted by a low back

liquid scintillation counter.

9-2-1. Source monitoring

Source monitoring is monitoring of the source term (annual discharge amount (total amount) of each nuclide contained in the ALPS treated water, which is diluted and discharged into the sea). In this analysis, we collect samples after homogenization of ALPS treated water every time the measurement/confirmation facility is fully filled with ALPS treated water, and all nuclides to be measured in ALPS treated water (the 30 nuclides subject to measurement and assessment when ALPS treated water is discharged into the sea, tritium, and other nuclides subject to removal by ALPS, except for the 30 nuclides) are analyzed and assessed⁴⁷. From the analysis results, we verified that

Reason for Revision

Appropriate description due to

the selection of nuclides to be

measured and assessed

- The sum of the ratios to regulatory concentrations limits⁴⁸ of the concentrations of 30 nuclides subject to measurement and assessment for discharge of ALPS treated water into the sea excluding tritium falls below 1, which is the regulatory standard
- This is the basis for the determination of the flow rate of the ALPS treated amount to be diluted and discharged based on the measured tritium concentration to surely make the concentration after dilution less than 1,500Bq/L, which is the concentration specified in the fundamental policy of the government.

(Omission)

Table 9-5 Measurement and assessment methods of each nuclide

1able 9-5 Measurement and assessment methods of each nuclide					
	No.	Nuclide	<u>Measure</u>	Measurement or evaluation method	
			<u>ment</u> <u>object</u>		
	-	Tritium (FWT)	<u>β</u> -	Isolated by distillation, mixed scintillator and counted by low-back liquid scintillation counter	
the sea	<u>1</u>	C-14	<u>β</u> -	Converted to CO2, collected and isolated on absorbent, mixed with a scintillator, and counted by a low back liquid scintillation counter.	
e into	<u>2</u>	Mn-54	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
scharg	<u>3</u>	Co-60	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
ing Di	<u>4</u>	Ni-63	<u>β⁻</u>	Isolated with resin, mixed with scintillators, and counted with a low-back liquid scintillation counter	
<u>nt dur</u>	<u>5</u>	<u>Se-79</u>	<u>β</u> -	<u>Isolated</u> with resin, mixed with scintillators, and counted with a <u>low-back liquid scintillation counter</u>	
sessme	<u>6</u>	Sr-90	<u>β-</u>	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish	
ent/as	<u>7</u>	Y-90	Ξ	[Evaluation value] Concentration assessment as radioactive equilibrium with Sr-90	
surem	<u>8</u>	Тс-99	Mass	Samples are diluted with dilute nitric acid and counted with the inductively coupled plasma mass spectrometry (ICP-MS).	
or Mea	9	Ru-106	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>lides f</u>	<u>10</u>	Cd-113m	<u>β</u> -	Isolated by ion exchange, mixed with a scintillator, and counted by a low back liquid scintillation counter.	
et nuc	<u>11</u>	Sb-125	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
r Targ	<u>12</u>	Te-125m	Ξ	[Evaluation value] Concentration assessment as radioactive equilibrium with Sb-125	
ALPS treated water Target nuclides for Measurement/assessment during Discharge into the sea	<u>13</u>	I-129	Mass	Samples were counted with the inductively coupled plasma mass spectrometry (ICP-MS) after adjusting to iodate ion by the addition of reagents.	
S trea	<u>14</u>	Cs-134	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
ALI	<u>15</u>	Cs-137	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	

			Current		ioni i tuoioni i o t	Reason for Revision		
<u>20</u>	Cd-115m	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>16</u>	Ce-144	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	Appropriate description due to the selection of nuclides to be
<u>21</u>	Sn-119m	γ	[Evaluation value] Assessed from the measured value of the radioactive concentration of Sn-123 and the calculated nuclide abundance ratio Homogenized samples are collected in a Marinelli container and counted with	<u>17</u>	Pm-147	=	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated nuclide abundance ratio.	measured and assessed
2 <u>2</u> 2 <u>3</u>	Sn-123 Sn-126	<u>βγ</u> <u>βγ</u>	a Ge semiconductor detector. Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>18</u>	Sm-151	=	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated	
<u>24</u>	Sb-124	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>19</u>	Eu-154	γ	nuclide abundance ratio Homogenized sample is collected in marinelli containers and	
<u>25</u>	Sb-125	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>20</u>	Eu-155	γ	counted by a Ge detector. Homogenized sample is collected in marinelli containers and	
<u>26</u>	Te-123m	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.			<u>'</u>	counted by a Ge detector. After iron is removed by iron coprecipitation, the sample is	
<u>27</u>	Te-125m	γ	[Evaluation value] Concentration assessment as radioactive equilibrium with Sb-125	<u>21</u>	<u>U-234</u>	<u>a</u>	evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnSα automatic measuring device is used as it is without proportionate division with other	
<u>28</u>	Te-127	βγ	Homogenized samples are collected in a Marinelli container, counted with a Ge semiconductor detector, and assessed using the half-life of the parent nuclide (Te-127m).				nuclides After iron is removed by iron coprecipitation, the sample is	
<u>29</u>	Te-127m	βγ	[Evaluation value] Assessed from the measured value of the radioactive concentration of Te-127 and the calculated nuclide abundance ratio	22	<u>U-238</u>	<u>α</u>	evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring	
<u>30</u>	Te-129	βγ	Homogenized samples are collected in a Marinelli container, counted with a Ge semiconductor detector, and assessed using the half-life of the parent			_	device is used as it is without proportionate division with other nuclides	
<u>31</u>	Te-129m	βγ	nuclide (Te-129m). Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	23	Np-237	<u>α</u>	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnSα automatic measuring	
<u>32</u>	I-129	βγ	Samples were counted with the inductively coupled plasma mass spectrometry (ICP-MS) after adjusting to iodate ion by the addition of reagents.			_	device is used as it is without proportionate division with other nuclides	
<u>33</u>	Cs-134	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>24</u>	Pu-238	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring	
<u>34</u>	Cs-135	В	[Evaluation value] Assessed from the measured value of the radioactive concentration of Cs-137 and the calculated nuclide abundance ratio	_			device is used as it is without proportionate division with other nuclides	
<u>35</u>	Cs-136	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.				After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α	
<u>36</u>	Cs-137	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector. [Evaluation value] Concentration assessment as radioactive equilibrium with	<u>25</u>	Pu-239	α	measured value counted with the $ZnS\alpha$ automatic measuring device is used as it is without proportionate division with other	
<u>37</u>	Ba-137m	γ	Cs-137 Homogenized samples are collected in a Marinelli container and counted with				nuclides After iron is removed by iron coprecipitation, the sample is	
38	Ba-140	βγ	a Ge semiconductor detector. Homogenized samples are collected in a Marinelli container and counted with	<u>26</u>	Pu-240	α	evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring	
<u>39</u>	Ce-141	βγ	a Ge semiconductor detector. Homogenized samples are collected in a Marinelli container and counted with				device is used as it is without proportionate division with other nuclides	
<u>40</u> <u>41</u>	Ce-144 Pr-144	<u>βγ</u> <u>βγ</u>	a Ge semiconductor detector. [Evaluation value] Concentration assessment as radiation equilibrium with	<u>27</u>	Pu-241	=	[Evaluation value] Assessed from the total α discrete value and the isotopic ratio of Pu-238	
42	Pr-144m	γ	Ce-144, using half-life of parent nuclide (Pr-144m) [Evaluation value] Concentration assessment as radioactive equilibrium with	<u>28</u>	Am-241	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring	
43	Pm-146	βγ	Ce-144 Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	20	7111-241	u.	device is used as it is without proportionate division with other nuclides	
<u>44</u>	Pm-147	βγ	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated nuclide abundance ratio				After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α	
<u>45</u>	Pm-148	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>29</u>	Cm-243	α	measured value counted with the ZnSα automatic measuring device is used as it is without proportionate division with other nuclides	
<u>46</u>	Pm-148m	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.	<u>30</u>	Cm-244	α	After iron is removed by iron coprecipitation, the sample is	

			Current	Revised				Reason for Revision
<u>47</u> <u>48</u>	Sm-151 Eu-152	<u>βγ</u>	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated nuclide abundance ratio Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.				evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	Appropriate description due to the selection of nuclides to be measured and assessed
<u>49</u>	Eu-154	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.		Fe-59	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>50</u>	Eu-155	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.		Co-58	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>51</u>	Gd-153	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.		Zn-65	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>52</u>	Tb-160	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.		Rb-86	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>53</u>	Pu-238	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides		Sr-89	<u>β</u> -	Isolated with resin and recovered from sedimentation are mounted and counted by β nuclide analyzer in a stainless steel dish.	
<u>54</u>	Pu-239	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate		Y-91	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector. Homogenized sample is collected in marinelli containers and	
			division with other nuclides After iron is removed by iron coprecipitation, the sample is evaporated to		Nb-95	γ	counted by a Ge detector.	
<u>55</u>	Pu-240	α	dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate		Ru-103	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
56	Du 241	Q	division with other nuclides [Evaluation value] Assessed from the total α discrete value and the isotopic	emoval	Rh-103m	=	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-103γ	
<u>56</u>	Pu-241	β	ratio of Pu-238 After iron is removed by iron coprecipitation, the sample is evaporated to	Remo	Rh-106	=	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-106	
<u>57</u>	Am-241	α	dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	ALPS	Ag-110m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>58</u>	Am-242m	α	[Evaluation value] Assessed from the isotopic ratio of Am-241	ect to	Cd-115m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>59</u>	Am-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	ides subj	Sn-119m	<u>=</u>	[Evaluation value] Assessed from the measured value of the radioactive concentration of Sn-123 and the calculated nuclide abundance ratio	
			After iron is removed by iron coprecipitation, the sample is evaporated to	r nuclid	Sn-123	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>60</u>	Cm-242	α	dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	Other	Sn-126	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
			After iron is removed by iron coprecipitation, the sample is evaporated to		Sb-124	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>61</u>	Cm-243	α	dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides		Te-123m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
<u>62</u>	Cm-244	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate		Te-127	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector, and evaluated using the half-life of the parent nuclide (Te-127m).	
-	Tritium (FWT)	β	division with other nuclides Isolated by distillation, mixed with a scintillator, and counted by a low back liquid scintillation counter.		Te-127m	=	[Evaluation value] Assessed from the measured value of the radioactive concentration of Te-127 and the calculated nuclide abundance ratio	
-	C-14	β	Converted to CO ₂ , collected and isolated on absorbent, mixed with a scintillator, and counted by a low back liquid scintillation counter.		Te-129	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector., and evaluated using the half-life of the parent nuclide (Te-129m).	
					Te-129m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
					Cs-135	=	[Evaluation value] Assessed from the measured value of the of the calculated nuclide abundance ratio	
The Ion					Cs-136	γ	Homogenized sample is collected in marinelli containers and	

Comparison Table of amendments in the Implementation Plan for Fi Current		niem i vacicai i ov	ver station	Revised	Reason for Revision
				counted by a Ge detector.	
		Ba-137m	γ	[Evaluation value] Concentration assessment as radioactive equilibrium with Cs-137	
		Ba-140	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Ce-141	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Pr-144	=	[Evaluation value] Concentration assessment as radiation equilibrium with Ce-144, using half-life of parent nuclide (Pr-144m)	
		Pr-144m	=	[Evaluation value] Concentration assessment as radioactive equilibrium with Ce-144	
		Pm-146	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Pm-148	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Pm-148m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Eu-152	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Gd-153	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Tb-160	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
		Am-242m	<u>-</u>	[Evaluation value] Assessed from the isotopic ratio of Am-241	
		Am-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	
		Cm-242	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides	
	tored	<u>C1-36</u>	<u>β</u> -	Sedimentation with silver chloride, mixed with scintillator, counted by low-back liquid scintillation counter, or counted by β-nuclide analyzer	Appropriate description due to the selection of nuclides to be measured and assessed
	moni	<u>Fe-55</u>	<u>X</u>	Isolated with resin and counted by Ge detector for low-energy γ and X rays	
	Target nuclides to be monitored	<u>Nb-93m</u>	Υ	Isolated with resin and counted by Ge detector for low-energy γ and X rays	
	uclide	<u>Mo-93</u>	Υ	Isolated with resin and counted by Ge detector for low-energy γ-rays and X rays	
	rget n	<u>Nb-94</u>	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
	Ta	<u>Ba-133</u>	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.	
(Omission)	(Omission)				

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2) Reason for Revision Current Revised 9-2-2. Monitoring at the discharge vertical shaft (upper-stream storage) 9-2-2. Monitoring at the discharge vertical shaft (upper-stream storage) ALPS treated water to be discharged into the sea is treated by ALPS until the sum of the ratios to regulatory ALPS treated water to be discharged into the sea is treated by ALPS until the sum of the ratios to regulatory concentrations limits of 63 nuclides excluding tritium fall below 1, in order to ensure the safety of ALPS treated concentrations limits of nuclides excluding tritium fall below 1, in order to ensure the safety of ALPS treated water Appropriate description due to water to be discharged into the environment. to be discharged into the environment. the selection of nuclides to be On the other hand, to the extent of the available knowledge, ALPS treated water, etc., contains 0.15 to 2.16 million On the other hand, to the extent of the available knowledge, ALPS treated water, etc., contains 0.15 to 2.16 million measured and assessed Bq/L of tritium, which exceeds the regulatory concentration limit (60,000 Bq/L), which is the upper limit on the Bq/L of tritium, which exceeds the regulatory concentration limit (60,000 Bq/L), which is the upper limit on the discharge into the environment specified by laws. In addition, the Basic Policy of the government in April 2021 discharge into the environment specified by laws. In addition, the Basic Policy of the government in April 2021 stipulates that the tritium concentration be less than 1,500 Bq/L as with the groundwater bypass and subdrain. In stipulates that the tritium concentration be less than 1,500 Bq/L as with the groundwater bypass and subdrain. In response to it, we decided to dilute ALPS treated water, etc., with a lot of seawater before discharge in order to meet response to it, we decided to dilute ALPS treated water, etc., with a lot of seawater before discharge in order to meet the regulatory concentration limit and dispel concerns of consumers, etc., as much as possible for minimization of the regulatory concentration limit and dispel concerns of consumers, etc., as much as possible for minimization of reputation damage. reputation damage. Tritium is a nuclide that emits week beta rays, which cannot be monitored continuously, unlike gamma rays from Tritium is a nuclide that emits week beta rays, which cannot be monitored continuously, unlike gamma rays from Cs-137. Therefore, the appropriateness of dilution is verified by collecting samples and measurement with the liquid Cs-137. Therefore, the appropriateness of dilution is verified by collecting samples and measurement with the liquid scintillation counting device. scintillation counting device. To start discharge into the sea, for the time being, we shall verify that appropriate dilution is performed by the To start discharge into the sea, for the time being, we shall verify that appropriate dilution is performed by the dilution facility by the procedure shown in Figure 9-4 below and the tritium concentration is less than 1,500 Bq/L dilution facility by the procedure shown in Figure 9-4 below and the tritium concentration is less than 1,500 Bq/L at the discharge vertical shaft (upper-stream storage) immediately before discharge into the environment, for each at the discharge vertical shaft (upper-stream storage) immediately before discharge into the environment, for each type of ALPS treated water (about 10,000 m3/tank group) of which sum of the ratios to regulatory concentrations type of ALPS treated water (about 10,000 m3/tank group) of which sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium is less than 1 by the analysis and assessment by the limits of 30 nuclides other than tritium is less than 1 by the analysis and assessment by the measurement/confirmation facility (See 9-2-1). measurement/confirmation facility (See 9-2-1). From transfer facility From transfer facility From transfer facility From transfer facility Transfer to the down-stream storage Transfer to the down-stream storage discharge discharge (1) Empty the discharge vertical shaft (upper-stream (2) Store ALPS treated water transferred by the transfer facility (1) Empty the discharge vertical shaft (upper-stream (2) Store ALPS treated water transferred by the transfer facility and diluted by the dilution facility, in the discharge vertical and diluted by the dilution facility, in the discharge vertical shaft (upper-stream storage). shaft (upper-stream storage). Appropriate description From transfer facility From transfer facility From transfer facility From transfer facility Nater sampling/Measurement Water sampling/Measurement Water Water discharge

(3) Stop the pump before the discharge vertical shaft (upper-stream storage) is fully filled with water, and collect and measure sample water in the discharge vertical shaft (upper-stream storage) (suspend the

(4) Verify that the actual concentration is close to the calculated tritium concentration and less than 1,500 Bq/L, before flowing seawater and discharging the water in the discharge vertical shaft (upper-stream storage) into the sea.

Figure 9-4 Analysis and discharge procedure at the discharge vertical shaft (upper-stream storage)

(3) Stop the pump before the discharge vertical shaft (upper-stream storage) is fully filled with water, and collect and measure sample water in the discharge vertical shaft (upper-stream storage).
 (4) Verify that the actual concentration is comparable to

(4) Verify that the actual concentration is comparable to the calculated tritium concentration and less than 1,500 Bq/L.

Figure 9-4

(5) Activate two or more seawater pumps. After getting stable volume of seawater flow, continuously discharge the water into the sea by activating the transfer pumps of ALPS treated water as the step 2. Stored water in the discharge vertical shaft (upper-stream storage) will be drained into the discharge facility.

Analysis and discharge procedure at the discharge vertical shaft (upper-stream storage)

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)

Current	Revised	Reason for Revision
(Omission)	(Omission)	
9-3. Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station	9-3. Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station	
(Omission)	(Omission)	
The following shows the monitoring plan conducted and to be performed in the future by each implementation entity as of the end of March 2022.	The following shows the monitoring plan conducted and to be performed in the future by each implementation entity as of the end of March 2022. <u>Each plan is stipulated in the Government's Comprehensive Radiation Monitoring Plan.</u>	Appropriate description
9-3-1. Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO	9-3-1. Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO	
(Omission)	(Omission)	
To continuously get data for comparison with the diffusion state and migration state after discharge, it is planned to formulate the sea area monitoring plan setting the detection limit in addition to the consideration result announced in August 2021 and started the implementation of the plan in April 2022 before starting discharge. For this monitoring (sampling, radiation measurement, etc.), it is planned to ask agriculture, forestry and fisheries workers, related parties in local governments, etc. participate in and observe monitoring, and request an analysis by a third party organization specified by us and involvement of the IAEA as with source monitoring in order to secure objectivity and reliability of the monitoring result.	formulate the sea area monitoring plan setting the detection limit in addition to the consideration result announced in August 2021. Understanding the environmental status before actual discharge is important to assess	
(Omission)	(Omission)	
We decided to enhance and expend see area monitoring as follows: Figure 0.7 shows the details of enhancement	 As a result of considerations based on the results of this radiological environmental impact assessment, TEPCO selected sites and nuclides to be monitored in light of following points: The result of dispersion simulation showed that there was no area where the concentration is significantly higher than that of the surroundings, because dispersion was carried out quickly in the environment after the discharge at the discharge point. The concentration of each nuclide in the ALPS treated water is below the detection limit, except for the seven major nuclides, tritium, and C-14. In addition, the ALPS treated water containing those nuclides will be discharged from the outlet after being diluted more than 100 times, and the diluted water will be dispersed in the environment. Therefore, even if environmental distribution or concentration are considered, the concentration in environmental samples of these nuclides of which concentration in the treated water is below the detection limit is very low, and even if the detection limit is lowered to a feasible extent, it is considered difficult to detect the concentrations. Therefore, it is appropriate to screen a wide range of nuclides to be monitored, focusing on those that are particularly easy to observe (in addition to H-3 and Cs-137, and I-129 which tends to accumulate in seaweed) among the detected nuclides described above, to analyse in detail if abnormal values are found. 	
We decided to enhance and expand sea area monitoring as follows. Figure 9-7 shows the details of enhancement and expansion of our sea area monitoring	We decided to enhance and expand sea area monitoring as follows. Figure 9-7 shows the details of enhancement and expansion of our sea area monitoring. The items shown below are implemented as part of the Government's Comprehensive Radiation Monitoring Plan.	
 Increase in measurement points and targets Considering that we are the executing body of discharge of ALPS treated water into the sea, we decided to perform monitoring focusing on the area around the discharge outlet and added a total of 13 tritium measurement points of the seawater and marine organisms (fish) in the area near the FDNPS and the coast of Fukushima (See red and orange boxes in Figure 9-7). For seawater monitoring, we added three new monitoring points on the boundary of the "area where no fishing is conducted on a daily basis" considered in this assessment of radiation impact on human and environment (See the red texts in Figure 9-7). For fish, we currently analyze cesium, which is representative in the measurement of radiation impact, based on samples collected in 11 locations within 20 km off the coast of Fukushima (in 	 Increase in measurement points and targets Considering that we are the executing body of discharge of ALPS treated water into the sea, we decided to perform monitoring focusing on the area around the discharge outlet and added a total of 13 tritium measurement points of the seawater and marine organisms (fish) in the area near the FDNPS and the coast of Fukushima (See red and orange boxes in Figure 9-7). For seawater monitoring, we added three new monitoring points on the boundary of the "area where no fishing is conducted on a daily basis" considered in this assessment of radological impact on human and environment (See the red texts in Figure 9-7). For fish, we currently analyze cesium, which is representative in the measurement of radiological environmental impact, based on samples collected in 11 locations within 20 km off the coast of 	

The Japanese version shall prevail.

Comparison Table of amendments in the Implementation Plan for F	ukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
Current	Revised	Reason for Revision
one of which tritium analysis is still performed), and will analyze tritium in fish caught in a total of 11 locations including 10 new locations where currently tritium is not analyzed, in order to verify the impact of concentration of tritium (See orange boxes in the right figure in Figure 9-7). Tritium analysis is also performed for the seawater on the point.	Fukushima (in one of which tritium analysis is still performed), and will analyze tritium in fish caught in a total of 11 locations including 10 new locations where currently tritium is not analyzed, in order to verify the impact of concentration of tritium (See orange boxes in the right figure in Figure 9-7). Tritium analysis is also performed for the seawater on the point.	
(Omission)	(Omission)	
 In the assessment, verify, for example, whether the result is within the marine diffusion simulation result, whether the result is equivalent to the concentration used for the radiological impact assessment, etc., and express them in an easy-to-understand manner. 	• In the assessment, verify, for example, whether the result is within the marine diffusion simulation result, whether the result is equivalent to the concentration used for the radiological environmental impact assessment, etc., and express them in an easy-to-understand manner.	Appropriate description
(Omission)	(Omission)	
9-4. Actions to be taken in case of abnormalities Verify that it is within the assumed range, by comparison with the marine diffusion simulation result, the concentration used for the radiological impact assessment, etc., for the sea area monitoring described in 9-3. If it exceeds the variation range of usual values, verify the results of other implementation entities of monitoring for the investigation of the cause. If any greatly exceeding the variation range of usual values is observed, stop discharge into the sea, measure the corresponding points again, tentatively expand the range and frequency, and verify that there is no abnormality in the surrounding sea area. Therefore, we will accumulate the analysis results of sea area monitoring from April 2022 to ascertain them as usual values before discharge into the sea.	9-4. Actions to be taken in case of abnormalities Verify that it is within the assumed range, by comparison with the marine diffusion simulation result, the concentration used for the radiological environmental impact assessment, etc., for the sea area monitoring described in 9-3. If it exceeds the variation range of usual values, verify the results of other implementation entities of monitoring for the investigation of the cause. If any greatly exceeding the variation range of usual values is observed, stop discharge into the sea, measure the corresponding points again, tentatively expand the range and frequency, and verify that there is no abnormality in the surrounding sea area. Therefore, we will accumulate the analysis results of sea area monitoring from April 2022 to ascertain them as usual values before discharge into the sea.	
(Omission)	(Omission)	
As mentioned above, while the government, Fukushima prefecture and we are proceeding with sea area monitoring, sea area monitoring is enhanced and expanded before and after discharge of ALPS treated water. If any abnormal value is detected in enhanced and expanded sea area monitoring or any abnormal value is detected in monitoring, we will make sure to stop discharge until it is verified that discharge can be performed safely. 10. Summary For planned discharge of ALPS treated water into the sea in the FDNPS, the exposure assessment on human and environment is performed based on the current information (design stage). The result of a calculation setting multiple source terms and multiple food ingestions assuming that 0.05mSv/year is equivalent to the dose constraint with the optimization based on the Basic Policy of the government in April 2021, shows the annual exposure amount of the set representative person 3E-05 to 4E-04mSv/year, which is much smaller than 1mSv/year, which is the dose limit to public shown in the ICRP recommendation, as well as 0.05mSv/year deemed by the Nuclear Regulation Authority to be equivalent to the dose constraint. The result of a calculation setting multiple source terms for the impact on the environment as with the assessment for the human shows that the value for the reference plants and animals set based on the ICRP recommendation is 2E-05 to 6E-05mGy/day, which is much lower than 1 to 10mGy/day for flatfish and brown seaweeds and 10 to 100mGy/day for crabs, which as the derived consideration reference levels (DCRL) shown in the ICRP recommendation for the reference plants and animals.	9-5. Summary of monitoring As mentioned above, while the government, Fukushima prefecture and we are proceeding with sea area monitoring, sea area monitoring is enhanced and expanded before and after discharge of ALPS treated water. If any significant difference to the variation range of baseline monitoring is detected in enhanced and expanded sea area monitoring, we will make sure to stop discharge until it is verified that discharge can be performed safely. 10. Summary For planned discharge of ALPS treated water into the sea in the FDNPS, the exposure assessment on human and environment is performed based on the current information (construction stage). The result of a calculation setting multiple source terms and multiple food ingestions assuming that 0.05mSv/year is equivalent to the dose constraint with the optimization based on the Basic Policy of the government in April 2021, shows the annual exposure amount of the set representative person 2E-06 to 2E-05mSv/year, which is much smaller than 1mSv/year, which is the dose limit to public shown in the ICRP recommendation, as well as 0.05mSv/year deemed by the Nuclear Regulation Authority to be equivalent to the dose constraint. The result of a calculation setting multiple source terms for the impact on the environment as with the assessment for the human shows that the value for the reference plants and animals set based on the ICRP recommendation is 4E-07 to 1E-06mGy/day, which is much lower than 1 to 10mGy/day for flatfish and brown seaweeds and 10 to 100mGy/day for crabs, which as the derived consideration reference levels (DCRL) shown in the ICRP recommendation for the reference plants and animals.	Appropriate description for change of the date Appropriate description due to the selection of nuclides to be measured and assessed

	Current		Revised	Reason for Revision
Refe	rences	Refe	rences	
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[2]	International Atomic Energy Agency, IAEA Safety Standards Series No.GSG-10 "Prospective Radiological Environmental Impact Assessment for Facilities and Activities", IAEA, 2018.	[2]	International Atomic Energy Agency, IAEA Safety Standards Series No.GSG-10 "Prospective Radiological Environmental Impact Assessment for Facilities and Activities", IAEA, 2018.	
[3]	International Commission on Radiological Protection, 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, 1990.	[3]	International Commission on Radiological Protection, 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, 1990.	
[4]	D.Tsumune, T.Tsubono, K.Misumi, Y.Tateda, Y.Toyoda, Y.Onda, and M.Aoyama, "Impacts of direct release and river discharge on oceanic 137Cs derived from the Fukushima Dai-ichi Nuclear Power Plant accident", 2020.	[4]	D.Tsumune, T.Tsubono, K.Misumi, Y.Tateda, Y.Toyoda, Y.Onda, and M.Aoyama, "Impacts of direct release and river discharge on oceanic 137Cs derived from the Fukushima Dai-ichi Nuclear Power Plant accident", 2020.	
[5]	Nuclear Safety Commission, Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities, 1989.	[5]	Nuclear Safety Commission, Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities, 1989.	
[6]	Ministry of Health, Labour and Welfare, National Health and Nutrition Survey in Japan in 2019, 2020.	[6]	Ministry of Health, Labour and Welfare, National Health and Nutrition Survey in Japan in 2019, 2020.	
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[8]	Tritiated Water Taskforce, Tritiated Water Taskforce Report, 2016.	[8]	Tritiated Water Taskforce, Tritiated Water Taskforce Report, 2016.	
[9]	Sub-committee on the Handling of ALPS Treated Water, Sub-committee on the Handling of ALPS Treated Water Report, 2020.	[9]	Sub-committee on the Handling of ALPS Treated Water, Sub-committee on the Handling of ALPS Treated Water Report, 2020.	
[10]	Ministerial Meeting on Decommissioning, Contaminated Water and Treated Water Measures, Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station, 2021.	[10]	Ministerial Meeting on Decommissioning, Contaminated Water and Treated Water Measures, Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station, 2021.	
[11]	Tokyo Electric Power Company Holdings, Inc., TEPCO Holdings' Action in Response to the Government's Policy on the Handling of ALPS Treated Water from the Fukushima Daiichi Nuclear Power Station, 2021.	[11]	Tokyo Electric Power Company Holdings, Inc., TEPCO Holdings' Action in Response to the Government's Policy on the Handling of ALPS Treated Water from the Fukushima Daiichi Nuclear Power Station, 2021.	
[12]	Nuclear Regulation Authority, Concept and Assessment Guidelines for Verifications in the Radiological Inpact Assescement, 2022.	[12]	Nuclear Regulation Authority, Concept and Assessment Guidelines for Verifications in the Radiological Inpact Assescement, 2022.	
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[14]	L'Institut de Radioprotection et de Sûreté Nucléaire, Tritium and the environment, 2012.	[14]	L'Institut de Radioprotection et de Sûreté Nucléaire, Tritium and the environment, 2012.	
[15]	Tokyo Electric Power Company Holidigs, Inc., Results from secondary treatment performance confirmation tests on water treated with multi-nuclide removal equipment (final report), 2020.	[15]	Tokyo Electric Power Company Holidigs, Inc., Results from secondary treatment performance confirmation tests on water treated with multi-nuclide removal equipment (final report), 2020.	
[16]	International Commission on Radiological Protection, ICRP Publication 107, "Nuclear Decay Data for Dosimetric Calculations", 2008.	[16]	International Commission on Radiological Protection, ICRP Publication 107, "Nuclear Decay Data for Dosimetric Calculations", 2008.	
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[20]	Y.Miyazawa, R.Zhang, X.Guo, H.Tamura, D.Ambe, JS.Lee, A.Okuno, H.Yoshinari, T.Setou, and K.Komatsu, Water mass variability in the western North Pacific detected in a 15-year eddy resolving ocean reanalysis, 2009.	[21]	Y.Miyazawa, R.Zhang, X.Guo, H.Tamura, D.Ambe, JS.Lee, A.Okuno, H.Yoshinari, T.Setou, and K.Komatsu, Water mass variability in the western North Pacific detected in a 15-year eddy resolving ocean reanalysis, 2009.	
[21]	Central Research Institute of Electric Power Industry, The environmental impact assessment technology investigation of decommissioning of reactor for power generation, attachment "the Handbook for Determining Environmental Impacts of Decommissioning Work (3rd edition)", 2006 consigned investigation of the Ministry of Economy, Trade and Industry, 2007.	[22]	Central Research Institute of Electric Power Industry, The environmental impact assessment technology investigation of decommissioning of reactor for power generation, attachment "the Handbook for Determining Environmental Impacts of Decommissioning Work (3rd edition)", 2006 consigned investigation of the Ministry of Economy, Trade and Industry, 2007.	

	Comparison Table of amendments in the Implementation Plan for F	ukush	ima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2)	
	Current	ukusii	Revised	Reason for Revision
[22]	Japan Nuclear Fuel Service, Application for the Designation of Reprocessing Business of Rokkasho Plant, 1989.	[23]	Japan Nuclear Fuel Service, Application for the Designation of Reprocessing Business of Rokkasho Plant, 1989.	Appropriate description for addition of references
[23]	International Atomic Energy Agency, Determining the Suitability of Materials for Disposal at Sea under the London COnvention 1972 and London Protocol 1996: A Radiological Assessment Procedure, 2015.	[24]	International Atomic Energy Agency, Determining the Suitability of Materials for Disposal at Sea under the London COnvention 1972 and London Protocol 1996: A Radiological Assessment Procedure, 2015.	
[24]	Decision by the Atomic Energy Commission, Guidlines for the Assessment of Dose Target Values Around Light Water Reactor Facilities, 1976.	[25]	Decision by the Atomic Energy Commission, Guidlines for the Assessment of Dose Target Values Around Light Water Reactor Facilities, 1976.	
[25]	International Atomic Energy Agency, Technical Reports Series No.422 "Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment", 2004.	[26]	International Atomic Energy Agency, Technical Reports Series No.422 "Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment", 2004.	
[26]	Stanley E. Thompson, C. Ann Burton, Dorothy J. Quinn, Yook C. Ng, CONCENTRATION FACTORS OF CHEMICAL ELEMENTS IN EDIBLE AQUATIC ORGANISM, LAWRENCE LIVERMORE LABORATORY, 1972.			Delete description due to the selection of nuclides to be measured and assessed
[27]	International Commission on Radiological Protection, ICRP Publication 101a, "Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public", 2006.	[27]	International Commission on Radiological Protection, ICRP Publication 101a, "Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public", 2006.	
[28]	International Commission on Radiological Protection, ICRP Publication 124, "Protection of the Environment under Different Exposure Situations", 2013.	[28]	International Commission on Radiological Protection, ICRP Publication 124, "Protection of the Environment under Different Exposure Situations", 2013.	
[29]	International Commission on Radiological Protection, ICRP Publication 136, "Dose Coefficients for Nonhuman Biota Environmentally Exposed to Radiation, 2017.	[29]	International Commission on Radiological Protection, ICRP Publication 136, "Dose Coefficients for Nonhuman Biota Environmentally Exposed to Radiation, 2017.	
[30]	International Commission on Radiological Protection, "BiotaDC v.1.5.1," 2017. [Online]. Available: http://biotadc.icrp.org/.	[30]	International Commission on Radiological Protection, "BiotaDC v.1.5.1," 2017. [Online]. Available: http://biotadc.icrp.org/.	
[31]	International Commission on Radiological Protection, ICRP Publication 114, "Environmental Protection: Transfer Parameters for Reference Animals and Plants", 2019.	[31]	International Commission on Radiological Protection, ICRP Publication 114, "Environmental Protection: Transfer Parameters for Reference Animals and Plants", 2019.	
[32]	Environment Agency, 4th fundamental investigation for natural environment preservation - Environmental investigation report of marine organisms (Tideland, seaweed bed, and coral reef investigation), 1994.	[32]	Environment Agency, 4th fundamental investigation for natural environment preservation - Environmental investigation report of marine organisms (Tideland, seaweed bed, and coral reef investigation), 1994.	
[33]	Agency for Cultural Affairs, Emergency investigation of natural monuments, Vegetation map/Major plant and animal map, Fukushima, 1971.	[33]	Agency for Cultural Affairs, Emergency investigation of natural monuments, Vegetation map/Major plant and animal map, Fukushima, 1971.	
[34]	Nuclear Regulation Authority, Pronouncement which set the dose limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials, 2015.	[34]	Nuclear Regulation Authority, Pronouncement which set the dose limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials, 2015.	
(Om:	ssion)	(Omi	ssion)	

	Comparison Table of amendments in the Im-	plementation Plan for Fukushima	Daiichi Nuclear Power Station as	Specified Nuclear Facility (Reference	e. Attachment-2)
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	Compa	irison Table of amendments in the Implementation Plan for F		uclear Power Station	as Specified Nuclear Facility (Reference, Attachment-2)	1		
		Current		Reason for Revision				
appointed and extern	al experts were invited as	anel with knowledge on the radiological impact assessment were s members in three fields, which are especially important for the ion protection, environmental protection, and marine dispersion	For preparation of thi appointed and externa	Preparation member (as of November 1, 2022) For preparation of this report, in-house personnel with knowledge on the radiological impact assessment were appointed and external experts were invited as members in three fields, which are especially important for the radiological impact assessment: human radiation protection, environmental protection, and marine dispersion				
Sponsor Junichi Matsumoto (Tokyo Electric Power Company Holdings, Inc.)				(Tokyo Electric Power	Company Holdings, Inc.)			
Assessment mem Team leader: Team members:	Tomomi Okamura Hideo Kiyooka Yuta Ichiba Ryota Taguchi Itsumasa Urabe Yutaka Tateda	(Tokyo Electric Power Company Holdings, Inc.) (Professor Emeritus, Fukuyama University, Environmental impact assessment) (Guest Research Fellow, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, marine animals and plants exposure assessment)	Assessment memb Team leader: Team members:	Tomomi Okamura Yuta Ichiba Itsumasa Urabe Hideo Kiyooka Michiya Sasaki	(Tokyo Electric Power Company Holdings, Inc.) (Tokyo Electric Power Company Holdings, Inc.) (Professor Emeritus, Fukuyama University, Environmental impact assessment) (Tokyo Electric Power Company Holdings, Inc.) (Senior Research Fellow, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, human exposure assessment) (Guest Research Fellow, Sustainable System Research Laboratory,	Appropriate description for addition of members		
	Takatoshi Hattori Yukio Masumoto Daisuke Tsumune	(Associate Vice President, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, human exposure assessment) (Professor, The University of Tokyo, dispersion calculation) (Senior Research Scientist, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, dispersion calculation)		Daisuke Tsumune Takatoshi Hattori Yukio Masumoto Kazuhiro Misumi	Central Research Institute of Electric Power Industry, marine animals and plants exposure assessment) (Senior Research Scientist, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, dispersion calculation) (Managing Director, Technological Strategy Group, Nuclear Damage Compensation and Decomissioning Facilitation Corporation, human exposure assessment) (Professor, The University of Tokyo, dispersion calculation) (Senior Research Fellow, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry,			
ObserverSecretariat	Tadafumi Koyama Gaku Sato Katsuhisa Matsuzaki	(Distinguished Research Scientist, Central Research Institute of Electric Power Industry) (Tokyo Electric Power Company Holdings, Inc.) (Tokyo Electric Power Company Holdings, Inc.)	ObserverSecretariat	Tadafumi Koyama Gaku Sato Katsuhisa Matsuzaki	dispersion calculation) (Distinguished Research Scientist, Central Research Institute of Electric Power Industry) (Tokyo Electric Power Company Holdings, Inc.) (Tokyo Electric Power Company Holdings, Inc.)			
		End			End			

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi I	Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and F	Reference A-G)
Current	Revised	Reason for Revision
Attachment I Rationale behind the selection of <u>nuclides subject to removal</u> by ALPS	Attachment I Rationale behind the selection of nuclides subject to <u>be measured and assessed for discharge of ALPS treated water into the sea</u>	Change description due to the selection of nuclides to be measured and assessed
I-1. Selection of nuclides subject to removal	I-1. <u>Overview</u>	
It is assumed that the water to be treated in the advanced liquid processing system (fresh water, RO concentrated		
salt water, and treatment device outlet water) contains radioactive materials derived from the fuel in the Units 1 to	•	
3 reactors (hereinafter called "FP nuclide") and radioactive materials derived from corrosion products contained in	· · · · · · · · · · · · · · · · · · ·	
the water retained during plant operation (hereinafter called "CP nuclide"). In order to reduce the risk of radiation	· · · · · · · · · · · · · · · · · · ·	
exposure to the surrounding public area in the event of leakage of the water to be treated into the environment, it is	considered sufficiently decayed and become less abundant by the time of the discharge of ALPS treated water into	
necessary to estimate the nuclides present at high concentrations so that they can be removed by the advanced liquid	the sea. Therefore, the sum of the ratios to regulatory concentration limits is considered to satisfy less than 1.	
processing system among FP nuclides and CP nuclides contained in the water to be treated. Therefore in estimation the concentration of radioactive metanicle contained in the vector to be treated for EP.	In order to ensure that the sum of the ratios to regulatory concentration limits is less than 1, target nuclides to be	
Therefore, in estimating the concentration of radioactive materials contained in the water to be treated, for FP nuclides, nuclides assumed to exist at significant concentrations were selected based on the assessment results of	-	
the core inventory; for nuclides for which measurement of radioactive materials was carried out in March 2011, the		
concentration in the stagnant water was estimated from the measurement results; and for nuclides for which		
measurement was not carried out, the concentration in the stagnant water was estimated from the assessment results	I-2. Policy on the selection of nuclides to be measured and evaluated	
of the core inventory.	For verification of nuclides which have possibility to be significantly contained in contaminated water at FDNPS,	
The concentration of CP nuclides in the stagnant water was estimated using the measurement results of CP nuclides	· · · · · · · · · · · · · · · · · · ·	
in the water retained in the reactor and the concentrated waste liquid tank during plant operation, because nuclides	·	
contained in the water retained in the reactor during plant operation were transferred to the stagnant water, and it is	· · · · · · · · · · · · · · · · · · ·	
considered that nuclides contained in the water retained in the concentrated waste liquid tank were mixed when the	Table I-1 Elements considered in the selection of nuclides to be measured and assessed	
stagnant water was transferred to the high-temperature incinerator building.	Nuclide analysis	
The operation of the advanced liquid processing system was assumed to be started 1 year (365 days) after reactor	Verify whether or not the nuclides to be assessed in the research on decommissioning and disposal	
shutdown for both FP and CP nuclides, so the concentration in the stagnant water was estimated by decay correction	facilities are also significantly present in contaminated water by actual analysis of water. Also	
365 days after reactor shutdown considering the half-life. Comparing the estimated concentration obtained by decay	verify the results of past nuclide analyses.	
correction at 365 days after reactor shutdown and nuclides over 1/100 of the regulatory concentration limit were	THIVCHUI V ASSESSITICITE	
selected as nuclides subject to removal by the advanced liquid processing system assuming that they exist at	Assess an inventory of fission products in the same way as in the study of nuclides subject to	
significant concentrations in the stagnant water. The sum of the ratio of the estimated concentration to the regulatory concentration limit of nuclides which are excluded because they are below 1/100 of the regulatory concentration	removal by ALPS. Assess the inventory quantity generated by activation of such as structures in	
limit is about 0.05 at maximum. Therefore, the concentration of the excluded nuclides is considered to be	reactor pressure vessel based on the studies on decommissioning and disposal facilities. In the	
sufficiently low.	above assessments, taken into account the reduction of inventory quantity due to decay as the 12	
	years have passed since the earthquake until discharge.	
I-2. Selection method and selection result of nuclides subject to removal	Based on the above assessment results, verify the existence of nuclides that may be significantly	
(1) Selection method and selection result of nuclides subject to removal from FP nuclides	contained in contaminated water, taking into account such as the ease of transfer to water.	
Nuclides subject to removal from FP nuclides were selected according to the flow of Figure I-1. As a result, 56		
nuclides were selected as nuclides subject to removal.	Based on the results of nuclide analysis and inventory assessment, the nuclides to be measured and assessed are	
(2) Selection method and selection result of nuclides subject to removal from CP nuclides	selected, taking into account the impacts on dose assessment.	
Nuclides subject to removal from CP nuclides were selected according to the flow of Figure I-2. As a result, 6	I-3. Selection of nuclides to be measured and assessed at the time of the discharge of ALPS treated water into the	
nuclides were selected as nuclides subject to removal.	1-3. Selection of nuclides to be incastred and assessed at the time of the discharge of ALF 5 heated water into the	
(3) Summary of the selection result of nuclides subject to removal A total of 62 nuclides were selected: 56 nuclides selected from FP nuclides and 6 nuclides selected from CP	I-3-1 Rational behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated	
nuclides (See Table I-1).	water into the sea	
indendes (See Table 1-1).	Based on the results of nuclide analysis and inventory assessment in section I-2 above, the nuclides to be measured	
	and assessed are selected according to the flowchart, shown in Figure I-1.	
		1

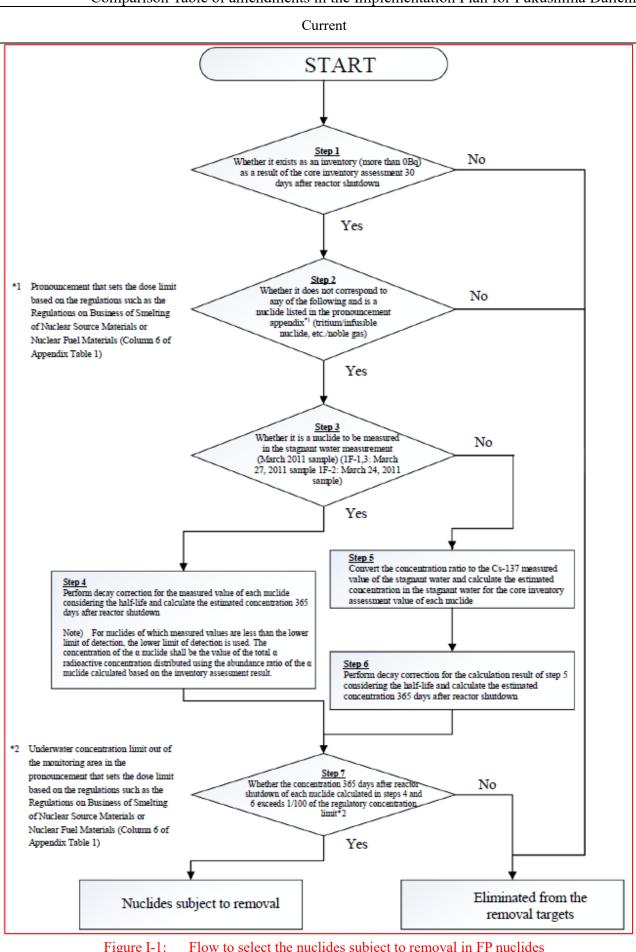
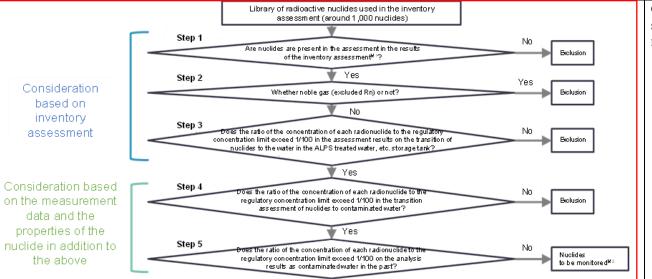


Figure I-1: Flow to select the nuclides subject to removal in FP nuclides



Yes

No

Is it tritium (be not able to remove by ALPS)?

Nuclides to be measured

** 1: The decay period of the inventory evaluation is appropriately set according to the time when the selection result is to be used. (First time set to 2023 (12 years after the accident))

Revised

Figure I-1 Flowchart for selection of nuclides to be measured and assessed for discharge of ALPS treated water into the sea

*2: Nuclides were continuously confirmed whether are significantly presence in contaminated water

I-3-2 Selection result

As a result of the selection process according to the above flowchart, the following 30 nuclides were selected. Before discharging ALPS treated water into the sea, it will be confirmed that the nuclides selected for measurement and assessment based on the flowchart in Figure I-1 satisfy the discharge criteria (sum of the ratios to regulatory concentration limit of nuclides other than tritium is less than 1.)

Table I-2 Nuclides to be measured and assessed (30 nuclides)

<u>C-14</u>	<u>Mn-54</u>	<u>Co-60</u>	<u>Ni-63</u>	<u>Se-79</u>	<u>Sr-90</u>
<u>Y-90</u>	<u>Tc-99</u>	<u>Ru-106</u>	<u>Cd-113m</u>	Sb-125	<u>Te-125m</u>
<u>I-129</u>	<u>Cs-134</u>	<u>Cs-137</u>	<u>Ce-144</u>	<u>Pm-147</u>	<u>Sm-151</u>
<u>Eu-154</u>	<u>Eu-155</u>	<u>U-234</u>	<u>U-238</u>	<u>Np-237</u>	<u>Pu-238</u>
<u>Pu-239</u>	<u>Pu-240</u>	<u>Pu-241</u>	<u>Am-241</u>	<u>Cm-243</u>	<u>Cm-244</u>

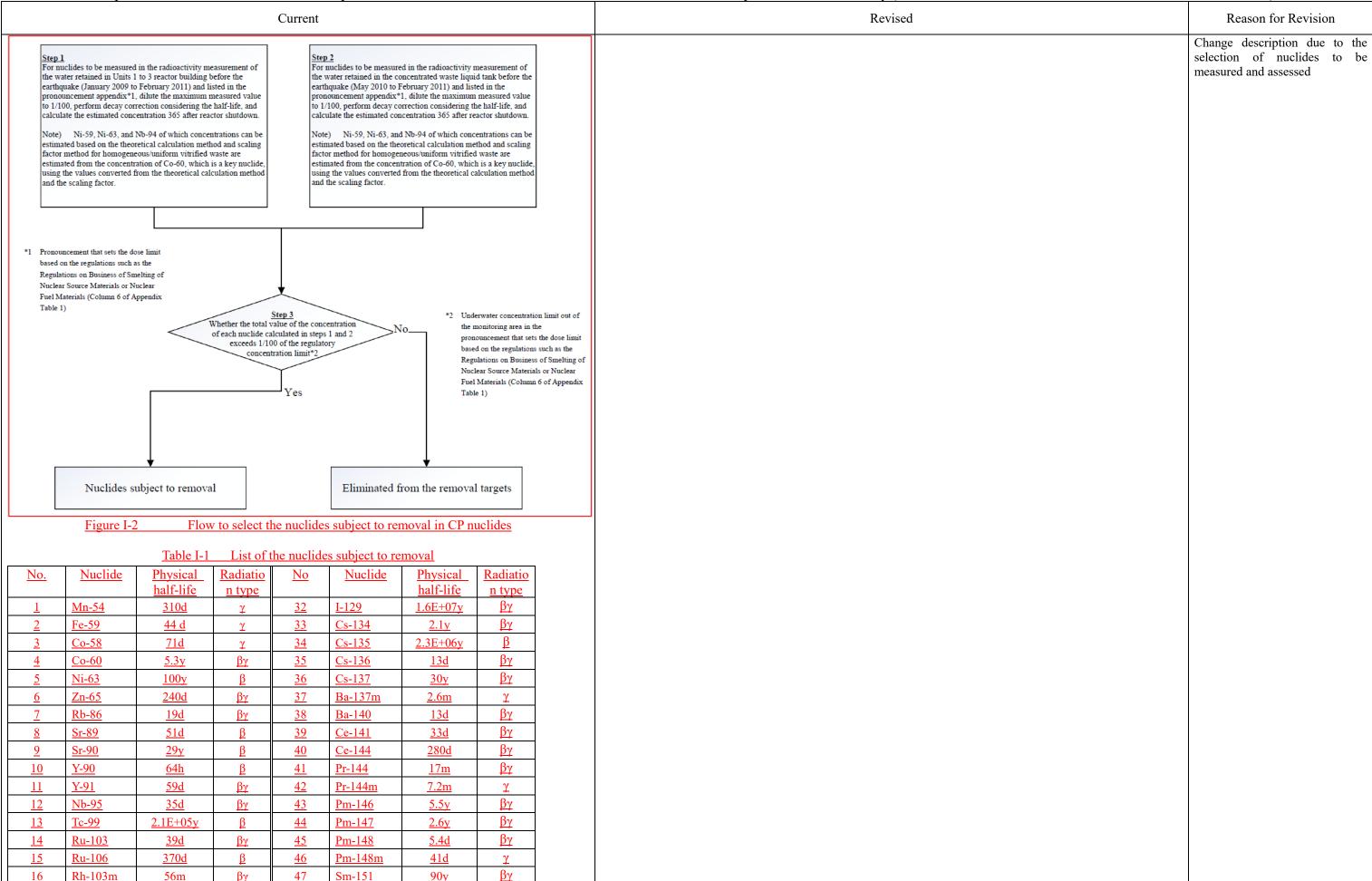
These nuclides to be measured and assessed are selected based on the results of past analyses. However, there is a possibility that the situation may change depending on the progress of the decommissioning work in the future. Therefore, the following methods are used to confirm that there are no significant nuclides other than the selected nuclides to be measured and assessed (hereinafter "other nuclides"). If it is confirmed that other nuclides are significantly present during this confirmation process, re-assessment of the nuclides to be measured and assessed will be performed. The decay of radionuclides will be also reflected in the selection flowchart.

- When confirming that ALPS treated water meets the discharge limit, also confirm that no other nuclides are present significantly by measuring with gross α , gross β , and Ge semi-conductor detectors.
- Confirm that concentrations of radionuclides, regularly checked in contaminated water of downstream from the centralized radioactive waste building, are below the previously confirmed concentration and there is no change in the status of the transfer of radionuclides to contaminated water.
- The existence of other nuclides is investigated when the event with concern is confirmed in the above two cases. Even if such concerns are dispelled, check the presence of the nuclides subject to be monitored in contaminated water prior to ALPS treatment at a frequency of once a year in order to investigate the presence of other nuclides.

Change description due to the selection of nuclides to measured and assessed

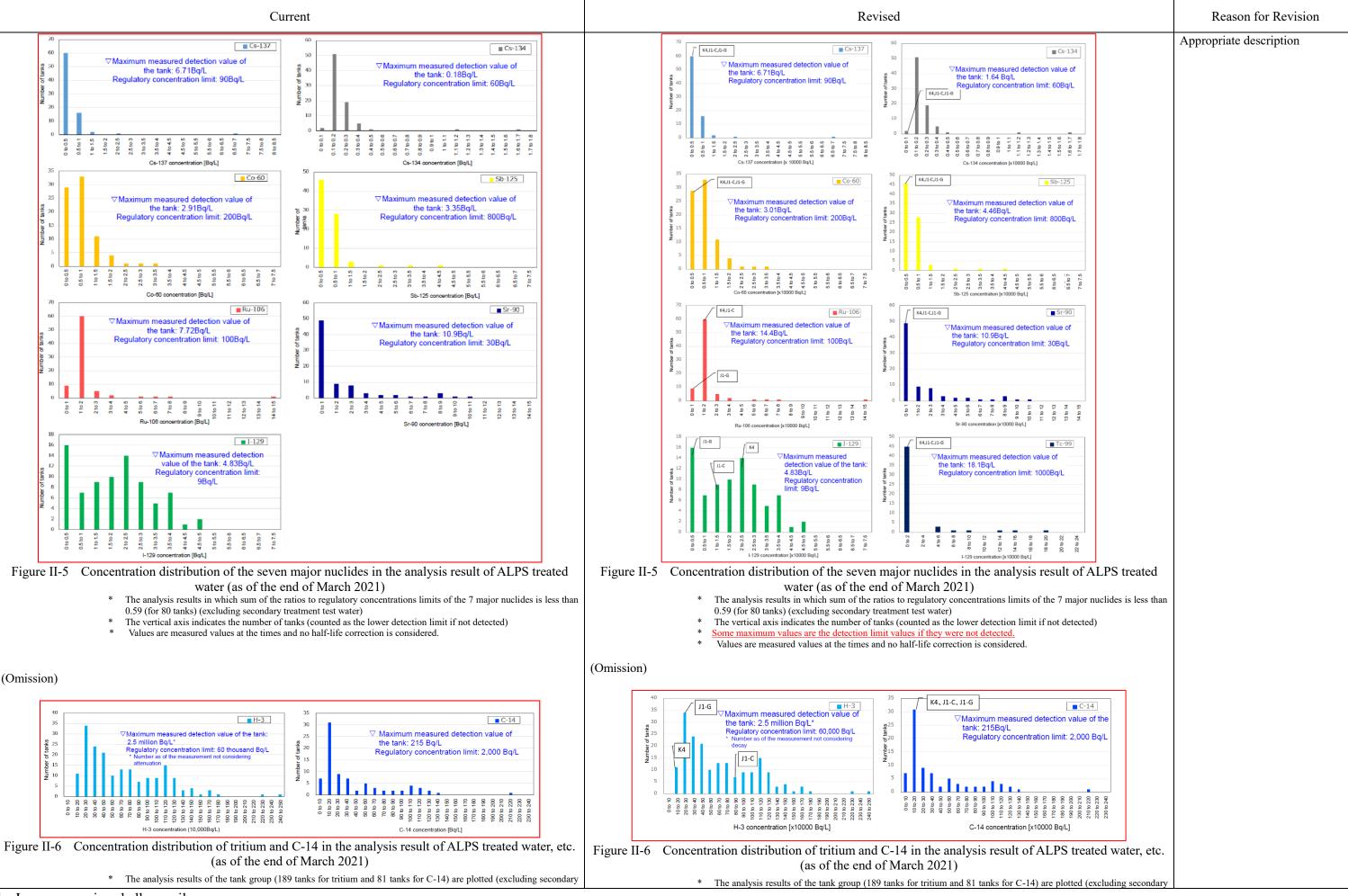
Biclusion

Reason for Revision



Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi	Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and I	, ,		
Current	Revised	Reason for Revision		
<u>17</u> <u>Rh-106</u> <u>30s</u> <u>γ</u> <u>48</u> <u>Eu-152</u> <u>14y</u> <u>βγ</u>		Change description due to the		
<u>18 Ag-110m</u> <u>250d</u> <u>βγ</u> <u>49 Eu-154</u> <u>8.6y</u> <u>βγ</u>		selection of nuclides to be measured and assessed		
<u>19</u> <u>Cd-113m</u> <u>14 y</u> <u>γ</u> <u>50</u> <u>Eu-155</u> <u>4.8y</u> <u>βγ</u>		measured and assessed		
<u>20</u> <u>Cd-115m</u> <u>45d</u> <u>βγ</u> <u>51</u> <u>Gd-153</u> <u>240d</u> <u>γ</u>				
21 Sn-119m 290d γ 52 Tb-160 72d βγ 22 Sn-123 1331 0 53 P-330 0				
22 Sn-123 130d βγ 53 Pu-238 88y α 33 Sn-126 2.3F+05 8 54 Pu-238 2.4F+04 α				
$\frac{25}{26}$ $\frac{30^{-125}}{\text{Te-123m}}$ $\frac{120d}{2}$ $\frac{7}{2}$ $\frac{57}{2}$ $\frac{\text{Am-241}}{\text{Am-241}}$ $\frac{430y}{2}$ $\frac{\alpha}{2}$				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
29 Te-127m 110d βγ 60 Cm-242 160d α				
30 Te-129 70 m $\beta \gamma$ 61 Cm-243 29 y α				
<u>31 Te-129m</u> <u>34d</u> <u>βγ</u> <u>62 Cm-244</u> <u>18y</u> <u>α</u>				
Attachment II Properties of ALPS treated water, etc.	Attachment II Properties of ALPS treated water, etc.			
(Omission)	(Omission)			
II-1. Overview of the occurrence of contaminated water (stagnant water in the building) and the system of the contaminated water treatment facility	II-1. Overview of the occurrence of contaminated water (stagnant water in the building) and the system of the contaminated water treatment facility			
In the FDNPS, the residual fuel debris in the building is cooled with water, and mixing of the cooling water and the	In the FDNPS, the residual fuel debris in the building is cooled with water, and mixing of the cooling water and the			
groundwater or rainwater entering the building causes contaminated water. The daily average amount of contaminated water was reduced to about 140m ³ in the result of FY2020 thanks to the	groundwater or rainwater entering the building causes contaminated water.	Appropriate description for		
reduction of water entering the reactor building by countermeasures such as land side impermeable wall (froze		change of the date		
soil wall) and sub-drains.	soil wall) and sub-drains.			
To reduce the risks caused by radioactive materials contained in contaminated water, at first cesium and strontium				
were removed preferentially, which accounts for most of the radioactive materials contained in contaminated wate using cesium adsorption devices such as Kurion and SARRY. After that, water desalinated with desalination devices				
is recirculated for cooling the burst slug in the core, and the residual concentrated water is treated with the advance				
liquid processing system (hereinafter called "ALPS") as "strontium treated water (water before treated by ALPS)	" treated with the advanced liquid processing system (hereinafter called "ALPS") as "strontium treated water (water			
to remove the 62 nuclides subject to removal, which accounts for most of the nuclides, other than tritium, and the stored in tanks installed on high ground.	before treated by ALPS)" to remove the 62 nuclides subject to removal ¹ , which accounts for most of the nuclides, other than tritium, and then stored in tanks installed on high ground.			
		Appropriate description due to the		
	¹ For details of the selection process and the selected nuclides, see Attachment F "Rationale behind the selection of	selection of nuclides to be		
	nuclides subject to removal by ALPS."	measured and assessed		
(Omission)	(Omission)			
II-2. Overview of the system of ALPS	II-2. Overview of the system of ALPS			
ALPS is designed to be able to remove up to less than the regulatory concentration limit without dilution of the 6	ALPS is designed to be able to remove up to less than the regulatory concentration limit without dilution of the 62			
nuclides estimated to be contained in the above-mentioned strontium treated water at such high concentrations that they should be removed execut tritium, which ALDS connect removes by treatment using abvoiced and showing				
they should be removed except tritium, which ALPS cannot remove, by treatment using physical and chemical properties such as coprecipitation with chemicals, adsorption by active carbon and physical materials, and filtration				
with a physical filter; this capability has already been demonstrated through the actual operation (For details of the				
performance, see II-3. "Performance of ALPS").	performance, see II-3. "Performance of ALPS").			
(Omission)	(Omission)			
¹ For details of the selection process and the selected nuclides, see Attachment I "Rationale behind the selection of nuclides subject to removal by ALPS."	$\underline{\mathbf{f}}$			
(Omission)	(Omission)			

Current	Revised	Reason for Revision
II-5. Analysis of the radioactive materials in the stored ALPS treated water, etc. (Omission) In other words, when the transfer destination tank group (8 to 10 tanks connected at the time of water reception) becomes full, water of which ratios to regulatory concentrations limits of 63 nuclides other than tritium were estimated to be less than 1 using the following formula is judged as ALPS treated water and the other water as treated water to be purified, based on the measurement result of the sample (water) collected in the ALPS outlet (measured point (7)) during reception of water in the corresponding tanks group from ALPS. $C_{All} = C_{M7} + C_{C-14} + C_{55} < 1$ Where $C_{All} : \text{Sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium}$ $C_{M7} : \text{Sum of the ratios to regulatory concentrations limits calculated from the measurement results}$ of the seven major nuclides $C_{C-14} : \text{Ratio to the regulatory concentrations limit of C-14 (conservatively set to the ratio to the regulatory concentrations limit of 0.11 calculated from the maximum concentration (215Bq/L) measured in the past) C_{55} : Estimated value of the sum of the ratios to regulatory concentrations limits of the 55 nuclides not included in the 7 nuclides among the 62 nuclides (The estimated value based on the past measurement results is set to 0.3)$	II-5. Analysis of the radioactive materials in the stored ALPS treated water, etc. (Omission) In other words, when the transfer destination tank group (8 to 10 tanks connected at the time of water reception) becomes full, water of which ratios to regulatory concentrations limits of nuclides other than tritium were estimated to be less than 1 using the following formula is judged as ALPS treated water and the other water as treated water to be purified, based on the measurement result of the sample (water) collected in the ALPS outlet (measured point (7)) during reception of water in the corresponding tanks group from ALPS $C_{All} = C_{M7} + C_{C-14} + C_0 < 1$ Where $C_{All} : \text{Sum of the ratios to regulatory concentrations limits of nuclides other than tritium}$ $C_{M7} : \text{Sum of the ratios to regulatory concentrations limits calculated from the measurement results}$ of the seven major nuclides $C_{C-14} : \text{Ratio to the regulatory concentrations limit of C-14 (conservatively set to the ratio to the regulatory concentrations limit of 0.11 calculated from the maximum concentration (215Bq/L) measured in the past) C_{O} : Estimated value of the sum of the ratios to regulatory concentrations limits of the nuclides not included in the 7 nuclides among the nuclides other than tritium (The estimated value based on the past measurement results is set to 0.3)$	Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)	(Omission)	



Compar	ison Table of amendme	ents in th	e Impleme	entation Pla	n for Fuku	shima Daiichi N	Juclear Power Station as	Specified Nuclear Fa	cility (R	eference, A	ttachment-	2, Attachm	ent I-XIII and	Reference A-G)
		Curren	t						Revise	d				Reason for Revision
	treatment test water)						treatment test water)							
	The vertical axis indicates the nun					eted)	* The vertical axis indicates the number of tanks (counted as the lower detection limit if not detected)							
*	Values are measured values at the	e times and no	o half-life correc	ction is considere	ed.		 Values are measured values at the times and no half-life correction is considered. 							
As a result of the above-	mentioned estimation, app	prox. 70%	of the wate	r currently s	tored in the	tanks is judged to	As a result of the above-m	nentioned estimation, app	orox. 70%	of the water	r currently st	ored in the t	anks is judged to	
	urified," which does not sa						be "treated water to be pur							
	s limits of 63 nuclides (CA						regulatory concentrations							' Appropriate description due to th
	eatment is conducted imr						is discharged only after sec							
confirmed that the regula	atory concentration limit is	s less than	I with the f	acility for m	easurement a	and confirmation.	it is confirmed that the confirmation.	regulatory concentration	n limit is	less than I	with the fa	icility for n	neasurement and	measured and assessed
							commutation.							
(Omission)							(Omission)							
II-6. Water quality other	than radioactive materials	3					II-6. Water quality other the	nan radioactive materials						
(Omission)							(Omission)							
Takla II 0 -1 4 4 1		laa 	-11 - 4 - J 1	4la a 4!!	£		Table II 0 -1 4 4 1			ا الدعودال	Alam Alimati C	`		
	group from which sampleshow the results of the 46						Table II-8 shows the tank tanks. Table II-9-1 and 2 sl							
	It was verified that all of						management guideline." I							
			Swiidui u		una ora		of Fukushima prefecture.			Swiidult	22707 1110	<u>111 vupu</u>		1.pp.oprime description
(Omission)							(Omission)							
Table II 0 1 Pecults of ar	nalyses of chemical substa	onces etc	in tanks co	ntaining AII	DS trantad xv	oter etc (Port 1)	Table II-9-1 Results of an	alvege of chamical substa	onces etc	in tanks co	ntaining AII	OS trantad su	oter etc (Dort 1)	
Item	Guideline or permissible	Unit	, iii taliks co.		tank group	aici, cic. (1 ait 1)	Item	Guideline or permissible	Unit	, ili taliks co	Area and t		atci, etc. (i ait i)	
	limit		G3	J4	H1	K3		limit		G3	J4	H1	К3	
11-1	5.0 <9.0</td <td> TT</td> <td>A 8.8</td> <td>8.3</td> <td>E 7.8</td> <td>8.3</td> <td>IId</td> <td>5.0<!--<9.0</td--><td>11</td><td>A 8.8</td><td>8.3</td><td>E 7.8</td><td>A 8.3</td><td></td></td>	TT	A 8.8	8.3	E 7.8	8.3	IId	5.0 <9.0</td <td>11</td> <td>A 8.8</td> <td>8.3</td> <td>E 7.8</td> <td>A 8.3</td> <td></td>	11	A 8.8	8.3	E 7.8	A 8.3	
Hydrogen ion Mass of suspended solids	Permissible limit 200	pН					Hydrogen ion Mass of suspended solids	Permissible limit 200	pН					
(SS)	(Daily average 150)	mg/L	<1	<1	<1	<1	(SS)	(Daily average 150)	mg/L	<1	<1	<1	<1	
Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	2.4	2.8	3.9	3.9	Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	2.4	2.8	3.9	3.9	
	Permissible limit 230	/T	2.5	4.4	2.2	0.0		Permissible limit 230	/T	2.5	4.4	2.2	0.0	
Boron (mg/L)	(Sea area)	mg/L	3.5	4.4	2.3	0.9	Boron (mg/L)	(Sea area)	mg/L	3.5	4.4	2.3	0.9	
Soluble iron	Permissible limit 10	mg/L	<1	<1	<1	<1	Soluble iron	Permissible limit 10	mg/L	<1	<1	<1	<1	
Copper Nickel	Permissible limit 3 Permissible limit 2	mg/L mg/L	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	Copper Nickel	Permissible limit 3 Permissible limit 2	mg/L mg/L	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1	
Chromium	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1	Chromium	Permissible limit 2	mg/L mg/L	<0.1	<0.1	<0.1	<0.1	
Zinc	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1	Zinc	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1	
Biochemical oxygen	D 1 11 11 11 11 11						Biochemical oxygen	B 1 11 11 11 11 11 11 11 11 11 11 11 11						
demand	Permissible limit 160 (Daily average 120)	mg/L	<1	<1	<1	<1	demand	Permissible limit 160 (Daily average 120)	mg/L	<1	<1	<1	<1	
(BOD)	(Dully average 120)						(BOD)	(Daily average 120)						
Coliform count	Permissible limit	Pieces/ cm <u>3</u>	0	0	0	0	Coliform count	Permissible limit	Pieces/ cm ³	0	0	0	0	Appropriate description
Cadmium	Daily average 3000 Permissible limit 0.03	mg/L	< 0.01	< 0.01	< 0.01	<0.01	Cadmium	Daily average 3000 Permissible limit 0.03	mg/L	< 0.01	< 0.01	<0.01	<0.01	
Cyan	Permissible limit 1	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	Cyan	Permissible limit 1	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	
Organic phosphorus	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	<0.1	Organic phosphorus	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	<0.1	
Lead Hexavalent chromium	Permissible limit 0.1 Permissible limit 0.5	mg/L mg/L	<0.01 <0.05	<0.01 <0.05	<0.01 <0.05	<0.01 <0.05	Lead Hexavalent chromium	Permissible limit 0.1 Permissible limit 0.5	mg/L mg/L	<0.01 <0.05	<0.01 <0.05	<0.01 <0.05	<0.01 <0.05	
Arsenic	Permissible limit 0.1	mg/L	<0.03	<0.03	<0.03	<0.03	Arsenic	Permissible limit 0.3	mg/L mg/L	<0.03	<0.03	<0.03	<0.03	
Mercury	Permissible limit 0.005	mg/L	< 0.0005	< 0.0005	< 0.0005	<0.0005	Mercury	Permissible limit 0.005	mg/L	< 0.0005	< 0.0005	< 0.0005	<0.0005	
Alkyl mercury Polychlorinated biphenyls	It should not be detected Permissible limit 0.003	mg/L	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	Alkyl mercury Polychlorinated biphenyls	It should not be detected Permissible limit 0.003	mg/L	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	
Trichloroethylene	Permissible limit 0.003 Permissible limit 0.1	mg/L mg/L	<0.0005	<0.0005	<0.0005	<0.0005	Trichloroethylene	Permissible limit 0.003 Permissible limit 0.1	mg/L mg/L	<0.0005	<0.0005	<0.0005	<0.005	
Tetrachloroethylene	Permissible limit 0.1	mg/L mg/L	< 0.01	< 0.01	< 0.01	< 0.01	Tetrachloroethylene	Permissible limit 0.1	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	
Dichloromethane	Permissible limit 0.2	mg/L	<0.02	< 0.02	<0.02	<0.02	Dichloromethane	Permissible limit 0.2	mg/L	< 0.02	< 0.02	<0.02	<0.02	
Carbon tetrachloride	Permissible limit 0.02	mg/L	<0.002	<0.002 <0.004	<0.002	<0.002	Carbon tetrachloride 1,2-dichloroethane	Permissible limit 0.02	mg/L	<0.002	<0.002	<0.002	<0.002	
1,2-dichloroethane	Permissible limit 0.04 Permissible limit 1	mg/L mg/L	<0.004	<0.004	<0.004 <0.1	<0.004 <0.1	1,2-dichloroethane	Permissible limit 0.04 Permissible limit 1	mg/L mg/L	<0.004 <0.1	<0.004 <0.1	<0.004 <0.1	<0.004	
Cis-1, 2-dichloroethylene	Permissible limit 0.4	mg/L	<0.14	<0.1	<0.04	<0.04	Cis-1, 2-dichloroethylene	Permissible limit 0.4	mg/L	<0.14	<0.04	<0.04	<0.04	
			•	•	•		1				•			

Compari	son rable of amendin	Curren	•	iliation i lai	I IOI TUKU	isiiiiia Daiic	/III 1 N	Juciear Power Station as	Specified Nuclear 19	Revise	•	.taciiiieiit-	2, Attaciiii		Reason for Revision
1,1,1-trichloroethane	Permissible limit 3	mg/L	< 0.3	< 0.3	< 0.3	< 0.3		1,1,1-trichloroethane	Permissible limit 3	mg/L	< 0.3	< 0.3	< 0.3	< 0.3	
1,1,2-trichloroethane	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006	< 0.006		1,1,2-trichloroethane	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006	< 0.006	
1,3-dichloropropene	Permissible limit 0.02	mg/L	< 0.002	< 0.002	< 0.002	< 0.002		1,3-dichloropropene	Permissible limit 0.02	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	
Thiuram	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006	< 0.006		Thiuram	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006	< 0.006	
Simazine	Permissible limit 0.03	mg/L	< 0.003	< 0.003	< 0.003	< 0.003		Simazine	Permissible limit 0.03	mg/L	<0.003	< 0.003	< 0.003	< 0.003	
Thiobencarb	Permissible limit 0.2	mg/L	< 0.02	<0.02	<0.02	<0.02		Thiobencarb	Permissible limit 0.2	mg/L	<0.02	< 0.02	< 0.02	<0.02	
Benzene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01		Benzene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01	
Selenium Fenitrothion	Permissible limit 0.1 Permissible limit 0.03	mg/L	<0.01 <0.003	<0.01 <0.003	<0.01 <0.003	<0.01		Selenium Fenitrothion	Permissible limit 0.1 Permissible limit 0.03	mg/L	<0.01 <0.003	<0.01	<0.01 <0.003	<0.01 <0.003	
Phenols	Permissible limit 5	mg/L mg/L	<0.003	<0.003	<0.003	<0.003		Phenols	Permissible limit 5	mg/L mg/L	<0.003	<0.003	<0.003	<0.003	
	Permissible element 15			-					Permissible element 15						
Fluorine	(Sea area)	mg/L	< 0.5	< 0.5	< 0.5	<0.5		Fluorine	(Sea area)	mg/L	< 0.5	< 0.5	< 0.5	<0.5	
Soluble manganese	Permissible limit 10	mg/L	<1	<1	<1	<1		Soluble manganese	Permissible limit 10	mg/L	<1	<1	<1	<1	
Ammonia, ammonium		ma/I	<1	<1	<1	<1		Ammonia, ammonium		ma/I	<1	<1	<1	<1	
compounds		mg/L	~1	<u></u>	<u></u>	~1		compounds		mg/L	~1	\1	\ 1	~1	
Nitrous acid compound	Permissible limit 100		_	_				Nitrous acid compound	Permissible limit 100						
and nitrous acid		mg/L	2	2	<1	11		and nitrous acid compound		mg/L	2	2	<1	11	
compound	D : 11 11 14 0.5	/T	<0.05	<0.05	<0.05	<0.05		1.4-dioxane	D : 11 1: 1/05	/T	<0.05	<0.05	<0.05	<0.05	
1,4-dioxane	Permissible limit 0.5	mg/L	< 0.05	< 0.05	< 0.05	< 0.05		n-Hexane Extract (Mineral	Permissible limit 0.5	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	
n-Hexane Extract (Mineral oil)	Permissible limit 5	mg/L	< 0.5	< 0.5	< 0.5	< 0.5		oil)	Permissible limit 5	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	
n-Hexane Extract (Animal								n-Hexane Extract (Animal							
and vegetable oil)	Permissible limit 30	mg/L	<1	<1	<1	<1		and vegetable oil)	Permissible limit 30	mg/L	<1	<1	<1	<1	
Nitrogen	Permissible limit 120	mg/L	2	2.3	0.7	11.1		Nitrogen	Permissible limit 120 (Daily average 60)	mg/L	2	2.3	0.7	11.1	
	(Daily average 60)														
Phosphate	Permissible limit 16 (Daily average 8)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05		Phosphate	Permissible limit 16 (Daily average 8)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	
Table II-9-2 Results of ar	-	tances, etc.	. in tanks con	ntaining ALP Area and t		vater, etc. (Part	t 2)	Table II-9-2 Results of ar	nalyses of chemical subs	stances, etc Unit	. in tanks con		PS treated wa	ater, etc. (Part 2	2)
Item	Guideline or permissible limit	Unit	K4	Н	2	G1S			permissible limit		K4	Н	[2	G1S	
	•		A			A			•		A		C	A	
Hydrogen ion	5.0 <9.0</td <td>pН</td> <td>8.3</td> <td>8.</td> <td>5</td> <td>8.3</td> <td></td> <td>Hydrogen ion</td> <td>5.0<!--<9.0</td--><td>pН</td><td>8.3</td><td>8.</td><td>.5</td><td>8.3</td><td></td></td>	pН	8.3	8.	5	8.3		Hydrogen ion	5.0 <9.0</td <td>pН</td> <td>8.3</td> <td>8.</td> <td>.5</td> <td>8.3</td> <td></td>	pН	8.3	8.	.5	8.3	
Mass of suspended solids	Permissible limit 200	mg/L	<1	<	1	<1		Mass of suspended solids	Permissible limit 200	mg/L	<1		1	<1	
(SS)	(Daily average 150)	mg/L	~1		1	~1		(SS)	(Daily average 150)	mg/L	~1	,	1	~1	
Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	0.9	1.	8	1.5		Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	0.9	1.	.8	1.5	
Boron (mg/L)	Permissible limit 230 (Sea area)	mg/L	0.4	1.	1	1.1		Boron (mg/L)	Permissible limit 230 (Sea area)	mg/L	0.4	1.	.1	1.1	
Soluble iron	Permissible limit 10	mg/L	<1	<		<1		Soluble iron	Permissible limit 10	mg/L	<1		1	<1	
Copper	Permissible limit 3	mg/L	< 0.1	<0		< 0.1		Copper	Permissible limit 3	mg/L	< 0.1	<().1	< 0.1	
Nickel	Permissible limit 2	mg/L	< 0.1	<0		< 0.1		Nickel	Permissible limit 2	mg/L	< 0.1	<(< 0.1	
Chromium	Permissible limit 2	mg/L	< 0.1	<0		< 0.1		Chromium	Permissible limit 2	mg/L	< 0.1	<(<0.1	
Zinc	Permissible limit 2	mg/L	< 0.1	<0	.1	< 0.1		Zinc	Permissible limit 2	mg/L	< 0.1	<(0.1	<0.1	
Biochemical oxygen	B : 111 11 1: 1: 1:0							Biochemical oxygen	D : 111 11 1: 1: 1:0						
demand	Permissible limit 160	mg/L	2	<	1	<1		demand	Permissible limit 160	mg/L	2	<	1	<1	
(BOD)	(Daily average 120)							(BOD)	(Daily average 120)						
Coliform count	Permissible limit Daily average 3000	Pieces/ cm <u>3</u>	0	0		0		Coliform count	Permissible limit Daily average 3000	Pieces/ cm ³	0	()	0	Appropriate description
Cadmium	Permissible limit 0.03	mg/L	< 0.01	<0.	01	< 0.01		Cadmium	Permissible limit 0.03	mg/L	< 0.01	<0	.01	< 0.01	
Cyan	Permissible limit 1	mg/L	< 0.05	<0.		< 0.05		Cyan	Permissible limit 1	mg/L	< 0.05	<0		< 0.05	
Organic phosphorus	Permissible limit 1	mg/L	<0.1	<0		<0.1		Organic phosphorus	Permissible limit 1	mg/L	<0.1	<(<0.1	
Lead	Permissible limit 0.1	mg/L	< 0.01	<0.		< 0.01		Lead	Permissible limit 0.1	mg/L	< 0.01	<0		< 0.01	
Hexavalent chromium	Permissible limit 0.5	mg/L	< 0.05	<0.	05	< 0.05		Hexavalent chromium	Permissible limit 0.5	mg/L	< 0.05	<0	.05	< 0.05	
Arsenic	Permissible limit 0.1	mg/L	< 0.01	<0.	01	< 0.01		Arsenic	Permissible limit 0.1	mg/L	< 0.01	<0	.01	< 0.01	
Mercury	Permissible limit 0.005	mg/L	< 0.0005	< 0.0	005	< 0.0005		Mercury	Permissible limit 0.005	mg/L	< 0.0005	<0.0	0005	< 0.0005	
Alkyl mercury	It should not be detected	mg/L	< 0.0005	<0.0	005	< 0.0005		Alkyl mercury	It should not be detected	mg/L	< 0.0005	<0.0	0005	< 0.0005	
Polychlorinated biphenyls	Permissible limit 0.003	mg/L	< 0.0005	< 0.0	005	< 0.0005		Polychlorinated biphenyls	Permissible limit 0.003	mg/L	< 0.0005	<0.0	0005	< 0.0005	
Trichloroethylene	Permissible limit 0.1	mg/L	< 0.03	<0.		< 0.03		Trichloroethylene	Permissible limit 0.1	mg/L	< 0.03	<0		<0.03	
Tetrachloroethylene	Permissible limit 0.1	mg/L	< 0.01	<0.		< 0.01		Tetrachloroethylene	Permissible limit 0.1	mg/L	< 0.01	<0		< 0.01	
Dichloromethane	Permissible limit 0.2	mg/L	< 0.02	<0.		< 0.02		Dichloromethane	Permissible limit 0.2	mg/L	< 0.02	<0		< 0.02	
Carbon tetrachloride	Permissible limit 0.02	mg/L	< 0.002	<0.0	002	< 0.002		Carbon tetrachloride	Permissible limit 0.02	mg/L	< 0.002	<0.	002	< 0.002	

1,2-dichloroethane

1,1-dichloroethane

1,1,1-trichloroethane

1,1,2-trichloroethane

1,3-dichloropropene

Thiuram

Simazine

Benzene

Selenium

Phenols

Fluorine

Ammonia,

compounds

compound 1,4-dioxane

n-Hexane

Nitrogen

(Mineral oil)

and vegetable oil)

and

Thiobencarb

Fenitrothion

Soluble manganese

Nitrous acid compound

Extract

nitrous

n-Hexane Extract (Animal

Cis-1, 2-dichloroethylene

		Curren	t		
1,2-dichloroethane	Permissible limit 0.04	mg/L	< 0.004	< 0.004	< 0.004
1,1-dichloroethane	Permissible limit 1	mg/L	< 0.1	< 0.1	< 0.1
Cis-1, 2-dichloroethylene	Permissible limit 0.4	mg/L	< 0.04	< 0.04	< 0.04
1,1,1-trichloroethane	Permissible limit 3	mg/L	< 0.3	< 0.3	< 0.3
1,1,2-trichloroethane	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006
1,3-dichloropropene	Permissible limit 0.02	mg/L	< 0.002	< 0.002	< 0.002
Thiuram	Permissible limit 0.06	mg/L	< 0.006	< 0.006	< 0.006
Simazine	Permissible limit 0.03	mg/L	< 0.003	< 0.003	< 0.003
Thiobencarb	Permissible limit 0.2	mg/L	< 0.02	< 0.02	< 0.02
Benzene	Permissible limit 0.1	mg/L	< 0.01	< 0.01	< 0.01
Selenium	Permissible limit 0.1	mg/L	< 0.01	< 0.01	< 0.01
Fenitrothion	Permissible limit 0.03	mg/L	< 0.003	< 0.003	< 0.003
Phenols	Permissible limit 5	mg/L	< 0.1	< 0.1	< 0.1
Fluorine	Permissible element 15 (Sea area)	mg/L	<0.5	<0.5	< 0.5
Soluble manganese	Permissible limit 10	mg/L	<1	<1	<1
Ammonia, ammonium compounds		mg/L	<1	<1	<1
Nitrous acid compound and nitrous acid compound	Permissible limit 100	mg/L	25	7	10
1,4-dioxane	Permissible limit 0.5	mg/L	< 0.05	< 0.05	< 0.05
n-Hexane Extract (Mineral oil)	Permissible limit 5	mg/L	<0.5	<0.5	<0.5
n-Hexane Extract (Animal and vegetable oil)	Permissible limit 30	mg/L	<1	<1	<1
Nitrogen	Permissible limit 120 (Daily average 60)	mg/L	24.6	7.5	10
Phosphate	Permissible limit 16 (Daily average 8)	mg/L	<0.05	<0.05	<0.05

II-7. Reason for generation of treated water to be purified

ALPS can remove the 62 nuclides subject to removal from contaminated water and make the sum of the ratios to regulatory concentrations limits less than 1 by performing treatment once, but as a result of estimation by the above-mentioned method, "treated water to be purified" of which contained radioactive material concentration is equivalent to or higher than the sum of the ratios to regulatory concentrations limits of 1 and which is to be subject to secondary treatment accounts for 70% of all water stored in the tank (about 67% as of February 2022). The following shows the reason depending on the timing of each treatment.

(Omission)

Attachment V Impacts of intake and discharge of diluted water on outside

(Omission)

Table V-2 Comparison of the exposure assessment results of representative persons (Large amount of ingestion of seafood)

		Source term of the	K4 tank group ba values	sed on measured	Source term of	f the J1-G tank g measured values		
Assessed case		Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	the port (North side of the unit 5/6 discharge (North side within the port)		Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Remarks
External	Sea surface	6.5E-09	<u>7.4E-08</u>	1.4E-07	4.7E-08	1.1E-07	<u>1.8E-07</u>	
exposure	Hull	4.8E-09	5.8E-08	1.1E-07	3.3E-08	8.7E-08	1.4E-07	
(mSv/year)	During swimming	4.5E-09	5.1E-08	9.4E-08	3.2E-08	7.9E-08	1.2E-07	
	Beach sand	7.8E-06	9.4E-05	1.7E-04	5.6E-05	1.4E-04	2.2E-04	
	Fishing net	1.6E-06	1.7E-05	3.1E-05	1.2E-05	2.7E-05	4.1E-05	
Internal	Ingestion of water	3.3E-07	7.3E-07	1.2E-06	3.2E-07	7.2E-07	1.2E-06	Value of an adult
exposure	Inhalation of spray	9.3E-08	4.1E-07	7.8E-07	4.0E-07	7.2E-07	1.1E-06	
(mSv/year)	Ingestion of seafood	6.1E-05	7.3E-05	8.4E-05	3.0E-04	3.1E-04	3.2E-04	
T	otal	7E-05	2E-04	3E-04	4E-04	5E-04	6E-04	

Phosphate Permissible limit 16 (Daily average 8) mg/L

II-7. Reason for generation of treated water to be purified

ALPS can remove the 62 nuclides subject to removal from contaminated water and make the sum of the ratios to regulatory concentrations limits of nuclides other than tritium less than 1 by performing treatment once, but as a result of estimation by the above-mentioned method, "treated water to be purified" of which contained radioactive material concentration is equivalent to or higher than the sum of the ratios to regulatory concentrations limits of 1 and which is to be subject to secondary treatment accounts for 70% of all water stored in the tank (about 67% as of February 2022). The following shows the reason depending on the timing of each treatment.

Revised

mg/L

Permissible limit 0.04

Permissible limit 1

Permissible limit 0.4

Permissible limit 3

Permissible limit 0.06

Permissible limit 0.02

Permissible limit 0.06

Permissible limit 0.03

Permissible limit 0.2

Permissible limit 0.1

Permissible limit 0.1

Permissible limit 0.03

Permissible limit 5

Permissible element 15

(Sea area)

Permissible limit 10

Permissible limit 100

Permissible limit 0.5

Permissible limit 5

Permissible limit 30

Permissible limit 120

(Daily average 60)

Permissible limit 16

< 0.004

< 0.1

< 0.04

< 0.3

< 0.006

< 0.002

< 0.006

< 0.003

< 0.02

< 0.01

< 0.01

< 0.003

< 0.1

< 0.5

<1

<1

25

< 0.05

< 0.5

<1

24.6

< 0.05

< 0.004

< 0.1

< 0.04

< 0.3

< 0.006

< 0.002

< 0.006

< 0.003

< 0.02

< 0.01

< 0.01

< 0.003

< 0.1

< 0.5

<1

<1

< 0.05

< 0.5

<1

7.5

< 0.05

< 0.004

< 0.1

< 0.04

< 0.3

< 0.006

< 0.002

< 0.006

< 0.003

< 0.02

< 0.01

< 0.01

< 0.003

< 0.1

< 0.5

<1

<1

10

< 0.05

< 0.5

<1

10

< 0.05

(Omission)

Attachment V Impacts of intake and discharge of diluted water on outside

(Omission)

Table V-2 Comparison of the exposure assessment results of representative persons (Large amount of ingestion of seafood)

		Source term of the	K4 tank group ba	sed on measured	Source term of	of the J1-G tank g	roup based on	
			values					
Asses	ssed case	Exposure assessment under normal conditions Water intake outsi the port (North side of th unit 5/6 discharge outlet)		Water intake inside the port (North side within the port)	Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Remarks
External	Sea surface	7.6E-10	6.8E-08	1.3E-07	4.8E-10	6.8E-08	1.3E-07	
exposure	Hull	7.2E-10	5.4E-08	1.0E-07	4.6E-10	5.4E-08	1.0E-07	
(mSv/year)	During swimming	5.2E-10	4.7E-08	9.0E-08	3.2E-10	4.7E-08	9.0E-08	
	Beach sand	9.1E-07	8.7E-05	1.7E-04	5.6E-07	8.6E-05	1.7E-04	
	Fishing net	1.8E-07	1.6E-05	3.0E-05	1.1E-07	1.5E-05	3.0E-05	
Internal	Ingestion of water	3.3E-07	7.3E-07	1.2E-06	3.1E-07	7.2E-07	1.2E-06	Value of an adult
exposure	Inhalation of spray	9.1E-08	4.1E-07	7.8E-07	3.8E-07	7.0E-07	1.1E-06	
(mSv/year)	Ingestion of seafood	2.0E-05	3.1E-05	4.2E-05	9.0E-06	2.0E-05	3.0E-05	
T	Total	2E-05	1E-04	2E-04	1E-05 1E-04 2E-04			

Appropriate description due to the selection of nuclides to be measured and assessed

Appropriate description due to the

selection of nuclides to be

measured and assessed

Reason for Revision

	Comparison Table of amendments in the Implementation Plan for Fukushima Daiio							ishima Daiichi N	uclear Pow	er Station	n as Specif	ied Nuclea			Attachmen	it-2, Attach	iment I-XIII and I		
				Curre									Revis					Reason for Revision	
	Table V-3			ires assessment based on measured		arge amount of the J1-G tank g	of ingestion of	seafood)		Table V-3		ernal exposu le K4 tank group b			arge amount of the J1-G tank g	of ingestion o	f seafood)		
			values Water intake outside	Water intake inside the		measured values Water intake outside	Water intake inside the					values Water intake outside	Water intake inside the		measured values Water intake outside	Water intake inside the			
Assesse	d case	Exposure assessment under	the port (North side of the unit	port (North side within the	Exposure assessment under	the port (North side of the unit	port (North side within the	Remarks	Assesse	ed case	Exposure assessment under	the port (North side of the unit	port (North side within the	Exposure assessment under	the port (North side of the unit	port (North side within the	Remarks		
Total and 1	Adult	normal conditions 3.3E-07	5/6 discharge outlet) 7.3E-07	port) 1.2E-06	normal conditions 3.2E-07	5/6 discharge outlet) 7.2E-07	port) 1.2E-06		T-+1	Adult	normal conditions 3.3E-07	5/6 discharge outlet) 7.3E-07	port) 1.2E-06	normal conditions 3.1E-07	5/6 discharge outlet) 7.2E-07	port) 1.2E-06			
Internal exposure from	Child under	5.7E-07	9.2E-07	1.4E-06	5.5E-07	9.0E-07	1.2E-06		Internal exposure from	Child under	5.7E-07	9.2E-07	1.4E-06	5.4E-07	8.7E-07	1.2E-06	1		
ingestion of water	school year	3./E-0/	9.2E-07	1.4E-00	3.3E-07	9.0E-07	1.5E-00		ingestion of water	school year	3./E-0/	9.2E-07	1.4E-00	3.4E-07	<u>8./E-0/</u>	1.3E-00			
(mSv/year)	Infant	_	_	_	_	_	_		(mSv/year)	Infant	_	_	_	_	_	_			
Internal exposure from	Adult Child under	9.3E-08	4.1E-07	7.8E-07	4.0E-07	7.2E-07	1.1E-06		Internal exposure from	Adult Child under	9.1E-08	4.1E-07	7.8E-07	3.8E-07	7.0E-07	1.1E-06	-		
inhalation of	school year	<u>6.2E-08</u>	2.8E-07	5.4E-07	2.2E-07	4.4E-07	6.9E-07		inhalation of	school year	<u>6.0E-08</u>	2.8E-07	5.4E-07	2.1E-07	4.3E-07	6.8E-07			
spray (mSv/year)	Infant	<u>4.0E-08</u>	1.5E-07	2.9E-07	<u>1.2E-07</u>	2.3E-07	3.6E-07		spray (mSv/year)	Infant	3.9E-08	1.5E-07	2.8E-07	<u>1.1E-07</u>	2.2E-07	3.6E-07			
Internal	Adult	<u>6.1E-05</u>	<u>7.3E-05</u>	8.4E-05	3.0E-04	3.1E-04	3.2E-04		Internal	Adult	2.0E-05	3.1E-05	4.2E-05	9.0E-06	2.0E-05	3.0E-05			
exposure from ingestion of	Child under school year	9.4E-05	9.9E-05	<u>1.1E-04</u>	<u>5.6E-04</u>	<u>5.6E-04</u>	<u>5.7E-04</u>		exposure from ingestion of	Child under school year	<u>2.0E-05</u>	<u>2.4E-05</u>	<u>2.8E-05</u>	<u>9.9E-06</u>	<u>1.4E-05</u>	1.8E-05			
seafood (mSv/year)	Infant	1.1E-04	1.1E-04	1.2E-04	<u>7.1E-04</u>	<u>7.1E-04</u>	7.2E-04		seafood (mSv/year)	Infant	1.2E-05	1.6E-05	2.0E-05	<u>1.1E-05</u>	1.5E-05	1.8E-05			
Attachment	VI Ti	ransfer pathy	ways and ex	posure pathw	vays other th	an the assess	sment targets		Attachment	t VI T	ransfer path	ways and exp	posure pathy	ays other th	an the assess	sment targets	S		
stage) (Novin the Safe Commissio Light Wate (hereinafter exposure pacase studies the dose assignathways and (Omission) On the other transfer patthe pathway viewpoint of Specifically assessment assessment	ember 202 ty Review n, which h r Reactor" called "R thways, as s of potenti esessment to re simulate er hand, IA hways and gys, and aft f the scale t, the trans procedure method sh	AEA GSG-14 exposure per the simuland compression and exposure per the simuland compression in this per the simuland compression and compression in this per the simuland compression in this per the simuland compression and compression in this per the simuland compression in the simuland compressio	er called "the reial Light nulating the pplication of pplication") and IAEA GS ant exposure in the safety erassessmen. O shows pate athways we lation of the hensiveness posure path nining the standard document.	ways describsuitability of	port") refers for Facilities fety guideling gnation of I precedent coeference. In the performed eactor facility dioactive manner from the again from lose, the additional fed with the fed with the fed with the fer actor facility for the performance of the performance of the fed with the fed	to "Dose Assa" approved less, (hereinaf Reprocessing ase, in the same ase, in the same ase as the examiles for power terials in liquid for transfer the viewpoind ditional path	by the form the called "Day Business of selection of sment of Light in the called the ca	to the Sea (design the General Public er Nuclear Safety ose Assessment of Rokkasho Plant, the migration and the Water Reactor," the basic concept of and the following er pathways. These aprehensiveness of xamined from the VI-1] (radiological assessed using the alts in the original	stage) (November 1988) the Safety Commission Light Water (hereinafter exposure particles the dose as pathways at (Omission) On the oth Radiological / Revised we exposure particles the simulate comprehensions specifically assessment and studied while swimmer In this revise the Safety of the simulate comprehensions of the simulate comprehen	Review of the siveness of the transprocedure method shall meds aming and sion, since of the asset of the asse	21, hereinaft of Commerce ad been form of Commerce ad been form of Commerce and been form of the publice of the publice of as the dose of exposure of exposure of exposure. See for determination of the nuclides essment in the commerce of the nuclides of the see of the commerce of the nuclides of the nu	er called "the ial Light Woulding the application for population of population of the population of the safety end assessment of the safety end again from se, the additional posure pathenining the safety end additional additional additional additional additional end additiona	thways to be ding the viewpo ional pathways describes and compared at the beach at the beach at the beach and compared at the beach and assections are the beach and assections are the beach and compared at the beach and assections are the beach are distributed as a section are the beach are distributed as a section are distributed ase	e considered that of the considered in the consumer was a were added seed in ALP	"Dose Asses approved bes, (hereinaf Reprocessing ase, in the se "Dose Asses as the examiles for power terials in liquid for transfering the sed Report" mprehensive amined from IAEA-TECE for sea dumposure assess by The exposure assess by The exposure assess treated was approved to the search of t	ssment to the by the form fter called "I g Business of selection of selection of the generation of the generation uid waste. The and expose water into the part of the part o	nto the Sea (design to General Public in the Nuclear Safety Dose Assessment of the Rokkasho Plant, the migration and ght Water Reactor," the basic concept of the part of the same pathways. The tessea (Design stage and pathways, and after int of the scale and the sinth the first report, by of drinking water the tessement using the seement using the seem	Appropriate description change of the date	for
VI-1-1. Sou Since nucli	rce term les with la	rge exposure	e impacts di	of TECDOC ffer dependir luding all the	ng on the exp		sment method	l and pathway, the	VI-1-1. Sou Since nucli	arce term des with land based on	rge exposur	e impacts di	of TECDOC ffer dependir uding all the	ng on the ex		sment metho	od and pathway, the	Appropriate description due to selection of nuclides to measured and assessed	
(8)	Since ALP		ter was dilu	ted with seav				ed into the sea and way in the report		Since ALP	S treated wa		ted with sear				ged into the sea and y in the first report	Appropriate description change of the date	for

considering that there is almost no impact of exposure from the radioactive materials diffused from
seawater to air

In TECDOC-1759, examples of a pathway <u>of migration</u> as spray from seawater and a calculation method are exemplified, so it was selected as a pathway.

Current

(9) Migration from coastal sediment to air

Since only a small amount of coastal sediment migrates to the air, and it remains on the seashore for only a short time, so the exposure impact was negligible and it was not selected as a <u>migration</u> pathway in the <u>original</u> report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was selected as a pathway.

(10) Migration from seawater to seafood

Migration (concentration) from seawater to seafood is widely known and has been assessed in domestic precedent cases including light water reactors, so it was selected in the <u>original</u> report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was also selected as a pathway.

Though the diffusion simulation uses the same calculation result as that of the report, in TECDOC-1759, the dissolved concentration $C_{DW(j)}$ is calculated considering the suspended particle concentration and migration to seabed sediment from the equilibrium concentration $C_{BOX(j)}$ of nuclide j calculated from the annual discharge amount of the nuclides discharged into the calculation area and the amount of seawater which passes through the calculation area by the following equation:

(Omission)

$$C_{EB}(j,k) = CF(j,k)C_{DW}(j)$$
 (VI-11)

where

CF(j,k) is the concentration factor for nuclide j of seafood k ((Bq/kg)/(Bq/L)).

C_{DW}(j) is the dissolved concentration of radionuclide j in the seawater (Bq/m³) and is calculated by equation (VI-1).

(Omission)

Table VI-1 Dose conversion factor for the effective dose from radiation from beach sand (Source: U.S. EPA FGR15)

Nuclide	Dose conversion factor for the effective dose	Remarks
	$((Sv/s)/(Bq/m^2))$	
H-3	6.7E-22	
C-14	6.1E-19	
Mn-54	5.3E-16	
<u>Fe-59</u>	<u>7.3E-16</u>	<u>—</u>
<u>Co-58</u>	<u>6.2E-16</u>	_
Co-60	1.5E-15	
Ni-63	8.0E-20	
<u>Zn-65</u>	<u>3.6E-16</u>	_
<u>Rb-86</u>	<u>1.6E-16</u>	_
<u>Sr-89</u>	<u>8.9E-17</u>	_
Sr-90	6.5E-18	
Y-90	1.5E-16	
<u>Y-91</u>	9.4E-17	_

considering that there is almost no impact of exposure from the radioactive materials diffused from seawater to air.

In TECDOC-1759, examples of a <u>transfer</u> pathway as spray from seawater and a calculation method are exemplified, so it was selected as a pathway.

As a result of this review, it was added as a transition/exposure pathway in the revised report.

Revised

(9) Migration from coastal sediment to air

Since only a small amount of coastal sediment migrates to the air, and it remains on the seashore for only a short time, so the exposure impact was negligible, and it was not selected as a <u>transfer</u> pathway in the <u>first</u> report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was selected as a pathway.

As a result of this review, it was added as a transition/exposure pathway in the revised report.

(10) Migration from seawater to seafood

Migration (concentration) from seawater to seafood is widely known and has been assessed in domestic precedent cases including light water reactors, so it was selected in the <u>first</u> report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was also selected as a pathway.

Though the diffusion simulation uses the same calculation result as that of the first report, in TECDOC-1759, the dissolved concentration $C_{DW(j)}$ is calculated considering the suspended particle concentration and migration to seabed sediment from the equilibrium concentration $C_{BOX(j)}$ of nuclide j calculated from the annual discharge amount of the nuclides discharged into the calculation area and the amount of seawater which passes through the calculation area by the following equation:

(Omission)

$$C_{EB}(j,k) = CF(j,k)C_{DW}(j) \cdot 1E-03$$

(VI-11)

Appropriate description

Reason for Revision

Appropriate description

change of the date

where

CF(j,k) is the concentration factor for nuclide j of seafood k ((Bq/kg)/(Bq/L)).

C_{DW}(j) is the dissolved concentration of radionuclide j in the seawater (Bq/m³) and is calculated by equation (VI-1). 1E-03 is unit conversion (m³ /L)

(Omission)

Table VI-1 Dose conversion factor for the effective dose from radiation from beach sand (Source: U.S. EPA FGR15)

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m²))	Remarks
H-3	6.7E-22	
C-14	6.1E-19	
Mn-54	5.3E-16	
Co-60	1.5E-15	
Ni-63	8.0E-20	
<u>Se-79</u>	<u>6.8E-19</u>	_
Sr-90	6.5E-18	
Y-90	1.5E-16	
Tc-99	2.0E-18	
Ru-106	1.7E-20	
Cd-113m	6.3E-18	
Sb-125	2.7E-16	
Te-125m	4.1E-18	

Appropriate description due to the selection of nuclides to be measured and assessed

Nb-95 Tc-99 2.0E-18	_	I-129	I	
		1-129	4.4E-18	Appropriate description due to the
2.27		Cs-134	1.0E-15	selection of nuclides to be measured and assessed
<u>Ru-103</u> <u>3.2E-16</u>	_	Cs-137	7.9E-18	incasured and assessed
Ru-106 1.7E-20		Ce-144	1.1E-17	
<u>Rh-103m</u> <u>4.3E-20</u>	_	Pm-147	9.4E-19	
<u>Rh-106</u> 3.4E-16	_	Sm-151	1.1E-19	
<u>Ag-110m</u> <u>1.7E-15</u>	_	Eu-154	7.9E-16	
Cd-113m 6.3E-18		Eu-155	3.1E-17	
<u>Cd-115m</u> <u>1.1E-16</u>	_	<u>U-234</u>	1.2E-15 —	
<u>Sn-119m</u> <u>9.6E-19</u>	_	<u>U-238</u>	1.4E-15 —	
<u>Sn-123</u> <u>8.1E-17</u>	_	Np-237	1.8E-15 —	
<u>Sn-126</u> <u>1.1E-15</u>	Sb-126m is considered	Pu-238	2.1E-20	
<u>Sb-124</u> <u>1.2E-15</u>	_	Pu-239	4.2E-20	
Sb-125 2.7E-16		Pu-240	2.2E-20	
<u>Te-123m</u> <u>7.7E-17</u>	_	Pu-241	1.7E-21	
Te-125m 4.1E-18		Am-241	9.9E-18	
<u>Te-127</u> <u>1.5E-17</u>	_	Cm-243	7.1E-17	
<u>Te-127m</u> <u>1.7E-18</u>	<u>Te-127 is considered</u>	Cm-244	3.1E-20	
<u>Te-129</u> <u>1.1E-16</u>	_			
<u>Te-129m</u> <u>5.1E-17</u>	<u>Te-129 is considered</u>			
I-129 4.4E-18				
Cs-134 1.0E-15				
<u>Cs-135</u> <u>1.6E-18</u>	_			
<u>Cs-136</u> <u>1.3E-15</u>	_			
Cs-137 7.9E-18				
<u>Ba-137m</u> <u>3.9E-16</u>	_			
<u>Ba-140</u> <u>1.6E-15</u>	<u>La-140 is considered</u>			
<u>Ce-141</u> 4.5E-17	_			
Ce-144 1.1E-17				
<u>Pr-144</u> <u>2.0E-16</u>	_			
<u>Pr-144m</u> 3.5E-18	<u> </u>			
<u>Pm-146</u> 4.8E-16	_			
Pm-147 9.4E-19				
<u>Pm-148</u> <u>4.6E-16</u>	_			
<u>Pm-148m</u> <u>1.3E-15</u>				
Sm-151 1.1E-19				
<u>Eu-152</u> 7.2E-16	<u> </u>			
Eu-154 7.9E-16				
Eu-155 3.1E-17				
<u>Gd-153</u> <u>4.3E-17</u>	<u> </u>			
<u>Tb-160</u>	<u> </u>			
Pu-238 2.1E-20				

•	Cui	rent
Pu-239	4.2E-20	
Pu-240	2.2E-20	
Pu-241	1.7E-21	
Am-241	9.9E-18	
<u>Am-242m</u>	<u>1.4E-17</u>	Am-242 is considered
<u>Am-243</u>	<u>1.3E-16</u>	Np-239 is considered
<u>Cm-242</u>	<u>2.6E-20</u>	_
Cm-243	7.1E-17	
Cm-244	3.1E-20	

Table VI-2 Committed effective dose per unit intake for ingestion (Source: IAEA GSR-Part3)

	Ef	fective dose factive (Sv/Bq)	tor		
Target Nuclide	Adult	Child under school age	Infant	Remarks	
H-3 (THO)	1.8E-11	3.1E-11	6.4E-11	Used for the assessment of ingestion of water	
H-3 (considering OBT)	2.0E-11	3.5E-11	7.0E-11	Used for the assessment of ingestion of seafood assuming that 10% of tritium to be ingested is OBT	
C-14	5.8E-10	9.9E-10	1.4E-09		
Mn-54	7.1E-10	1.9E-09	5.4E-09		
<u>Fe-59</u>	1.8E-09	7.5E-09	3.9E-08	_	
<u>Co-58</u>	<u>7.4E-10</u>	2.6E-09	7.3E-09	_	
Co-60	3.4E-09	1.7E-08	5.4E-08		
Ni-63	1.5E-10	4.6E-10	1.6E-09		
<u>Zn-65</u>	3.9E-09	9.7E-09	3.6E-08	_	
<u>Rb-86</u>	2.8E-09	9.9E-09	3.1E-08	_	
<u>Sr-89</u>	2.6E-09	8.9E-09	3.6E-08	_	
Sr-90	2.8E-08	4.7E-08	2.3E-07	Including the impact of the progeny nuclide	
Y-90	2.7E-09	1.0E-08	3.1E-08		
<u>Y-91</u>	<u>2.4E-09</u>	<u>8.8E-09</u>	2.8E-08	_	
<u>Nb-95</u>	<u>5.8E-10</u>	1.8E-09	4.6E-09	_	
Tc-99	6.4E-10	2.3E-09	1.0E-08		
<u>Ru-103</u>	<u>7.3E-10</u>	<u>2.4E-09</u>	<u>7.1E-09</u>	Including the impact of the progeny nuclide	
Ru-106	7.0E-09	2.5E-08	8.4E-08	Including the impact of the progeny nuclide	
<u>Rh-103m</u>	3.8E-12	<u>1.3E-11</u>	<u>4.7E-11</u>		
<u>Rh-106</u>	_	_	_	Independent intake is not considered because the half-life is short enough (about 30 seconds).	
<u>Ag-110m</u>	<u>2.8E-09</u>	<u>7.8E-09</u>	<u>2.4E-08</u>		
Cd-113m	2.3E-08	3.9E-08	1.2E-07		
<u>Cd-115m</u>	<u>3.3E-09</u>	<u>9.7E-09</u>	<u>4.1E-08</u>	_	

Table VI-2 Committed effective dose per unit intake for ingestion (Source: IAEA GSR-Part3)

Revised

	Ef	fective dose fac (Sv/Bq)	tor	Remarks	
Target Nuclide	Adult	Child under school age	Infant		
H-3 (THO)	1.8E-11	3.1E-11	6.4E-11	Used for the assessment of ingestion of water	
H-3 (considering OBT)	2.0E-11	3.5E-11	7.0E-11	Used for the assessment of ingestion of seafood assuming that 10% of tritium to be ingested is OBT	
C-14	5.8E-10	9.9E-10	1.4E-09		
Mn-54	7.1E-10	1.9E-09	5.4E-09		
Co-60	3.4E-09	1.7E-08	5.4E-08		
Ni-63	1.5E-10	4.6E-10	1.6E-09		
<u>Se-79</u>	2.9E-09	1.9E-08	4.1E-08	_	
Sr-90	2.8E-08	4.7E-08	2.3E-07		
Y-90	2.7E-09	1.0E-08	3.1E-08		
Tc-99	6.4E-10	2.3E-09	1.0E-08		
Ru-106	7.0E-09	2.5E-08	8.4E-08		
Cd-113m	2.3E-08	3.9E-08	1.2E-07	Including the impact of the progeny nuclide	
Sb-125	1.1E-09	3.4E-09	1.1E-08		
Te-125m	8.7E-10	3.3E-09	1.3E-08		
I-129	1.1E-07	1.7E-07	1.8E-07		
Cs-134	1.9E-08	1.3E-08	2.6E-08		
Cs-137	1.3E-08	9.6E-09	2.1E-08	Including the impact of the progeny nuclide	
Ce-144	5.2E-09	1.9E-08	6.6E-08	Including the impact of the progeny nuclide	
Pm-147	2.6E-10	9.6E-10	3.6E-09		
Sm-151	9.8E-11	3.3E-10	1.5E-09	Independent intake is not considered because the half-life is short enough (about 30 seconds).	
Eu-154	2.0E-09	6.5E-09	2.5E-08		
Eu-155	3.2E-10	1.1E-09	4.3E-09		
<u>U-234</u>	4.9E-08	8.8E-08	3.7E-07	_	
<u>U-238</u>	4.5E-08	8.0E-08	3.4E-07	_	
<u>Np-237</u>	1.1E-07	1.4E-07	2.0E-06	_	

The Japanese version shall prevail.

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

	Comparison Table of amendments in the implementation Fian for Fukusinina Dancin Nuc				Revised					Reason for Revision	
<u>Sn-119m</u>	3.4E-10	1.3E-09	4.1E-09	_		Pu-238	2.3E-07	3.1E-07	4.0E-06		Appropriate description due to the
<u>Sn-123</u>	2.1E-09	7.8E-09	2.5E-08	_		Pu-239	2.5E-07	3.3E-07	4.2E-06		selection of nuclides to be measured and assessed
<u>Sn-126</u>	4.7E-09	1.6E-08	5.0E-08	_		Pu-240	2.5E-07	3.3E-07	4.2E-06		incasured and assessed
<u>Sb-124</u>	2.5E-09	8.4E-09	2.5E-08	_		Pu-241	4.8E-09	5.5E-09	5.6E-08		
Sb-125	1.1E-09	3.4E-09	1.1E-08			Am-241	2.0E-07	2.7E-07	3.7E-06		
<u>Te-123m</u>	1.4E-09	4.9E-09	1.9E-08	_		Cm-243	1.5E-07	2.2E-07	3.2E-06		
Te-125m	8.7E-10	3.3E-09	1.3E-08			Cm-244	1.2E-07	1.9E-07	2.9E-06		
<u>Te-127</u>	1.7E-10	6.2E-10	1.5E-09	_							
<u>Te-127m</u>	2.3E-09	9.5E-09	<u>4.1E-08</u>	_							
<u>Te-129</u>	<u>6.3E-11</u>	2.1E-10	<u>7.5E-10</u>	_							
<u>Te-129m</u>	3.0E-09	<u>1.2E-08</u>	<u>4.4E-08</u>	Including the impact of the progeny nuclide							
I-129	1.1E-07	1.7E-07	1.8E-07								
Cs-134	1.9E-08	1.3E-08	2.6E-08								
<u>Cs-135</u>	2.0E-09	<u>1.7E-09</u>	<u>4.1E-09</u>	_							
<u>Cs-136</u>	3.0E-09	<u>6.1E-09</u>	1.5E-08	_							
Cs-137	1.3E-08	9.6E-09	2.1E-08	Including the impact of the progeny nuclide							
<u>Ba-137m</u>	_	_	_	Independent intake is not considered because the half-life is short enough (about 2.6 minutes).							
<u>Ba-140</u>	2.6E-09	9.2E-09	3.2E-08	_							
<u>Ce-141</u>	<u>7.1E-10</u>	2.6E-09	<u>8.1E-09</u>	_							
Ce-144	5.2E-09	1.9E-08	6.6E-08	Including the impact of the progeny nuclide							
<u>Pr-144</u>	5.0E-11	1.7E-10	<u>6.4E-10</u>	_							
<u>Pr-144m</u>	_	_	_	Independent intake is not considered because the half-life is short enough (about 7.2 minutes).							
<u>Pm-146</u>	9.0E-10	2.8E-09	1.0E-08	_							
Pm-147	2.6E-10	9.6E-10	3.6E-09								
<u>Pm-148</u>	2.7E-09	9.7E-09	3.0E-08	_							
<u>Pm-148m</u>	<u>1.7E-09</u>	<u>5.5E-09</u>	<u>1.5E-08</u>	_							
Sm-151	9.8E-11	3.3E-10	1.5E-09								
<u>Eu-152</u>	<u>1.4E-09</u>	<u>4.1E-09</u>	<u>1.6E-08</u>	_							
Eu-154	2.0E-09	6.5E-09	2.5E-08								
Eu-155	3.2E-10	1.1E-09	4.3E-09								
<u>Gd-153</u>	2.7E-10	<u>9.4E-10</u>	2.9E-09	_							
<u>Tb-160</u>	<u>1.6E-09</u>	<u>5.4E-09</u>	<u>1.6E-08</u>	_							
Pu-238	2.3E-07	3.1E-07	4.0E-06								
Pu-239	2.5E-07	3.3E-07	4.2E-06								
Pu-240	2.5E-07	3.3E-07	4.2E-06								
Pu-241	4.8E-09	5.5E-09	5.6E-08								
Am-241	2.0E-07	2.7E-07	3.7E-06								
<u>Am-242m</u>	<u>1.9E-07</u>	<u>2.3E-07</u>	3.1E-06	_							
<u>Am-243</u>	2.0E-07	<u>2.7E-07</u>	3.6E-06	_							

							Revised		Reason for Revision	
<u>Cm-242</u>	1.2E-08	3.9E-08	5.9E-07	_						Appropriate description due to the
Cm-243	1.5E-07	2.2E-07	3.2E-06							selection of nuclides to be measured and assessed
Cm-244	1.2E-07	1.9E-07	2.9E-06							111011011101111111111111111111111111111
Table VI-3 C	ommitted effect	tive dose per un	it intake fron	n inhalation (Source: IAEA GSR-Part3)	Table VI-3 Co	ommitted effec	tive dose per ur	nit intake fron	n inhalation (Source: IAEA GSR-Part3)	
	Effecti	ve dose factor ((Sv/Bq)			Effectiv	re dose factor	(Sv/Bq)		
Target Nuclide	Adult	Child under school age	Infant	Remarks	Target Nuclide	Adult	Child under school age	Infant	Remarks	
H-3	1.8E-11	3.1E-11	6.4E-11	The conversion factor of tritium vapor is used	H-3	1.8E-11	3.1E-11	6.4E-11	The conversion factor of tritium vapor is used	
C-14	5.8E-09	1.1E-08	1.9E-08		C-14	5.8E-09	1.1E-08	1.9E-08		
Mn-54	1.5E-09	3.8E-09	7.5E-09		Mn-54	1.5E-09	3.8E-09	7.5E-09		
<u>Fe-59</u>	4.0E-09	<u>8.1E-09</u>	2.1E-08	_	Co-60	3.1E-08	5.9E-08	9.2E-08		
<u>Co-58</u>	2.1E-09	4.5E-09	9.0E-09	_	Ni-63	1.3E-09	2.7E-09	4.8E-09		
Co-60	3.1E-08	5.9E-08	9.2E-08		<u>Se-79</u>	<u>6.8E-09</u>	1.3E-08	<u>2.3E-08</u>	_	
Ni-63	1.3E-09	2.7E-09	4.8E-09		Sr-90	1.6E-07	2.7E-07	4.2E-07		
<u>Zn-65</u>	2.2E-09	<u>5.7E-09</u>	1.5E-08	_	Y-90	1.5E-09	4.2E-09	1.3E-08		
<u>Rb-86</u>	9.3E-10	3.4E-09	1.2E-08	_	Tc-99	1.3E-08	2.4E-08	4.1E-08		
<u>Sr-89</u>	7.9E-09	1.7E-08	3.9E-08	_	Ru-106	6.6E-08	1.4E-07	2.6E-07		
Sr-90	1.6E-07	2.7E-07	4.2E-07	Including the impact of the progeny	Cd-113m	1.1E-07	1.8E-07	3.0E-07		
Y-90				nuclide	Sb-125	1.2E-08	2.4E-08	4.2E-08		
	1.5E-09	4.2E-09	1.3E-08		Te-125m	4.2E-09	7.8E-09	1.7E-08		
<u>Y-91</u>	8.9E-09	1.9E-08	4.3E-08	_	I-129	3.6E-08	6.1E-08	7.2E-08		
Nb-95 Tc-99	1.8E-09	3.6E-09	7.7E-09	_	Cs-134	2.0E-08	4.1E-08	7.0E-08		
	1.3E-08	2.4E-08	4.1E-08	Including the impact of the progeny	Cs-137	3.9E-08	7.0E-08	1.1E-07		
<u>Ru-103</u>	3.0E-09	<u>6.0E-09</u>	<u>1.3E-08</u>	nuclide	Ce-144	5.3E-08	1.4E-07	3.6E-07		
Ru-106	6.6E-08	1.4E-07	2.6E-07	Including the impact of the progeny	Pm-147	5.0E-09	1.1E-08	2.1E-08		
				nuclide	Sm-151	4.0E-09	6.7E-09	1.1E-08		
<u>Rh-103m</u>	2.7E-12	<u>6.7E-12</u>	2.0E-11		Eu-154	5.3E-08	9.7E-08	1.6E-07		
<u>Rh-106</u>		_	_	Independent intake is not considered because the half-life is short enough	Eu-155	6.9E-09	1.4E-08	2.6E-08		
<u>KII-100</u>	_	_	=	(about 30 seconds).	<u>U-234</u>	<u>9.4E-06</u>	<u>1.9E-05</u>	<u>3.3E-05</u>	_	
<u>Ag-110m</u>	1.2E-08	2.6E-08	4.6E-08		<u>U-238</u>	<u>8.0E-06</u>	<u>1.6E-05</u>	2.9E-05	_	
Cd-113m	1.1E-07	1.8E-07	3.0E-07		<u>Np-237</u>	<u>5.0E-05</u>	6.0E-05	<u>9.8E-05</u>	_	
<u>Cd-115m</u>	7.7E-09	1.7E-08	4.6E-08	_	Pu-238	1.1E-04	1.4E-04	2.0E-04		
<u>Sn-119m</u>	2.2E-09	4.7E-09	1.0E-08	_	Pu-239	1.2E-04	1.5E-04	2.1E-04		
<u>Sn-123</u>	8.1E-09	1.8E-08	4.0E-08		Pu-240	1.2E-04	1.5E-04	2.1E-04		
<u>Sn-126</u>	2.8E-08	6.2E-07	1.2E-07	_	Pu-241	2.3E-06	2.6E-06	2.8E-06		
<u>Sb-124</u>	8.6E-09	1.8E-08	3.9E-08	_	Am-241	9.6E-05	1.2E-04	1.8E-04		
Sb-125	1.2E-08	2.4E-08	4.2E-08		Cm-243	6.9E-05	9.5E-05	1.6E-04		
<u>Te-123m</u>	<u>5.1E-09</u>	9.8E-09	2.0E-08	_	Cm-244	5.7E-05	8.3E-05	1.5E-04		
Te-125m	4.2E-09	7.8E-09	1.7E-08							

1			Current		Revised	Reason for Revision
<u>Te-127</u>	<u>1.4E-10</u>	3.9E-10	<u>1.2E-09</u>	_		Appropriate description due to the
<u>Te-127m</u>	9.8E-09	2.0E-08	4.1E-08	_		selection of nuclides to measured and assessed
<u>Te-129</u>	3.9E-11	1.0E-10	3.5E-10			incasured and assessed
<u>Te-129m</u>	7.9E-09	1.7E-08	3.8E-08	Including the impact of the progeny nuclide		
I-129	3.6E-08	6.1E-08	7.2E-08			
Cs-134	2.0E-08	4.1E-08	7.0E-08			
<u>Cs-135</u>	<u>8.6E-09</u>	1.6E-08	<u>2.7E-08</u>	_		
<u>Cs-136</u>	<u>2.8E-09</u>	<u>6.0E-09</u>	<u>1.5E-08</u>	_		
Cs-137	3.9E-08	7.0E-08	1.1E-07	Including the impact of the progeny nuclide		
<u>Ba-137m</u>	_	=	=	Independent intake is not considered because the half-life is short enough (about 2.6 minutes).		
<u>Ba-140</u>	<u>5.8E-09</u>	1.2E-08	2.9E-08	_		
<u>Ce-141</u>	3.8E-09	<u>7.1E-09</u>	1.6E-08	_		
Ce-144	<u>5.3E-08</u>	1.4E-07	3.6E-07	Including the impact of the progeny nuclide		
<u>Pr-144</u>	<u>1.8E-11</u>	<u>5.2E-11</u>	<u>1.9E-10</u>			
<u>Pr-144m</u>	_	=	=	Independent intake is not considered because the half-life is short enough (about 7.2 minutes).		
<u>Pm-146</u>	<u>2.1E-08</u>	3.9E-08	6.4E-08	_		
Pm-147	5.0E-09	1.1E-08	2.1E-08			
<u>Pm-148</u>	<u>2.2E-09</u>	<u>5.5E-09</u>	<u>1.5E-08</u>	_		
<u>Pm-148m</u>	<u>5.7E-09</u>	<u>1.2E-08</u>	<u>2.5E-08</u>	_		
Sm-151	4.0E-09	6.7E-09	1.1E-08			
<u>Eu-152</u>	<u>4.2E-08</u>	<u>7.0E-08</u>	<u>1.1E-07</u>	_		
Eu-154	5.3E-08	9.7E-08	1.6E-07			
Eu-155	6.9E-09	1.4E-08	2.6E-08			
<u>Gd-153</u>	<u>2.1E-09</u>	<u>6.5E-09</u>	<u>1.5E-08</u>	_		
<u>Tb-160</u>	<u>7.0E-09</u>	<u>1.5E-08</u>	3.2E-08	_		
Pu-238	1.1E-04	1.4E-04	2.0E-04			
Pu-239	1.2E-04	1.5E-04	2.1E-04			
Pu-240	1.2E-04	1.5E-04	2.1E-04			
Pu-241	2.3E-06	2.6E-06	2.8E-06			
Am-241	9.6E-05	1.2E-04	1.8E-04			
<u>Am-242m</u>	<u>9.2E-05</u>	<u>1.1E-04</u>	<u>1.6E-04</u>	_		
<u>Am-243</u>	<u>9.6E-05</u>	<u>1.2E-04</u>	<u>1.8E-04</u>	_		
<u>Cm-242</u>	<u>5.9E-06</u>	<u>1.2E-05</u>	2.7E-05	_		
Cm-243	6.9E-05	9.5E-05	1.6E-04			
Cm-244	5.7E-05	8.3E-05	1.5E-04			
	VI-4 Skin equi	valent dose co	onversion fact	ors (β and γ emitting nuclides)	Table VI-4 Skin equivalent dose conversion factors (β and γ emitting nuclides)	

	Current		Revised	Reason for Revision
Nuclide	Skin equivalent dose conversion factors ((Sv/year)/(Bq/cm²))	Remarks	Nuclide Skin equivalent dose conversion factors ((Sv/year)/(Bq/cm²))	
H-3	0.0E+00		H-3 0.0E+00	
C-14	7.9E-03		C-14 7.9E-03	
Mn-54	5.3E-04		Mn-54 5.3E-04	
<u>Fe-59</u>	1.8E-02	_	Co-60 1.7E-02	Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	4.2E-03	_	Ni-63 1.6E-04	measured and assessed
Co-60	1.7E-02		Se-79 1.0E-02 —	
Ni-63	1.6E-04		Sr-90 4.5E-02	
<u>Zn-65</u>	<u>7.7E-04</u>	_	Y-90 2.4E-02	
<u>Rb-86</u>	2.3E-02	_	Te-99 1.4E-02	
<u>Sr-89</u>	2.3E-02	_	Ru-106 2.5E-02	
Sr-90	4.5E-02		Cd-113m 2.0E-02	
Y-90	2.4E-02		Sb-125 1.8E-02	
<u>Y-91</u>	2.3E-02	_	Te-125m 2.6E-02	
<u>Nb-95</u>	<u>6.4E-03</u>	_	I-129 5.8E-03	
Tc-99	1.4E-02		Cs-134 1.7E-02	
<u>Ru-103</u>	<u>1.1E-02</u>	_	Cs-137 2.2E-02	
Ru-106	2.5E-02		Ce-144 3.9E-02	
<u>Rh-103m</u>	<u>1.4E-05</u>	_	Pm-147 1.1E-02	
<u>Rh-106</u>	<u>0.0E+00</u>	_	Sm-151 2.5E-04	
<u>Ag-110m</u>	<u>8.5E-03</u>	_	Eu-154 3.1E-02	
Cd-113m	2.0E-02		Eu-155 7.6E-03	
<u>Cd-115m</u>	<u>2.3E-02</u>	_	<u>U-234</u> 3.7E-02 —	
<u>Sn-119m</u>	<u>0.0E+00</u>	_	<u>U-238</u> <u>3.7E-02</u> —	
<u>Sn-123</u>	<u>0.0E+00</u>	_	Np-237 3.1E-02 —	
<u>Sn-126</u>	<u>1.6E-02</u>	_	Pu-238 9.5E-04	
<u>Sb-124</u>	<u>2.2E-02</u>	_	Pu-239 1.3E-05	
Sb-125	1.8E-02		Pu-240 9.1E-07	
<u>Te-123m</u>	2.0E-02	_	Pu-241 1.4E-08	
Te-125m	2.6E-02		Am-241 6.3E-04	
<u>Te-127</u>	<u>2.1E-02</u>	_	Cm-243 1.7E-02	
<u>Te-127m</u>	<u>3.7E-02</u>	_	Cm-244 1.9E-05	
<u>Te-129</u>	<u>2.3E-02</u>	_		
<u>Te-129m</u>	<u>3.7E-02</u>	_		
I-129	5.8E-03			
Cs-134	1.7E-02			
<u>Cs-135</u>	9.6E-03	_		
<u>Cs-136</u>	<u>2.1E-02</u>	_		
Cs-137	2.2E-02			
<u>Ba-137m</u>	<u>0.0E+00</u>	_		
<u>Ba-140</u>	<u>5.3E-02</u>	_		

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment I-XIII and Reference A-G)

Comparison	•	lementation Plan for Fukushima Daiichi N	Nuclear Power S	tation as Spec	atted Nuclear Fa	•	e, Attachment-2, Attachment I-XIII and	
	Current					Revised		Reason for Revision
<u>Ce-141</u>	<u>2.5E-02</u>							Appropriate description due to the selection of nuclides to be
Ce-144	3.9E-02							measured and assessed
<u>Pr-144</u>	<u>0.0E+00</u>	<u> </u>						
<u>Pr-144m</u>	<u>0.0E+00</u>	<u> </u>						
<u>Pm-146</u>	<u>0.0E+00</u>	<u> </u>						
Pm-147	1.1E-02							
<u>Pm-148</u>	<u>0.0E+00</u>	<u> </u>						
<u>Pm-148m</u>	<u>0.0E+00</u>	_						
Sm-151	2.5E-04							
<u>Eu-152</u>	<u>1.5E-02</u>	_						
Eu-154	3.1E-02							
Eu-155	7.6E-03							
<u>Gd-153</u>	<u>3.6E-03</u>							
<u>Tb-160</u>	3.1E-02	_						
Pu-238	9.5E-04							
Pu-239	1.3E-05							
Pu-240	9.1E-07							
Pu-241	1.4E-08							
Am-241	6.3E-04							
<u>Am-242m</u>	<u>1.7E-02</u>	_						
<u>Am-243</u>	3.7E-02	_						
<u>Cm-242</u>	<u>2.1E-05</u>	_						
Cm-243	1.7E-02							
Cm-244	1.9E-05							
(0 : :)								
(Omission)			(Omission)					
VI-2. Exposure assessment re					1.			
The source terms of the follocompared with the results in the	wing three cases were assessed by the original report	the assessment method of TECDOC-1759 and	VI-2. Exposure			ere assessed by the	e assessment method of TECDOC-1759 and	1
		entration limits of <u>63</u> nuclides other than	compared with the	he results in <u>the</u>	body of the repor	t.		
tritium: <u>0.29</u>)				(4 tank group (5 itium: 0.28)	Sum of the ratios to	regulatory concen	tration limits of 30 nuclides other than	Appropriate description for change of the date and due to the
ii. J1-C tank group tritium: 0.35)	o (Sum of the ratios to regulatory con-	centration limits of 63 nuclides other than			(Sum of the ratios	to regulatory conce	entration limits of 30 nuclides other than	selection of nuclides to be
	p (Sum of the ratios to regulatory con-	centration limits of 63 nuclides other than	tr	itium: <u>0.23</u>)				measured and assessed
tritium: <u>0.22</u>)				l-G tank group itium: <u>0.12</u>)	(Sum of the ratios	to regulatory conce	entration limits of 30 nuclides other than	
The results of the comparison	are shown in Table VI-6(1) to (3).			(0.12)				
Regardless of the source term,	none of the assessment results exceed	ded the exposure from the ingestion of seafood,	,		re shown in Table			
fishing nets, and beach sand in	the <u>original</u> report. <u>However, because</u>	se the exposure from ingestion of seawater and surface, etc. described in the original report, it			one of the assessm the body of the rep		ed the exposure from the ingestion of seafood	,
	additional pathways for this report as				200 000) 01 010 10p			
		s by the source term of the K4 tank group	Table VI-60	1) Comparison	of the exposure a	ssessment results	by the source term of the K4 tank group	
1401C V1=0(1) Companso.	ii or the exposure assessment results	s by the source term of the K4 tank group	14010 11 0(., comparison		September 105uits	by the bourse term of the fr turn group	
Assessed case	Original report TECDOC-1759	Remarks	Assesse	ed case	The body of the report	TECDOC-1759	Remarks	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

			Current					Revised		Reason for Revision
	Exposure from sea surface	6.5E-09	Not to be assessed			Exposure from sea surface	7.6E-10	Not to be assessed		Appropriate description for change of the date and due to the selection of nuclides to be
	Exposure from hulls	4.8E-09	Not to be assessed			Exposure from hulls	7.2E-10	Not to be assessed		measured and assessed
External exposure	Exposure during swimming	4.5E-09	Not to be assessed		External exposure	Exposure during swimming	5.2E-10	Not to be assessed		
(mSv/year)	Exposure from beach sand	7.8E-06	4.0E-07	In the assessment of the <u>original</u> report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.	(mSv/year)	Exposure from beach sand	9.1E-07	1.3E-07	In the assessment of the body of the report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.	
	Exposure from fishing nets	<u>1.6E-06</u>	Not to be assessed			Exposure from fishing nets	<u>1.8E-07</u>	Not to be assessed		
	Ingestion of coastal sediment	Not to be assessed	7.8E-10			Ingestion of coastal sediment	Not to be assessed	6.2E-10		
Internal	Ingestion of seawater	Not to be assessed	3.3E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium.	Internal	Ingestion of seawater	3.3E-07	3.3E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium and the result is not changed.	
exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	<u>5.1E-12</u>		exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	4.5E-12		
	Inhalation of seawater spray	Not to be assessed	7.7E-08			Inhalation of seawater spray	9.1E-08	7.7E-08		
	Ingestion of seafood	6.1E-05	1.6E-05	In the assessment of the <u>original</u> report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.		Ingestion of seafood	2.0E-05	1.6E-05	In the assessment of the body of the original report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.	
Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	1.5E-09		Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	1.6E-10		
	Total Sv/year)	<u>7E-05</u>	2E-05			Total nSv/year)	<u>2E-05</u>	2E-05		
	6(2) Comparison essed case	of the exposure as Original report	TECDOC-1759	y the source term of the J1-C tank group Remarks		6(2) Comparison essed case	of the exposure as The body of the report	TECDOC-1759	by the source term of the J1-C tank group Remarks	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

ot to be assessed				1	1		
			Exposure from sea surface	<u>2.3E-10</u>	Not to be assessed		Appropriate description for change of the date and due to the selection of nuclides to be
lot to be assessed			Exposure from hulls	2.2E-10	Not to be assessed		measured and assessed
ot to be assessed		External exposure	Exposure during swimming	1.6E-10	Not to be assessed		
2.1E-07 wo	onservative dose conversion factors vere used for external exposures, and herefore the results are considered to be	(mSv/year)	Exposure from beach sand	2.7E-07		In the assessment of the body of the report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.	
lot to be assessed			Exposure from fishing nets	<u>5.3E-08</u>	Not to be assessed		
<u>6.6E-10</u>			Ingestion of coastal sediment	Not to be assessed	3.3E-10		
3.1E-07 cc af ex	vater before dilution, of which oncentration exceed the regulatory oncentration limit, has higher oncentration than the other nuclides fter discharge into the sea as well, the xposure through accidently ingestion	Internal	Ingestion of seawater	3.1E-07		after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by	
4.2E-11		exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	3.7E-11		
<u>7.5E-08</u>			Inhalation of seawater spray	1.9E-07	<u>8.1E-08</u>		
2.9E-06 that su se	ne concentration in seafood was ssessed using conservative oncentrations in seawater rather than aking into account adhesion to uspended particles and sea seabed ediment. Therefore, the assessment		Ingestion of seafood	<u>4.5E-06</u>	2.7E-06	In the assessment of the body of the report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.	
2.2E-09		Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	2.3E-10		
3E-06				<u>5E-06</u>	3E-06		
ssment results by t	the source term of the J1-G tank group	Table VI-6	6(3) Comparison	of the exposure as	sessment results b	y the source term of the J1-G tank grou	пр
TECDOC-1759	Remarks	Asso	essed case	The body of the report	TECDOC-1759	Remarks	
s	2.1E-07 with control of the series of the sesses of the se	In the assessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium. 4.2E-11 7.5E-08 In the assessment of the original report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative. 2.2E-09 3E-06 sment results by the source term of the J1-G tank group	In the assessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium. 4.2E-11 In the assessment of the original report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative. 2.2E-09 3E-06 Table VI-C	In the assessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium. 1. T.SE-08 In the assessment of the original report, the concentration in seafood was assessed using conservative concentration in seafood was assessed using conservative concentration in seafood was assessed using conservative concentrations in seafood was assessed using conservative. 2.2E-09 3E-06 Total (mSv/year) Table VI-6(3) Comparison.	In the assessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Since the tritium in the ALPS treated water before dilution, of which concentration limit, has higher concentration limit, has higher concentration limit, has higher concentration fan the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium. 4.2E-11 7.5E-08 In the assessment of the original report, the concentration in seaflood was assessed using conservative concentration in seaflood was assessed using conservative. 2.9E-06 In the assessment of the original report, the concentration in seaflood was assessed using conservative concentration in seaflood was assessed using conservative. 2.9E-06 Since the tritium in the ALPS treated water before dilution, of which concentration limit, has higher concentration fan the other nuclides after discharge into the sea as well, the exposure (mSv/year) dispersed coastal sediment Inhalation of dispersed coastal sediment Inhalation of seawater spray Ingestion of a seaflood seading more of the original report, the concentration in seaflood was assessed using conservative concentration in seaflood was assessed using conservative of the concentration in seaflood was assessed using conservative. 2.9E-06 Since the tritium in the ALPS treated water pediatory concentration limit, has higher concentration limit, has higher concentration of seawater (mSv/year) Internal exposure (mSv/year) Internal exposure from fishing nets as well, the exposure of dispersed coastal sediment Inhalation of seawater spray Inhalation of seawater spray Ingestion of seawater spray Internal exposure (mSv/year) Inhalation of seawater spray Internal exposure (mSv/year) Internal exposure (mSv/year) Internal exposure from fishing network for the seawater (mSv/year) Internal exposure (mSv/year) Internal exposure from fishing network for	In the assessment of the original report, conservative dose conversion factors were used for external exposure (mSv/year) 2.1E-07 In the assessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Exposure from beach and 2.7E-07 Since the tritium in the ALPS treated water before dilution, of which concentration limit, has higher concentration limit, has higher exposure through accidently ingestion of seawater is mainly caused by tritium. 4.2E-11 7.5E-08 In the assessment of the original report, the concentration in seafood was assessed using conservative. 2.9E-06 In the assessment of the original report, the concentration in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative. 2.2E-09 3E-06 Total (mSv/year) Total (mSv/year) The body of the TECDOC-1750 Table VI-6(3) Comparison of the exposure assessment results to the concentrations of the exposure assessment results to the concentration in searcher rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative. Total (mSv/year) Table VI-6(3) Comparison of the exposure assessment results to the body of the text of the concentrations of the exposure assessment results to the body of the text of the concentration and the concentration in sea the concentration of the exposure assessment results to the concentration in searcher rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment results to the search of the concentration in the concentration in searcher rather than taking into account adhesion to suspended particles and the concentration in searcher rather than taking into account adhesion to suspended particles and exposure (mSv/year) Internal Exposure from Exposure from the atten	to be assessed 2_1F=07 the sessessment of the original report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative. Exposure from beach small conservative dose conversion factors were used for external exposure, and therefore the results are considered to be conservative. Exposure from beach small conservative dose conversion factors were used for external exposure from beach small conservative. Exposure from fishing note Since the tritium in the ALPS treated water before dilution, of which concentration limit, has higher concentration limit, has higher exposure through acidently ingestion of seawater is mainly caused by tritium. Since the tritium in the ALPS treated water before dilution, of which concentration than the other muclides after discharge into the sea as well, the exposure through acidently ingestion of seawater is mainly caused by tritium. 2_2F=08 In the assessment of the original report, the concentration is made to the regulatory concentration limit, has higher exposure through acidently ingestion of seawater is mainly caused by tritium. 1_2F=08 In the assessment of the original report, the concentration is sealloud water before dilution, of which exposure through acidently ingestion of seawater is mainly caused by tritium and the result is not changed. (Adult) 1_2F=08 In the assessment of the original report, the concentration in sealloud water sequence (mSwyycar) (Adult) 1_2F=08 In the assessment of the original report, the concentration in sealloud water sequence (mSwyycar) (Adult) 1_2F=08 In the assessment of the original report, the concentration in sealloud water sequence (mSwyycar) (Adult) 1_2F=08 In the assessment of the original report, the concentration in sealloud water sequence (mSwyycar) (Adult) 1_2F=08 In the assessment of the original report, the concentration is not seawater attent than taking into account adhesion to seawater attent than taking into account adhesion to seawater at

	•		Current			•		Revised		Reason for Revision
	Exposure from sea surface	4.7E-08	Not to be assessed			Exposure from sea surface	4.8E-10	Not to be assessed		Appropriate description for change of the date and due to the selection of nuclides to be
	Exposure from hulls	3.3E-08	Not to be assessed			Exposure from hulls	<u>4.6E-10</u>	Not to be assessed		measured and assessed
External exposure	Exposure during Swimming	3.2E-08	Not to be assessed		External exposure	Exposure during Swimming	3.2E-10	Not to be assessed		
(mSv/year)	Exposure from beach sand	<u>5.6E-05</u>	2.1E-07	In the assessment of the <u>original</u> report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.	(mSv/year)	Exposure from beach sand	<u>5.6E-07</u>	7.0E-08	In the assessment of the body of the report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.	
	Exposure from fishing nets	1.2E-05	Not to be assessed			Exposure from fishing nets	<u>1.1E-07</u>	Not to be assessed		
	Ingestion of coastal sediment	f Not to be assessed	<u>6.6E-10</u>			Ingestion of coastal sediment	Not to be assessed	7.3E-10		
Internal	Ingestion of seawater	Not to be assessed	3.1E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium.	Internal	Ingestion of seawater	3.1E-07	3.1E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium and the result is not changed.	
exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	4.2E-11		exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	9.5E-11		
	Inhalation of seawater spray	Not to be assessed	<u>7.5E-08</u>			Inhalation of seawater spray	3.8E-07	9.4E-08		
	Ingestion of seafood	3.0E-04	4.6E-06	In the assessment of the <u>original</u> report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.		Ingestion of seafood	9.0E-06	4.1E-06	In the assessment of the <u>body</u> of the report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.	
Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	5.2E-09		Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	6.3E-10		
	Total Sv/year)	<u>4E-04</u>	5E-06			Total nSv/year)	<u>1E-05</u>	5E-06		
(Omission) Attachment I The 64 nuclio				urce term based on the measured value uclides which have never been detected in the	(Omission) Attachment I The 31 nucli				ource term based on the measured value nuclides which have never been detected in the	

Comparison Table of amendments in the Implementation Plan for Fukushima Dalichi N Current	Tucical 1 owe	Station as Spec.	irica ivacica.	Revi		Attachinicht	-2, Auaciiii	cht 1-2011 and 1	Reason for Revision
past analysis assessments. As shown in 6-1-2.(1) "Source term (annual discharge amount of each nuclide)" annual discharge amount is conservatively assumed to include nuclides below the detection limit in the source term based on actual measurement. However, it is estimated that the actual concentrations of many of the nuclides which have never been detected are much lower than the detection limit considering their half-lives, etc. In order to verify conservativeness in the result of the exposure assessment, the exposure assessment result of each nuclide is aggregated separating detected nuclides from undetected nuclides Tables IX-1 to 4 show the result. In both cases, it is considered that the contribution from undetected nuclides is significant, and the assessment result contains high conservativeness.	discharge am on actual mea never been de In order to ve assessment re Tables IX-1 t In both cases measured and	past analysis assessments. As shown in 6-1-2.(1) "Source term (annual discharge amount of each nuclide)" and discharge amount is conservatively assumed to include nuclides below the detection limit in the source term bath on actual measurement. However, it is estimated that the actual concentrations of many of the nuclides which have been detected are much lower than the detection limit considering their half-lives, etc. In order to verify the contribution from undetected nuclides in the result of the exposure assessment, the exposures assessment result of each nuclide is aggregated separating detected nuclides from undetected nuclides. Tables IX-1 to 4 show the result. In both cases, the contribution from undetected nuclides was significant before the selection of nuclides to measured and assessed, but the contribution from undetected nuclides is decreased. Table IX-1(1) Contributions of detected and undetected nuclides (human exposure, 64 nuclides)						ource term based ides which have ent, the exposure des f nuclides to be	Appropriate description due to the selection of nuclides to be measured and assessed
Table IX-1 Contributions of detected and undetected nuclides (human exposure)		IX-I <u>(I)</u> Contribut	ions of detect	ed and unde	etected nuclio	des (human e	exposure <u>, 64</u>	nuclides)	
(Omission)	(Omission)	IV 1(2) Contribut	: £ 4.44	. 4 4 4		1 -	21	1:4\	
	<u> Table</u>	IX-1(2) Contribut	ions of detect		e term based	•	-	<u>nucindes)</u>	
	Assessed	Source term -	i.K4 tank	group	<u>ii.J1-C ta</u>	ınk group	iii.J1-G ta	nnk group	
	<u>case</u>	Ingestion of seafood	Average	<u>Large</u>	Average	Large	Average	<u>Large</u>	
	Exposure* (mSv/year)	Detected Nuclide	5.7E-06	2.0E-05	<u>1.3E-06</u>	3.9E-06	2.1E-06	6.3E-06	
		Undetected Nuclide	4.6E-07	1.6E-06	5.3E-07	<u>1.4E-06</u>	1.3E-06	4.0E-06	
		<u>Total</u>	6.2E-06	2.2E-05	<u>1.9E-06</u>	5.4E-06	3.5E-06	1.0E-05	
	nucli	e of undetected des in total	<u>7%</u>	<u>7%</u>	28%	<u>27%</u>	39%	<u>39%</u>	
	* Exposure is the total of external exposure and internal exposure								
Table IX-2 Contributions of detected and undetected nuclides (environmental protection and K4 tank group)	Table IX-2(1) Contributions of detected and undetected nuclides (environmental protection and K4 tank group, 64 nuclides)								
(Omission)	(Omission)								
			X-2(2) Contribironmental pro						
				Steetion and		4 tank group	<u> </u>		
		Asse	ssed case	<u>I</u>	<u>latfish</u>	<u>Crab</u>	Brown seaweed		
]	Detected Nucli	<u>de</u> <u>7</u>	.5E-07	<u>7.6E-07</u>	<u>8.3E-07</u>		
		Exposure (mGy/day)	ndetected Nuc	lide 1	.7E-07	1.4E-07	1.7E-07		
			<u>Total</u>	9	.3E-07	9.0E-07	<u>1.0E-06</u>		
		Percentage of ur	idetected nuclion	des in	<u>19%</u>	<u>16%</u>	<u>17%</u>		
The Japanese version shall prevail.	I								

Current			F	Revised	e, Attaciiiieiii			Reason for Revision
Table IX-3 Contributions of detected and undetected nuclides (environmental protection and J1-C tank group)			e IX-3(1) Contributions on vironmental protection a					Appropriate description due to the selection of nuclides to be measured and assessed
(Omission)	(Omission)							measured and assessed
		<u>Table IX-3(2) Contributions of detected and undetected nuclides</u> (environmental protection and J1-C tank group, 31 nuclides)						
					J1-C tank grou			
		<u> </u>	Assessed case	Flatfish	Crab	Brown seaweed		
			Detected Nuclide	1.4E-07	1.4E-07	<u>1.5E-07</u>		
		Exposure (mGy/day)	<u>Undetected Nuclide</u>	3.5E-07	2.9E-07	3.6E-07		
			<u>Total</u>	<u>4.9E-07</u>	4.3E-07	<u>5.1E-07</u>		
		Percentage (of undetected nuclides in total	<u>71%</u>	<u>68%</u>	<u>71%</u>		
Table IX-4 Contributions of detected and undetected nuclides (environmental protection and J1-G tank group)			e IX-4(1) Contributions on vironmental protection a					
(Omission)	(Omission)							
	Table IX-4(2) Contributions of detected and undetected nuclides (environmental protection and J1-G tank group, 31 nuclides)							
				J1-G tank group				
		<u> </u>	Assessed case	<u>Flatfish</u>	<u>Crab</u>	Brown seaweed		
			Detected Nuclide	2.9E-07	2.8E-07	3.0E-07		
		Exposure (mGy/day)	<u>Undetected Nuclide</u>	9.8E-07	8.0E-07	1.0E-06		
			<u>Total</u>	<u>1.3E-06</u>	<u>1.1E-06</u>	<u>1.3E-06</u>		
		Percentage (of undetected nuclides in total	<u>77%</u>	<u>74%</u>	<u>77%</u>		
Attachment X Breakdown of the exposure assessment result by nuclide	Attachment X	Breakdo	own of the exposure assess	sment result by	nuclide			
 X-1. Internal exposures assessment of human For the following exposure assessments shown in 6-1. "Exposure assessment under normal conditions", Tables X-1-1 to 4, X-2-1 to 4, and X-3-1 to 4 show the internal exposure assessment result of each nuclide. Source term based on measured values of 64 nuclides K4 tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.29) J1-C tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.35) J1-G tank group (Sum of the ratios to regulatory concentration limits of 63 nuclides other than tritium: 0.22) 	X-1. Internal exposures assessment of human							

Table X-1-1	Internal exposure assessment result from ingestion of seawater
(So	urce term based on measured values (K4 tank group))

Current

(Sc	ource term bas	sed on measure	ed values (K4	tank group))
	Expos	ure assessmen	t result	
Nuclide		(mSv/year) Children		Remarks
Nucliuc	Adult	under	Infants	Remarks
		school age		
H-3	3.0E-07	5.2E-07	Exempted	
I-129	2.1E-08	3.2E-08	Exempted	
Ru-106	1.0E-09	3.6E-09	Exempted	
C-14	7.7E-10	1.3E-09	Exempted	
Sr-90	5.5E-10	9.2E-10	Exempted	
Cs-137	4.9E-10	3.6E-10	Exempted	
<u>Y-91</u>	<u>4.7E-10</u>	<u>1.7E-09</u>	Exempted	_
<u>Sn-123</u>	<u>2.2E-10</u>	<u>8.3E-10</u>	Exempted	_
<u>Cd-115m</u>	<u>1.9E-10</u>	<u>5.5E-10</u>	Exempted	_
Co-60	1.3E-10	6.7E-10	Exempted	
<u>Pm-148</u>	<u>1.2E-10</u>	<u>4.3E-10</u>	<u>Exempted</u>	_
<u>Te-129m</u>	<u>8.5E-11</u>	<u>3.4E-10</u>	<u>Exempted</u>	_
Cs-134	7.6E-11	5.2E-11	Exempted	
<u>Te-127m</u>	<u>6.5E-11</u>	2.7E-10	Exempted	_
Y-90	5.3E-11	2.0E-10	Exempted	
<u>Rb-86</u>	4.7E-11	1.7E-10	Exempted	_
Tc-99	4.0E-11	1.4E-10	Exempted	
Cd-113m	3.7E-11	6.2E-11	Exempted	
Sb-125	3.2E-11	1.0E-10	Exempted	
Ni-63	2.9E-11	9.0E-11	Exempted	
Ce-144	2.9E-11	1.1E-10	Exempted	
Te-125m	2.6E-11	9.7E-11	Exempted	
<u>Sr-89</u>	2.3E-11	<u>7.9E-11</u>	Exempted	_
<u>Ba-140</u>	2.2E-11	<u>7.8E-11</u>	Exempted	_
Pu-239	1.4E-11	1.8E-11	Exempted	
Pu-240	1.4E-11	1.8E-11	Exempted	
Pu-238	1.3E-11	1.7E-11	Exempted	
Pu-241	1.2E-11	1.4E-11	Exempted	
<u>Sn-126</u>	<u>1.1E-11</u>	3.8E-11	Exempted	_
Am-241	1.1E-11	1.5E-11	Exempted	
<u>Am-243</u>	<u>1.1E-11</u>	<u>1.5E-11</u>	Exempted	_
Cm-243	8.4E-12	1.2E-11	Exempted	
<u>Cs-136</u>	<u>8.0E-12</u>	<u>1.6E-11</u>	Exempted	_
<u>Pm-146</u>	7.8E-12	2.4E-11	Exempted	_
Cm-244	6.7E-12	1.1E-11	Exempted	
<u>Zn-65</u>	<u>5.2E-12</u>	1.3E-11	Exempted	_
<u>Sn-119m</u>	<u>5.1E-12</u>	2.0E-11	Exempted	

Table X-1-1 Internal exposure assessment result from ingestion of seawater (Source term based on measured values (K4 tank group))

Revised

	Exposi	2 177		
Nuclide	Adult under Infar school age		Infants	Remarks
H-3	3.0E-07	5.2E-07	Exempted	
I-129	2.1E-08	3.2E-08	Exempted	
Ru-106	1.0E-09	3.6E-09	Exempted	
C-14	7.7E-10	1.3E-09	Exempted	
Sr-90	5.5E-10	9.2E-10	Exempted	
Cs-137	4.9E-10	3.6E-10	Exempted	
<u>Se-79</u>	3.9E-10	2.5E-09	Exempted	-
Co-60	1.3E-10	6.7E-10	Exempted	
Cs-134	7.6E-11	5.2E-11	Exempted	
Y-90	5.3E-11	2.0E-10	Exempted	
Tc-99	4.0E-11	1.4E-10	Exempted	
Cd-113m	3.7E-11	6.2E-11	Exempted	
Sb-125	3.2E-11	1.0E-10	Exempted	
Ni-63	2.9E-11	9.0E-11	Exempted	
Ce-144	2.9E-11	1.1E-10	Exempted	
Te-125m	2.6E-11	9.7E-11	Exempted	
Pu-239	1.4E-11	1.8E-11	Exempted	
Pu-240	1.4E-11	1.8E-11	Exempted	
Pu-238	1.3E-11	1.7E-11	Exempted	
Pu-241	1.2E-11	1.4E-11	Exempted	
Am-241	1.1E-11	1.5E-11	Exempted	
Cm-243	8.4E-12	1.2E-11	Exempted	
Cm-244	6.7E-12	1.1E-11	Exempted	
Np-237	6.2E-12	7.8E-12	Exempted	_
Pm-147	4.4E-12	1.6E-11	Exempted	
<u>U-234</u>	2.7E-12	4.9E-12	Exempted	_
<u>U-238</u>	2.5E-12	4.5E-12	Exempted	_
Eu-154	2.1E-12	6.9E-12	Exempted	
Eu-155	9.4E-13	3.2E-12	Exempted	
Mn-54	4.2E-13	1.1E-12	Exempted	
Sm-151	7.8E-15	2.6E-14	Exempted	
Total	3.3E-07	5.7E-07	Exempted	

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

omparison i	able of affic	numents in t	me mipiemei	itation Plan for Fukt
		Curre	ent	
<u>Te-127</u>	4.8E-12	<u>1.8E-11</u>	<u>Exempted</u>	_
Pm-147	4.4E-12	1.6E-11	Exempted	
<u>Tb-160</u>	<u>4.0E-12</u>	<u>1.3E-11</u>	<u>Exempted</u>	_
<u>Eu-152</u>	3.5E-12	1.0E-11	<u>Exempted</u>	_
<u>Fe-59</u>	<u>2.7E-12</u>	1.1E-11	<u>Exempted</u>	_
Eu-154	2.1E-12	6.9E-12	Exempted	
<u>Sb-124</u>	<u>2.1E-12</u>	<u>7.1E-12</u>	<u>Exempted</u>	_
<u>Te-129</u>	<u>1.8E-12</u>	<u>6.0E-12</u>	Exempted	_
<u>Ce-141</u>	<u>1.6E-12</u>	<u>5.8E-12</u>	<u>Exempted</u>	_
<u>Ag-110m</u>	<u>1.4E-12</u>	3.9E-12	Exempted	_
<u>Pm-148m</u>	1.3E-12	4.1E-12	Exempted	_
<u>Te-123m</u>	<u>1.1E-12</u>	4.0E-12	Exempted	_
Eu-155	9.4E-13	3.2E-12	Exempted	
<u>Gd-153</u>	7.7E-13	2.7E-12	Exempted	_
Cm-242	6.7E-13	2.2E-12	Exempted	_
<u>Am-242m</u>	<u>6.6E-13</u>	8.0E-13	Exempted	_
<u>Ru-103</u>	6.5E-13	2.1E-12	Exempted	_
<u>Co-58</u>	<u>5.3E-13</u>	1.8E-12	Exempted	_
<u>Nb-95</u>	<u>5.2E-13</u>	1.6E-12	Exempted	_
Mn-54	4.2E-13	1.1E-12	Exempted	
<u>Pr-144</u>	2.8E-13	9.5E-13	Exempted	_
Sm-151	7.8E-15	2.6E-14	Exempted	
Rh-103m	3.4E-15	1.2E-14	Exempted	_
<u>Cs-135</u>	4.4E-16	3.8E-16	Exempted	_
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Exempted	Assessed with the parent nuclide
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Exempted	Assessed with the parent nuclide
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Exempted	Assessed with the parent nuclide
Total	3.3E-07	5.7E-07	Exempted	

Table X-1-2 Assessment result of internal exposure from inhalation of seawater spray (Source term based on measured values (K4 tank group))

	Exposi	ire assessmen		
		(mSv/year)		
Nuclide	Adult	Adult Children under Infants school age		Remarks
H-3	7.3E-08	5.0E-08	3.4E-08	
Ru-106	2.3E-09	1.9E-09	1.1E-09	
C-14	1.9E-09	1.4E-09	7.9E-10	
I-129	1.6E-09	1.1E-09	4.2E-10	
Pu-239	1.6E-09	7.9E-10	3.6E-10	
Pu-240	1.6E-09	7.9E-10	3.6E-10	

Table X-1-2 Assessment result of internal exposure from inhalation of seawater spray (Source term based on measured values (K4 tank group))

Revised

Exposi	t result		
			Remarks
Adult		Infants	
	school age		
7.3E-08	5.0E-08	3.4E-08	
2.3E-09	1.9E-09	1.1E-09	
1.9E-09	1.4E-09	7.9E-10	
1.6E-09	1.1E-09	4.2E-10	
1.6E-09	7.9E-10	3.6E-10	
1.6E-09	7.9E-10	3.6E-10	
	Adult 7.3E-08 2.3E-09 1.9E-09 1.6E-09	(mSv/year) Adult Children under school age 7.3E-08 5.0E-08 2.3E-09 1.9E-09 1.9E-09 1.4E-09 1.6E-09 7.9E-10	Adult Children under school age Infants 7.3E-08 5.0E-08 3.4E-08 2.3E-09 1.9E-09 1.1E-09 1.9E-09 1.4E-09 7.9E-10 1.6E-09 7.9E-10 3.6E-10

Reason for Revision

Appropriate description due to the selection of nuclides to be

		Curre	•	incompany in the contract of t	usinina Daneni Nucleai Fower Station as Spec		Revis			Reason for Revision
Pu-238	1.5E-09	7.4E-10	3.5E-10		Pu-238	1.5E-09	7.4E-10	3.5E-10		
Pu-241	1.4E-09	6.1E-10	2.2E-10		Pu-241	1.4E-09	6.1E-10	2.2E-10	-	
Am-241	1.3E-09	6.4E-10	3.1E-10		Am-241	1.3E-09	6.4E-10	3.1E-10	-	
Am-243	1.3E-09	6.4E-10	3.1E-10	_	Cm-243	9.3E-10	5.0E-10	2.8E-10		Appropriate description due to the
Cm-243	9.3E-10	5.0E-10	2.8E-10	_	Cm-244	7.7E-10	4.4E-10	2.6E-10	-	selection of nuclides to be measured and assessed
Cm-244	7.7E-10	4.4E-10	2.6E-10		Sr-90	7.5E-10	5.0E-10	2.5E-10	1	measured and assessed
Sr-90	7.5E-10	5.0E-10	2.5E-10		<u>Np-237</u>	6.7E-10	3.2E-10	1.7E-10		
<u>Y-91</u>	4.2E-10	3.5E-10	2.6E-10	_	Cs-137	3.5E-10	2.5E-10	1.3E-10		
Cs-137	3.5E-10	2.5E-10	1.3E-10		Co-60	2.9E-10	2.2E-10	1.1E-10	1	
Co-60	2.9E-10	2.2E-10	1.1E-10		<u>Se-79</u>	2.2E-10	1.6E-10	9.5E-11 _		
<u>Sn-123</u>	2.1E-10	1.8E-10	1.3E-10	_	Tc-99	1.9E-10	1.4E-10	7.9E-11	1	
Tc-99	1.9E-10	1.4E-10	7.9E-11		<u>U-234</u>	<u>1.3E-10</u>	1.0E-10	<u>5.7E-11</u> _	1	
<u>Cd-115m</u>	1.1E-10	9.1E-11	8.1E-11	_	<u>U-238</u>	1.1E-10	8.5E-11	5.0E-11 _	1	
Sb-125	8.5E-11	6.7E-11	3.8E-11		Sb-125	8.5E-11	6.7E-11	3.8E-11	1	
<u>Cm-242</u>	8.0E-11	<u>6.4E-11</u>	4.7E-11	_	Ce-144	7.2E-11	7.4E-11	6.3E-11	1	
<u>Am-242m</u>	7.7E-11	3.6E-11	1.7E-11	_	Ni-63	6.1E-11	5.0E-11	2.9E-11	1	
Ce-144	7.2E-11	7.4E-11	6.3E-11		Cd-113m	4.2E-11	2.7E-11	1.5E-11	1	
<u>Te-127m</u>	6.7E-11	<u>5.4E-11</u>	3.6E-11	_	Te-125m	3.0E-11	2.2E-11	1.5E-11		
Ni-63	6.1E-11	5.0E-11	2.9E-11		Pm-147	2.0E-11	1.8E-11	1.1E-11		
<u>Te-129m</u>	5.4E-11	4.6E-11	3.4E-11	_	Cs-134	1.9E-11	1.6E-11	8.7E-12	1	
<u>Pm-146</u>	4.4E-11	3.2E-11	1.7E-11	_	Eu-154	1.4E-11	9.8E-12	5.3E-12	1	
Cd-113m	4.2E-11	2.7E-11	1.5E-11		Y-90	7.1E-12	7.8E-12	7.9E-12	1	
Te-125m	3.0E-11	2.2E-11	1.5E-11		Eu-155	4.9E-12	3.9E-12	2.4E-12]	
<u>Eu-152</u>	<u>2.5E-11</u>	<u>1.6E-11</u>	8.5E-12	_	Mn-54	2.2E-13	2.1E-13	1.4E-13		
<u>Pm-148</u>	<u>2.4E-11</u>	2.3E-11	<u>2.1E-11</u>	_	Sm-151	7.7E-14	5.1E-14	2.7E-14		
Pm-147	2.0E-11	1.8E-11	1.1E-11		Total	<u>9.1E-08</u>	<u>6.0E-08</u>	3.9E-08		
Cs-134	1.9E-11	1.6E-11	8.7E-12						_	
<u>Sr-89</u>	1.7E-11	1.4E-11	<u>1.1E-11</u>	_						
<u>Sn-126</u>	<u>1.6E-11</u>	<u>1.4E-10</u>	8.9E-12	_						
Eu-154	1.4E-11	9.8E-12	5.3E-12							
<u>Ba-140</u>	1.2E-11	9.6E-12	7.6E-12	_						
<u>Sn-119m</u>	8.0E-12	<u>6.7E-12</u>	<u>4.7E-12</u>	_						
Y-90	7.1E-12	7.8E-12	7.9E-12							
Eu-155	4.9E-12	3.9E-12	2.4E-12							
<u>Tb-160</u>	<u>4.2E-12</u>	3.5E-12	2.5E-12	_						
<u>Rb-86</u>	3.8E-12	<u>5.4E-12</u>	<u>6.3E-12</u>	_						
<u>Ce-141</u>	2.0E-12	<u>1.5E-12</u>	<u>1.1E-12</u>	_						
<u>Cs-136</u>	<u>1.8E-12</u>	<u>1.5E-12</u>	<u>1.2E-12</u>	_						
<u>Sb-124</u>	<u>1.8E-12</u>	<u>1.4E-12</u>	<u>1.0E-12</u>	_						
<u>Fe-59</u>	<u>1.5E-12</u>	<u>1.2E-12</u>	9.8E-13	_						
<u>Ag-110m</u>	<u>1.4E-12</u>	<u>1.2E-12</u>	<u>7.1E-13</u>	_						
<u>Gd-153</u>	<u>1.4E-12</u>	<u>1.7E-12</u>	<u>1.3E-12</u>	_						

_	comparison racie of amendments in the implementation rian for rackast											
	Current											
	<u>Pm-148m</u>	1.0E-12	8.5E-13	<u>5.8E-13</u>	_							
	<u>Te-123m</u>	1.0E-12	7.6E-13	<u>5.1E-13</u>	_							
	<u>Te-127</u>	9.6E-13	1.0E-12	<u>1.1E-12</u>	_							
	<u>Zn-65</u>	<u>7.1E-13</u>	7.2E-13	<u>6.2E-13</u>	_							
	<u>Ru-103</u>	<u>6.4E-13</u>	<u>5.0E-13</u>	3.6E-13	_							
	<u>Nb-95</u>	3.9E-13	3.0E-13	2.1E-13	_							
	<u>Co-58</u>	3.6E-13	3.0E-13	2.0E-13	_							
	<u>Te-129</u>	2.7E-13	2.7E-13	3.1E-13	_							
	Mn-54	2.2E-13	2.1E-13	1.4E-13								
	Sm-151	7.7E-14	5.1E-14	2.7E-14								
	Pr-144	2.4E-14	2.8E-14	3.3E-14								
	<u>Rh-103m</u>	<u>5.8E-16</u>	<u>5.6E-16</u>	<u>5.5E-16</u>	_							
	<u>Cs-135</u>	4.6E-16	3.4E-16	<u>1.9E-16</u>	_							
	<u>Rh-106</u>	0.0E+00	0.0E+00	<u>0.0E+00</u>	Assessed with the parent nuclide							
	<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide							
	<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide							
	Total	<u>9.3E-08</u>	<u>6.2E-08</u>	<u>4.0E-08</u>								

Table X-1-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), Average ingestion)

	Exposi	ire assessmen	t result			
		(mSv/year)				
Nuclide	Adult	Children under school age	Infants	Remarks		
<u>Sn-123</u>	<u>9.8E-06</u>	<u>1.8E-05</u>	2.4E-05	_		
I-129	2.7E-06	2.0E-06	8.6E-07			
C-14	1.4E-06	1.2E-06	6.8E-07			
<u>Sn-126</u>	4.9E-07	<u>8.4E-07</u>	<u>1.1E-06</u>	_		
<u>Cd-115m</u>	3.0E-07	<u>4.4E-07</u>	<u>7.4E-07</u>	_		
<u>Sn-119m</u>	2.3E-07	4.3E-07	<u>5.6E-07</u>	_		
Cd-113m	5.8E-08	5.0E-08	6.1E-08			
Co-60	4.9E-08	1.2E-07	1.6E-07			
<u>H-3</u>	3.3E-08	<u>2.8E-08</u>	2.3E-08	_		
Ru-106	3.3E-08	5.7E-08	7.6E-08			
<u>Fe-59</u>	2.3E-08	<u>4.8E-08</u>	1.0E-07	_		
<u>Te-129m</u>	<u>1.8E-08</u>	3.6E-08	<u>5.3E-08</u>	_		
<u>Pm-148</u>	<u>1.7E-08</u>	<u>3.1E-08</u>	3.9E-08	_		
Tc-99	1.6E-08	2.8E-08	4.9E-08			
<u>Te-127m</u>	<u>1.4E-08</u>	<u>2.8E-08</u>	4.9E-08	_		
<u>Y-91</u>	<u>1.3E-08</u>	<u>2.3E-08</u>	2.9E-08	_		
<u>Zn-65</u>	<u>5.5E-09</u>	<u>7.0E-09</u>	1.0E-08	_		

Table X-1-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), Average ingestion)

Revised

	Expos	ure assessmen (mSv/year)	t result	
Nuclide	Adult	Children under school age	Infants	Remarks
I-129	2.7E-06	2.0E-06	8.6E-07	
C-14	1.4E-06	1.2E-06	6.8E-07	
<u>Se-79</u>	3.2E-07	<u>1.1E-06</u>	<u>9.4E-07</u>	_
Cd-113m	5.8E-08	5.0E-08	6.1E-08	
Co-60	4.9E-08	1.2E-07	1.6E-07	
Ru-106	3.3E-08	5.7E-08	7.6E-08	
<u>H-3</u>	3.2E-08	2.8E-08	<u>2.3E-08</u>	_
Tc-99	1.6E-08	2.8E-08	4.9E-08	
Cs-137	4.1E-09	1.5E-09	1.4E-09	
Ni-63	3.6E-09	5.4E-09	7.6E-09	
Ce-144	2.7E-09	4.9E-09	6.8E-09	
Sb-125	1.5E-09	2.3E-09	3.1E-09	
Am-241	1.4E-09	9.2E-10	5.0E-09	
Pu-239	1.4E-09	8.8E-10	4.4E-09	
Pu-240	1.4E-09	8.8E-10	4.4E-09	
Pu-238	1.2E-09	8.3E-10	4.2E-09	
<u>Te-125m</u>	1.2E-09	2.2E-09	3.6E-09	

Reason for Revision

Appropriate description due to the selection of nuclides to be

\$\frac{12\text{log}}{\chap4 \chap4	Current	Revised	Reason for Revision
Chi 3 41-140 15-140 14-140 Chi 34-140 Chi 34-140	Te-125m 5.5E-09 1.0E-08 1.6E-08	Pu-241 1.2E-09 6.5E-10 2.6E-09	Appropriate description due to the
No. No.			
Con-244 Section Sect			measured and assessed
Con-244 Section Sect			
Sh-125 1.5E-00 2.2E-00 5.1E-00			
Section Sect		Mn-54 3.2E-10 4.3E-10 4.8E-10	
Amp-241 1.44:0.0	<u>Y-90</u> <u>1.4E-09</u> <u>2.6E-09</u> <u>3.2E-09</u> _	Eu-154 3.1E-10 5.1E-10 7.7E-10	
Pro. 239	Am-241 1.4E-09 9.2E-10 5.0E-09	Sr-90 2.5E-10 2.1E-10 4.2E-10	
Pack	<u>Am-243</u> <u>1.4E-09</u> <u>9.2E-10</u> <u>4.9E-09</u> _	Eu-155 1.4E-10 2.4E-10 3.6E-10	
Pac288 12E-09 83E-10 42E-09 42E-09	Pu-239 1.4E-09 8.8E-10 4.4E-09	Np-237 3.4E-11 2.2E-11 1.2E-10 _	
Pn-146	Pu-240 1.4E-09 8.8E-10 4.4E-09	<u>Y-90</u>	
Proc 46	Pu-238 1.2E-09 8.3E-10 4.2E-09	<u>U-234</u>	
Total 194-99 194-99 184-99 184-99 Total 4.7E-96 4.6E-96 2.9E-96 Total 4.7E-96 184-10 1.24-99 1.84-99 Total 4.7E-96 4.6E-96 2.9E-96 Total 4.7E-96 4.6E-96 2.9E-96 Total 4.7E-96 4.6E-96 2.9E-96 Total 4.7E-96 4.6E-96 4	Pu-241 1.2E-09 6.5E-10 2.6E-09	<u>U-238</u>	
Cm-243 7,2E-10 3,0E-09 Pm-147 6,4E-10 1,2E-109 1,80c.00 Cc-134 6,4E-10 2,2E-10 1,8E-10 Cm-244 5,8E-10 4,4E-10 2,7E-09 1,8E-10 En-129 3,0E-10 6,3E-10 9,0E-10 1,8E-10 Mn-54 3,2E-10 6,3E-10 9,0E-10 1,8E-10 En-154 3,1E-10 5,1E-10 7,7E-10 1,8E-10 1,8E-10 5,1E-10 7,7E-10 En-154 3,1E-10 4,8E-10 5,1E-10 7,7E-10 1,8E-10 1,8E-10 3,1E-10 4,2E-10 6,6E-10 Sn-90 2,5E-10 4,2E-10 4,2E-10 6,6E-10 1,2E-10 1,2E-	<u>Pm-146</u> <u>1.1E-09</u> <u>1.8E-09</u> <u>2.5E-09</u> _	Sm-151 1.1E-12 1.9E-12 3.5E-12	
Pm-147	<u>Te-127</u> <u>1.0E-09</u> <u>1.9E-09</u> <u>1.8E-09</u> _	Total <u>4.7E-06</u> <u>4.6E-06</u> <u>2.9E-06</u>	
Cs-134 6.4E-10 2.2E-10 1.NE-10 Cm-244 5.8E-10 4.4E-10 2.7E-09 Es_152 5.1E-10 7.4E-10 1.2E-09 Ts-129 3.0E-10 6.3E-10 9.0E-10	Cm-243 7.2E-10 5.1E-10 3.0E-09		
Cm-244 5.8E-10	Pm-147 6.4E-10 1.2E-09 1.8E-09		
Eu-152 5.1F-10 7.4F-10 1.2F-09	Cs-134 6.4E-10 2.2E-10 1.8E-10		
TS-129 3.9E-10 6.3E-10 4.3E-10 4.8E-10 Mn-54 3.1E-10 5.1E-10 7.7E-10 1 Es-154 3.1E-10 5.1E-10 7.7E-10 1 Tb-160 2.7E-10 4.5E-10 5.3E-10 _ Se-90 2.5E-10 4.2E-10 6.6E-10 _ Co-58 2.0E-10 3.8E-10 _ _ Pm-148m 1.8E-10 3.8E-10 _ _ Co-141 1.5E-10 3.2E-10 _ _ Gd-153 1.4E-10 2.4E-10 _ _ Gd-153 1.1E-10 2.0E-10 _ _ Sb-124 9.7E-11 1.6E-10 2.0E-10 _ Cs-136 6.7E-11 6.9E-11 _ _ Cm-242 5.8E-11 9.8E-11 _ _ _ Rb-86 5.0E-11 _ _ _ _ _ _ Nb-95 2.8E-11 4.3E-11 _	Cm-244 5.8E-10 4.4E-10 2.7E-09		
Mn-54 3.2E-10 4.3E-10 4.8E-10 Eu-154 3.1E-10 5.1E-10 7.7E-10 Tb-160 2.7E-10 4.5E-10 5.3E-10 Se-90 2.5E-10 4.2E-10 4.2E-10 Te-123m 2.5E-10 3.8E-10	<u>Eu-152</u> <u>5.1E-10</u> <u>7.4E-10</u> <u>1.2E-09</u> _		
Eu-154 3.1E-10 5.1E-10 7.7E-10 Tb-160 2.7E-10 4.5E-10 5.3E-10	<u>Te-129</u> 3.9E-10 6.3E-10 9.0E-10		
Tb-160 2.7E-10 4.5E-10 5.3E-10	Mn-54 3.2E-10 4.3E-10 4.8E-10		
Sr-90 2.5E-10 2.1E-10 4.2E-10 Te-123m 2.5E-10 4.2E-10 6.6E-10 Co-58 2.0E-10 3.4E-10 3.8E-10	Eu-154 3.1E-10 5.1E-10 7.7E-10		
Te-123m 2.5E-10 4.2E-10 6.6E-10 Co-58 2.0E-10 3.4E-10 3.8E-10 Pm-148m 1.8E-10 3.0E-10 _ Ce-141 1.5E-10 2.7E-10 3.3E-10 Eu-155 1.4E-10 2.4E-10 _ Gd-153 1.1E-10 2.0E-10 _ Sb-124 9.7E-11 1.6E-10 2.0E-10 Am-242m 8.3E-11 4.9E-11 2.6E-10 Cs-136 6.7E-11 6.8E-11 6.9E-11 Cm-242 3.8E-11 9.E-11 5.5E-10 Rb-86 5.0E-11 8.9E-11 1.1E-10 Nb-95 2.8E-11 4.2E-11 4.3E-11 Pr-144 2.3E-11 3.7E-11 5.6E-11 Ru-103 2.1E-11 3.0E-11 _	<u>Tb-160</u> <u>2.7E-10</u> <u>4.5E-10</u> <u>5.3E-10</u> _		
Co-58 2.0E-10 3.4E-10 3.8E-10 _ Pm-148m 1.8E-10 3.0E-10 _ _ Ce-141 1.5E-10 2.7E-10 3.3E-10 _ Eu-155 1.4E-10 2.4E-10 _ _ Gd-153 1.1E-10 2.0E-10 _ _ Sb-124 9.7E-11 1.6E-10 _ _ Am-242m 8.3E-11 4.9E-11 _ _ Cs-136 6.7E-11 6.8E-11 _ _ Cm-242 5.8E-11 9.1E-11 _ _ Rb-86 5.0E-11 8.9E-11 _ _ Nb-95 2.8E-11 4.2E-11 _ _ Pp-144 2.3E-11 3.4E-11 _ _ Ru-103 2.1E-11 3.4E-11 _ _ Sr-89 1.1E-11 1.8E-11 _ _	Sr-90 2.5E-10 2.1E-10 4.2E-10		
Pm:148m 1.8E-10 3.0E-10 3.2E-10 Cc-141 1.5E-10 2.7E-10 3.3E-10 Eu-155 1.4E-10 2.4E-10 3.6E-10 Gd-153 1.1E-10 2.0E-10 2.4E-10 Sb-124 9.7E-11 1.6E-10 2.0E-10 Am-242m 8.3E-11 4.9E-11 2.6E-10 Cs-136 6.7E-11 6.8E-11 6.9E-11 Cm-242 5.8E-11 9.1E-11 5.5E-10 Rb-86 5.0E-11 8.9E-11 1.1E-10 Ba-140 3.9E-11 4.2E-11 4.3E-11 Pr-144 2.3E-11 3.7E-11 5.6E-11 Ru-103 2.1E-11 3.4E-11 4.0E-11 Sr-89 1.1E-11 1.8E-11 3.0E-11	Te-123m 2.5E-10 4.2E-10 6.6E-10		
Ce-141 1.5E-10 2.7E-10 3.3E-10 _ Eu-155 1.4E-10 2.4E-10 3.6E-10 _ Gd-153 1.1E-10 2.0E-10 _ _ Sb-124 9.7E-11 1.6E-10 _ _ Am-242m 8.3E-11 4.9E-11 _ _ Cs-136 6.7E-11 6.8E-11 _ _ Cm-242 5.8E-11 6.9E-11 _ _ Rb-86 5.0E-11 8.9E-11 _ _ Ba-140 3.9E-11 6.7E-11 _ _ Nb-95 2.8E-11 4.2E-11 _ _ Pr-144 2.3E-11 3.7E-11 _ _ Ru-103 2.1E-11 3.4E-11 _ _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _	<u>Co-58</u> <u>2.0E-10</u> <u>3.4E-10</u> <u>3.8E-10</u> _		
Eu-155 1.4E-10 2.4E-10 3.6E-10 Gd-153 1.1E-10 2.0E-10 2.4E-10 Sb-124 9.7E-11 1.6E-10 2.0E-10 Am-242m 8.3E-11 4.9E-11 2.6E-10 Cs-136 6.7E-11 6.8E-11 6.9E-11 Cm-242 5.8E-11 9.1E-11 5.5E-10 Rb-86 5.0E-11 8.9E-11 1.1E-10 Nb-95 2.8E-11 4.2E-11 4.3E-11 Pr-144 2.3E-11 3.7E-11 5.6E-11 Ru-103 2.1E-11 3.4E-11 4.0E-11 Sr-89 1.1E-11 1.8E-11 3.0E-11	<u>Pm-148m</u> <u>1.8E-10</u> <u>3.0E-10</u> <u>3.2E-10</u> _		
Gd-153 1.1E-10 2.0E-10 2.4E-10 _ Sb-124 9.7E-11 1.6E-10 2.0E-10 _ Am-242m 8.3E-11 4.9E-11 2.6E-10 _ Cs-136 6.7E-11 6.8E-11 6.9E-11 _ Cm-242 5.8E-11 9.1E-11 5.5E-10 _ Rb-86 5.0E-11 8.9E-11 1.1E-10 _ Ba-140 3.9E-11 6.7E-11 9.4E-11 _ Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Sb-124 9.7E-11 1.6E-10 2.0E-10 Am-242m 8.3E-11 4.9E-11 2.6E-10 Cs-136 6.7E-11 6.8E-11 6.9E-11 Cm-242 5.8E-11 9.1E-11 5.5E-10 Rb-86 5.0E-11 8.9E-11 1.1E-10 Ba-140 3.9E-11 6.7E-11 9.4E-11 Nb-95 2.8E-11 4.2E-11 4.3E-11 Pr-144 2.3E-11 3.7E-11 5.6E-11 Ru-103 2.1E-11 3.4E-11 4.0E-11 Sr-89 1.1E-11 1.8E-11 3.0E-11			
Am-242m 8.3E-11 4.9E-11 2.6E-10 _ Cs-136 6.7E-11 6.8E-11 _ _ Cm-242 5.8E-11 9.1E-11 5.5E-10 _ Rb-86 5.0E-11 8.9E-11 1.1E-10 _ Ba-140 3.9E-11 6.7E-11 9.4E-11 _ Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Cs-136 6.7E-11 6.8E-11			
Cm-242 5.8E-11 9.1E-11 5.5E-10 _ Rb-86 5.0E-11 8.9E-11 1.1E-10 _ Ba-140 3.9E-11 6.7E-11 9.4E-11 _ Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Rb-86 5.0E-11 8.9E-11 1.1E-10 _ Ba-140 3.9E-11 6.7E-11 9.4E-11 _ Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Ba-140 3.9E-11 6.7E-11 9.4E-11 _ Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Nb-95 2.8E-11 4.2E-11 4.3E-11 _ Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Pr-144 2.3E-11 3.7E-11 5.6E-11 _ Ru-103 2.1E-11 3.4E-11 4.0E-11 _ Sr-89 1.1E-11 1.8E-11 3.0E-11 _			
Ru-103 2.1E-11 3.4E-11 4.0E-11			
<u>Sr-89</u> <u>1.1E-11</u> <u>1.8E-11</u> <u>3.0E-11</u> _			
Sm-151 1.1E-12 1.9E-12 3.5E-12			
	Sm-151 1.1E-12 1.9E-12 3.5E-12		

Current											
<u>Rh-103m</u>	<u>1.7E-13</u>	2.9E-13	4.2E-13	_							
<u>Cs-135</u>	<u>3.7E-15</u>	<u>1.6E-15</u>	<u>1.6E-15</u>	_							
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide							
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide							
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide							
Total	<u>1.5E-05</u>	2.4E-05	2.9E-05								

Table X-1-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), More ingestion)

(**************************************	1	ire assessmen	·	oup), wore ingestion)
		(mSv/year)		
Nuclide		Children		Remarks
	Adult	under	Infants	
G., 100	2.70.05	school age	0.0E.05	
<u>Sn-123</u>	3.7E-05	7.0E-05	8.9E-05	_
I-129	1.3E-05	1.0E-05	4.1E-06	
C-14	5.2E-06	4.5E-06	2.5E-06	
<u>Sn-126</u>	<u>1.9E-06</u>	3.2E-06	<u>4.0E-06</u>	_
<u>Cd-115m</u>	<u>1.6E-06</u>	<u>2.3E-06</u>	3.8E-06	_
<u>Sn-119m</u>	<u>8.5E-07</u>	<u>1.6E-06</u>	2.1E-06	_
Cd-113m	3.1E-07	2.6E-07	3.1E-07	
Co-60	2.7E-07	6.8E-07	8.4E-07	
Ru-106	1.6E-07	2.9E-07	3.8E-07	
H-3	1.3E-07	1.1E-07	8.7E-08	
<u>Fe-59</u>	1.2E-07	2.6E-07	5.3E-07	_
<u>Pm-148</u>	9.4E-08	1.7E-07	2.0E-07	_
<u>Te-129m</u>	8.0E-08	<u>1.6E-07</u>	2.3E-07	_
Tc-99	7.7E-08	1.4E-07	2.3E-07	
<u>Y-91</u>	<u>6.7E-08</u>	<u>1.2E-07</u>	1.5E-07	_
<u>Te-127m</u>	<u>6.1E-08</u>	<u>1.3E-07</u>	<u>2.1E-07</u>	_
<u>Zn-65</u>	3.3E-08	<u>4.1E-08</u>	5.9E-08	_
<u>Te-125m</u>	2.4E-08	4.5E-08	7.0E-08	_
Cs-137	1.5E-08	5.6E-09	4.9E-09	
Ni-63	1.5E-08	2.3E-08	3.1E-08	
Ce-144	1.4E-08	2.5E-08	3.4E-08	
<u>Ag-110m</u>	<u>9.9E-09</u>	<u>1.4E-08</u>	<u>1.7E-08</u>	_
<u>Y-90</u>	7.5E-09	1.4E-08	<u>1.7E-08</u>	_
Pu-239	7.0E-09	4.6E-09	2.3E-08	
Pu-240	7.0E-09	4.6E-09	2.3E-08	
Am-241	6.7E-09	4.6E-09	2.4E-08	
<u>Am-243</u>	<u>6.7E-09</u>	4.6E-09	2.3E-08	
Pu-238	6.4E-09	4.3E-09	2.2E-08	

Table X-1-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), More ingestion)

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

153

(2001000000		ure assessmen	<u> </u>	oup), More ingestion)
Nuclide		(mSv/year) Children		Remarks
	Adult	under school age	Infants	
I-129	1.3E-05	1.0E-05	4.1E-06	
C-14	5.2E-06	4.5E-06	2.5E-06	
<u>Se-79</u>	<u>1.2E-06</u>	<u>4.0E-06</u>	3.4E-06	_
Cd-113m	3.1E-07	2.6E-07	3.1E-07	
Co-60	2.7E-07	6.8E-07	8.4E-07	
Ru-106	1.6E-07	2.9E-07	3.8E-07	
H-3	<u>1.2E-07</u>	1.1E-07	8.7E-08	
Tc-99	7.7E-08	1.4E-07	2.3E-07	
Cs-137	1.5E-08	5.6E-09	4.9E-09	
Ni-63	1.5E-08	2.3E-08	3.1E-08	
Ce-144	1.4E-08	2.5E-08	3.4E-08	
Pu-239	7.0E-09	4.6E-09	2.3E-08	
Pu-240	7.0E-09	4.6E-09	2.3E-08	
Am-241	6.7E-09	4.6E-09	2.4E-08	
Pu-238	6.4E-09	4.3E-09	2.2E-08	
Pu-241	6.0E-09	3.4E-09	1.3E-08	
Sb-125	5.2E-09	8.2E-09	1.1E-08	
<u>Te-125m</u>	<u>4.1E-09</u>	<u>8.0E-09</u>	1.3E-08	_
Cm-243	3.5E-09	2.5E-09	1.4E-08	
Pm-147	3.4E-09	6.4E-09	9.2E-09	
Cm-244	2.8E-09	2.2E-09	1.3E-08	
Cs-134	2.3E-09	8.1E-10	6.4E-10	
Mn-54	1.8E-09	2.5E-09	2.7E-09	
Eu-154	1.7E-09	2.7E-09	4.1E-09	
Sr-90	1.1E-09	9.6E-10	1.8E-09	
Eu-155	7.4E-10	1.3E-09	1.9E-09	
<u>Np-237</u>	<u>2.1E-10</u>	<u>1.3E-10</u>	<u>7.2E-10</u>	_
<u>Y-90</u>	<u>1.1E-10</u>	<u>2.0E-10</u>	<u>2.5E-10</u>	_

Current	Revised Reason for 1
Pm-146 6.1E-09 9.6E-09 1.3E-08	<u>U-234</u> <u>2.4E-11</u> <u>2.2E-11</u> <u>3.5E-11</u> _ Appropriate descrip
Pu-241 6.0E-09 3.4E-09 1.3E-08	U-238 2.2E-11 2.0E-11 3.2E-11 _ selection of nucleon measured and asses
Sb-125 5.2E-09 8.2E-09 1.1E-08	Sm-151 6.1E-12 1.0E-11 1.8E-11
<u>Te-127</u> <u>4.5E-09</u> <u>8.3E-09</u> <u>7.8E-09</u>	
Cm-243 3.5E-09 2.5E-09 1.4E-08	
Pm-147 3.4E-09 6.4E-09 9.2E-09	
Cm-244 2.8E-09 2.2E-09 1.3E-08	
<u>Eu-152</u> <u>2.7E-09</u> <u>4.0E-09</u> <u>6.1E-09</u>	
Cs-134 2.3E-09 8.1E-10 6.4E-10	
Mn-54 1.8E-09 2.5E-09 2.7E-09	
<u>Te-129</u> <u>1.7E-09</u> <u>2.8E-09</u> <u>3.9E-09</u>	
Eu-154 1.7E-09 2.7E-09 4.1E-09	
<u>Tb-160</u> <u>1.5E-09</u> <u>2.5E-09</u> <u>2.8E-09</u>	
Sr-90 1.1E-09 9.6E-10 1.8E-09	
<u>Co-58</u> <u>1.1E-09</u> <u>1.9E-09</u> <u>2.1E-09</u>	
<u>Te-123m</u> <u>1.1E-09</u> <u>1.9E-09</u> <u>2.8E-09</u>	
<u>Pm-148m</u> <u>9.9E-10</u> <u>1.6E-09</u> <u>1.7E-09</u>	
<u>Ce-141</u> 7.5E-10 1.4E-09 1.7E-09	
Eu-155 7.4E-10 1.3E-09 1.9E-09	
<u>Gd-153</u> <u>6.0E-10</u> <u>1.0E-09</u> <u>1.3E-09</u>	
<u>Am-242m</u> <u>4.0E-10</u> <u>2.4E-10</u> <u>1.2E-09</u>	
<u>Sb-124</u> <u>3.4E-10</u> <u>5.8E-10</u> <u>6.9E-10</u>	
<u>Cm-242</u> <u>2.8E-10</u> <u>4.5E-10</u> <u>2.6E-09</u>	
<u>Cs-136</u> <u>2.5E-10</u> <u>2.5E-10</u> <u>2.5E-10</u>	<u></u>
<u>Rb-86</u> <u>2.1E-10</u> <u>3.7E-10</u> <u>4.6E-10</u>	
<u>Ba-140</u> <u>1.6E-10</u> <u>2.9E-10</u> <u>4.0E-10</u>	
<u>Nb-95</u> <u>1.4E-10</u> <u>2.2E-10</u> <u>2.1E-10</u>	<u>-</u>
<u>Pr-144</u> <u>1.1E-10</u> <u>1.9E-10</u> <u>2.7E-10</u>	<u>-</u>
<u>Ru-103</u> <u>1.1E-10</u> <u>1.7E-10</u> <u>2.0E-10</u>	
<u>Sr-89</u> <u>4.8E-11</u> <u>8.2E-11</u> <u>1.3E-10</u>	
Sm-151 6.1E-12 1.0E-11 1.8E-11	
Rh-103m 9.4E-13 1.6E-12 2.2E-12	
<u>Cs-135</u> <u>1.4E-14</u> <u>5.9E-15</u> <u>5.6E-15</u>	
	l with the nuclide
$\frac{\text{Ba-}137\text{m}}{\text{Ba-}137\text{m}}$ $\frac{0.0\text{E}+00}{\text{0.0E}+00}$ $\frac{0.0\text{E}+00}{\text{0.0E}+00}$ $\frac{\text{Assesse}}{\text{parent}}$	l with the nuclide
Pr_1/1/1m	with the publicle
Total <u>6.1E-05</u> <u>9.4E-05</u> <u>1.1E-04</u>	nuclide

Current			•	tution i full for i ukus	sililia Dalicili Nucleai Fowei Si	unon us spec	THOU I VUCTOR	Revis	•	2,71140111	Reason for Revision	
		Exposi	ıre assessmen	t result				Expos	ure assessmer	nt result		
			(mSv/year)	Г					(mSv/year)			
	Nuclide		Children		Remarks		Nuclide		Children		Remarks	
		Adult	under	Infants				Adult	under	Infants		
-	H-3	3.0E-07	school age 5.2E-07	Exempted			H-3	3.0E-07	school age 5.2E-07	Exempted		
-	I-129	2.7E-09	4.2E-09	Exempted			I-129	2.7E-09	4.2E-09	Exempted		
-	Y-91	8.4E-10	3.1E-09	Exempted			C-14	2.7E-09 2.2E-10	3.7E-10	Exempted		Appropriate description due to the
	<u>Sn-119m</u>	2.9E-10	1.1E-09	Exempted Exempted	_		Ru-106	2.0E-10	7.2E-10	Exempted		selection of nuclides to be
	<u>Sn-11311</u> <u>Sn-123</u>	2.9E-10	1.1E-09	Exempted Exempted	_		Pu-239	1.7E-10	2.2E-10	Exempted		measured and assessed
	<u>5n 125</u> <u>Te-127m</u>	2.3E-10	9.6E-10	Exempted Exempted	_		Pu-240	1.7E-10	2.2E-10	Exempted		
	C-14	2.2E-10	3.7E-10	Exempted Exempted	_		Pu-238	1.6E-10	2.1E-10	Exempted		
-	Ru-106	2.0E-10	7.2E-10	Exempted			Am-241	1.4E-10	1.8E-10	Exempted		
-	<u>Cd-115m</u>	1.8E-10	5.4E-10	<u>Exempted</u>			Pu-241	1.2E-10	1.4E-10	Exempted		
-	Pu-239	1.7E-10	2.2E-10	Exempted	_		Cm-243	1.0E-10	1.5E-10	Exempted		
	Pu-240	1.7E-10	2.2E-10	Exempted			<u>Se-79</u>	9.0E-11	5.9E-10	Exempted		
	Pu-238	1.6E-10	2.1E-10	Exempted			Cm-244	8.2E-11	1.3E-10	Exempted		
	Am-241	1.4E-10	1.8E-10	Exempted			Np-237	7.5E-11	9.5E-11	Exempted		
-	<u>Am-243</u>	1.4E-10	1.8E-10	Exempted			Ce-144	6.1E-11	2.2E-10	Exempted		
-	Pu-241	1.2E-10	1.4E-10	Exempted			Cs-137	5.1E-11	3.8E-11	Exempted		
	Cm-243	1.0E-10	1.5E-10	Exempted			Cd-113m	4.0E-11	6.8E-11	Exempted		
	<u>Te-129m</u>	<u>8.7E-11</u>	3.5E-10	Exempted			<u>U-234</u>	3.3E-11	6.0E-11	Exempted		
	Cm-244	8.2E-11	1.3E-10	Exempted	_		U-238	3.1E-11	5.4E-11	Exempted	_	
	Ce-144	6.1E-11	2.2E-10	Exempted			Cs-134	3.0E-11	2.0E-11	Exempted	-	
	Cs-137	5.1E-11	3.8E-11	Exempted			Ni-63	2.6E-11	8.1E-11	Exempted		
	Cd-113m	4.0E-11	6.8E-11	Exempted			Co-60	2.3E-11	1.2E-10	Exempted		
	Cs-134	3.0E-11	2.0E-11	Exempted			Sr-90	2.1E-11	3.5E-11	Exempted		
	<u>Rb-86</u>	2.9E-11	1.0E-10	Exempted	_		Tc-99	1.6E-11	5.7E-11	Exempted		
	<u>Sn-126</u>	2.8E-11	9.6E-11	Exempted	_		Sb-125	5.2E-12	1.6E-11	Exempted		
	Ni-63	2.6E-11	8.1E-11	Exempted			Eu-154	4.5E-12	1.5E-11	Exempted		
	Co-60	2.3E-11	1.2E-10	Exempted			Pm-147	4.3E-12	1.6E-11	Exempted		
	Sr-90	2.1E-11	3.5E-11	Exempted			Te-125m	4.1E-12	1.6E-11	Exempted		
	<u>Te-127</u>	1.6E-11	6.0E-11	Exempted	_		Eu-155	2.2E-12	7.7E-12	Exempted		
	Тс-99	1.6E-11	5.7E-11	Exempted			Y-90	2.0E-12	7.4E-12	Exempted		
	<u>Pm-148</u>	<u>1.3E-11</u>	4.6E-11	<u>Exempted</u>	_		Mn-54	5.6E-13	1.5E-12	Exempted		
	<u>Ba-140</u>	<u>1.1E-11</u>	3.8E-11	<u>Exempted</u>	_		Sm-151	2.2E-14	7.5E-14	Exempted		
	<u>Cm-242</u>	8.2E-12	2.7E-11	<u>Exempted</u>	_		Total	3.1E-07	<u>5.3E-07</u>	Exempted		
	<u>Eu-152</u>	<u>8.1E-12</u>	2.4E-11	Exempted	_					•		
	<u>Zn-65</u>	<u>7.6E-12</u>	<u>1.9E-11</u>	Exempted	_							
	Sb-125	5.2E-12	1.6E-11	Exempted								
	<u>Sb-124</u>	<u>5.0E-12</u>	1.7E-11	Exempted	_							
	<u>Tb-160</u>	4.6E-12	1.6E-11	Exempted	_							
	Eu-154	4.5E-12	1.5E-11	Exempted								

	<u> </u>	Curre	•	ilitation Fian for Fukusiinna Dancin	1 (0,01002 1 0 1) 01			Revis				Reason for Revision
Pm-147	4.3E-12	1.6E-11	Exempted									
Te-125m	4.1E-12	1.6E-11	Exempted									
<u>Ce-141</u>	3.8E-12	1.4E-11	Exempted									Appropriate description due to the
<u>Fe-59</u>	3.2E-12	1.3E-11	Exempted	_								selection of nuclides to be
<u>Cs-136</u>	2.9E-12	5.9E-12	Exempted	_								measured and assessed
<u>Sr-89</u>	2.9E-12	9.9E-12	Exempted									
<u>Te-123m</u>	2.7E-12	9.3E-12	Exempted									
<u>Ag-110m</u>	2.5E-12	6.9E-12	Exempted									
<u>Am-242m</u>	2.3E-12	2.8E-12	Exempted	_								
Eu-155	2.2E-12	7.7E-12	Exempted									
Y-90	2.0E-12	7.4E-12	Exempted									
<u>Te-129</u>	1.8E-12	6.1E-12	Exempted	_								
<u>Pm-148m</u>	1.7E-12	5.4E-12	Exempted	_								
<u>Gd-153</u>	1.4E-12	5.0E-12	Exempted	_								
Pm-146	1.2E-12	3.9E-12	Exempted	_								
<u>Ru-103</u>	8.0E-13	2.6E-12	Exempted	_								
<u>Co-58</u>	6.3E-13	2.2E-12	Exempted	_								
<u>Nb-95</u>	6.0E-13	1.9E-12	Exempted	_								
<u>Pr-144</u>	5.9E-13	2.0E-12	Exempted	_								
Mn-54	5.6E-13	1.5E-12	Exempted									
Sm-151	2.2E-14	7.5E-14	Exempted									
<u>Rh-103m</u>	4.1E-15	1.4E-14	Exempted	_								
<u>Cs-135</u>	4.9E-17	4.2E-17	Exempted	_								
Rh-106	0.0E+00	0.0E+00	Exempted	Assessed with the								
<u>KH-100</u>	0.0L+00	0.0L+00	Lacinpica	<u>parent nuclide</u> Assessed with the								
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Exempted	parent nuclide								
<u>Pr-144m</u>	0.0E+00	<u>0.0E+00</u>	Exempted	Assessed with the parent nuclide								
Total	3.1E-07	<u>5.4E-07</u>	Exempted	•								
				inhalation of seawater spray C tank group))	Ta					inhalation of seawater s	pray	
	Expos	ure assessmen	t result				Exposi	ure assessmen	t result			
27 111		(mSv/year)		5 1		27 111		(mSv/year)				
Nuclide	Adult	Children	Infants	Remarks		Nuclide	Adult	Children under	Infants	Remarks		
	Adult	under school age	iniants				Adult	school age	iniants			
H-3	7.3E-08	5.0E-08	3.4E-08			H-3	7.3E-08	5.0E-08	3.4E-08			
Pu-239	2.0E-08	9.6E-09	4.4E-09			Pu-239	2.0E-08	9.6E-09	4.4E-09			
Pu-240	2.0E-08	9.6E-09	4.4E-09			Pu-240	2.0E-08	9.6E-09	4.4E-09			
Pu-238	1.8E-08	9.0E-09	4.2E-09			Pu-238	1.8E-08	9.0E-09	4.2E-09			
Am-241	1.6E-08	7.7E-09	3.8E-09			Am-241	1.6E-08	7.7E-09	3.8E-09			
<u>Am-243</u>	1.6E-08	7.7E-09	3.8E-09	_		Pu-241	1.4E-08	6.1E-09	2.1E-09			
					i	<u> </u>		1				

Cm-243

Pu-241

1.4E-08

6.1E-09

2.1E-09

6.1E-09

1.1E-08

3.4E-09

Companison	Current						Revised					
Cm-243	1.1E-08	6.1E-09	3.4E-09			Cm-244	9.3E-09	5.3E-09	3.2E-09			
Cm-244	9.3E-09	5.3E-09	3.2E-09			<u>Np-237</u>	8.2E-09	3.9E-09	<u>2.1E-09</u> _	1	Appropriate description due to the	
Cm-242	9.7E-10	7.7E-10	5.7E-10			<u>U-234</u>	1.5E-09	1.2E-09	7.0E-10	1	selection of nuclides to be measured and assessed	
<u>Y-91</u>	7.5E-10	6.3E-10	4.7E-10	_		<u>U-238</u>	1.3E-09	1.0E-09	6 1E-10	1		
C-14	5.2E-10	3.9E-10	2.2E-10	_		C-14	5.2E-10	3.9E-10	2.2E-10	1		
Ru-106	4.6E-10	3.8E-10	2.3E-10			Ru-106	4.6E-10	3.8E-10	2.3E-10	1		
<u>Sn-119m</u>	4.6E-10	3.8E-10	2.7E-10	_		I-129	2.1E-10	1.4E-10	5.5E-11	1		
<u>Am-242m</u>	2.7E-10	1.3E-10	6.0E-11	_		Ce-144	1.5E-10	1.6E-10	1.3E-10	1		
<u>Sn-123</u>	2.7E-10	2.3E-10	1.7E-10	_		Tc-99	7.7E-11	5.6E-11	3.1E-11	1		
<u>Te-127m</u>	2.4E-10	1.9E-10	1.3E-10	_		Ni-63	5.5E-11	4.5E-11	2.6E-11	1		
I-129	2.1E-10	1.4E-10	5.5E-11			Co-60	5.1E-11	3.8E-11	1.9E-11			
Ce-144	1.5E-10	1.6E-10	1.3E-10			<u>Se-79</u>	<u>5.1E-11</u>	3.8E-11	2.2E-11 _			
<u>Cd-115m</u>	1.0E-10	8.9E-11	7.9E-11	_		Cd-113m	4.6E-11	3.0E-11	1.6E-11			
Tc-99	7.7E-11	5.6E-11	3.1E-11			Cs-137	3.7E-11	2.6E-11	1.3E-11			
<u>Eu-152</u>	<u>5.8E-11</u>	3.8E-11	2.0E-11	_		Eu-154	2.9E-11	2.1E-11	1.1E-11			
<u>Te-129m</u>	<u>5.5E-11</u>	4.6E-11	3.4E-11	_		Sr-90	2.9E-11	1.9E-11	9.7E-12			
Ni-63	5.5E-11	4.5E-11	2.6E-11			Pm-147	2.0E-11	1.7E-11	1.1E-11			
Co-60	5.1E-11	3.8E-11	1.9E-11			Sb-125	1.4E-11	1.1E-11	6.2E-12			
Cd-113m	4.6E-11	3.0E-11	1.6E-11			Eu-155	1.2E-11	9.3E-12	5.6E-12			
<u>Sn-126</u>	<u>4.0E-11</u>	3.5E-10	<u>2.2E-11</u>	_		Cs-134	7.5E-12	6.1E-12	3.4E-12			
Cs-137	3.7E-11	2.6E-11	1.3E-11			Te-125m	4.8E-12	3.5E-12	2.5E-12			
Eu-154	2.9E-11	2.1E-11	1.1E-11			Mn-54	2.8E-13	2.8E-13	1.8E-13			
Sr-90	2.9E-11	1.9E-11	9.7E-12			Y-90	2.7E-13	2.9E-13	3.0E-13			
Pm-147	2.0E-11	1.7E-11	1.1E-11			Sm-151	2.2E-13	1.4E-13	7.7E-14			
Sb-125	1.4E-11	1.1E-11	6.2E-12			Total	1.9E-07	1.1E-07	<u>6.3E-08</u>			
Eu-155	1.2E-11	9.3E-12	5.6E-12									
Cs-134	7.5E-12	6.1E-12	3.4E-12									
<u>Pm-146</u>	<u>7.0E-12</u>	<u>5.1E-12</u>	<u>2.7E-12</u>	_								
<u>Ba-140</u>	<u>5.8E-12</u>	<u>4.7E-12</u>	3.7E-12	_								
<u>Ce-141</u>	<u>4.9E-12</u>	3.6E-12	<u>2.7E-12</u>	_								
<u>Tb-160</u>	4.9E-12	<u>4.1E-12</u>	<u>2.9E-12</u>	_								
Te-125m	4.8E-12	3.5E-12	2.5E-12									
<u>Sb-124</u>	<u>4.1E-12</u>	3.4E-12	<u>2.4E-12</u>	_								
<u>Te-127</u>	3.3E-12	3.6E-12	3.6E-12	_								
<u>Gd-153</u>	<u>2.7E-12</u>	3.3E-12	<u>2.5E-12</u>	_								
<u>Ag-110m</u>	2.6E-12	<u>2.2E-12</u>	<u>1.3E-12</u>	_								
<u>Pm-148</u>	<u>2.5E-12</u>	2.5E-12	<u>2.2E-12</u>	_								
<u>Te-123m</u>	2.3E-12	1.8E-12	<u>1.2E-12</u>	_								
<u>Rb-86</u>	<u>2.3E-12</u>	3.3E-12	3.8E-12	_								
<u>Sr-89</u>	<u>2.1E-12</u>	1.8E-12	<u>1.3E-12</u>	_								
<u>Fe-59</u>	<u>1.7E-12</u>	1.4E-12	<u>1.2E-12</u>	_								
<u>Pm-148m</u>	<u>1.4E-12</u>	<u>1.1E-12</u>	<u>7.7E-13</u>	_								

comparison rable of amendments in the implementation rian for rukusi										
		Curre	ent							
<u>Zn-65</u>	<u>1.0E-12</u>	<u>1.0E-12</u>	9.0E-13	_						
<u>Ru-103</u>	<u>7.9E-13</u>	<u>6.2E-13</u>	4.4E-13	_						
<u>Cs-136</u>	<u>6.5E-13</u>	<u>5.5E-13</u>	4.5E-13	_						
<u>Nb-95</u>	4.5E-13	3.5E-13	2.5E-13	_						
<u>Co-58</u>	<u>4.3E-13</u>	3.6E-13	2.4E-13	_						
Mn-54	2.8E-13	2.8E-13	1.8E-13							
<u>Te-129</u>	<u>2.7E-13</u>	<u>2.7E-13</u>	3.1E-13	_						
Y-90	2.7E-13	2.9E-13	3.0E-13							
Sm-151	2.2E-13	1.4E-13	7.7E-14							
<u>Pr-144</u>	<u>5.1E-14</u>	<u>5.8E-14</u>	<u>6.9E-14</u>	_						
<u>Rh-103m</u>	<u>7.1E-16</u>	<u>6.9E-16</u>	<u>6.8E-16</u>	_						
<u>Cs-135</u>	<u>5.1E-17</u>	3.7E-17	<u>2.1E-17</u>	_						
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
<u>Pr-144m</u>	<u>Pr-144m</u> <u>0.0E+00</u>		<u>0.0E+00</u>	Assessed with the parent nuclide						
Total	2.0E-07	1.1E-07	6.5E-08							

Table X-2-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), Average ingestion)

	Expos	ure assessmen	t result	
		(mSv/year)		
Nuclide		Children		Remarks
	Adult	under	Infants	
		school age		
<u>Sn-119m</u>	<u>1.3E-05</u>	2.5E-05	3.2E-05	_
<u>Sn-123</u>	<u>1.3E-05</u>	<u>2.3E-05</u>	3.1E-05	_
<u>Sn-126</u>	<u>1.2E-06</u>	<u>2.1E-06</u>	2.7E-06	_
C-14	3.8E-07	3.3E-07	1.9E-07	
I-129	3.6E-07	2.7E-07	1.1E-07	
<u>Cd-115m</u>	<u>2.9E-07</u>	<u>4.3E-07</u>	7.2E-07	_
Cd-113m	6.4E-08	5.4E-08	6.7E-08	
<u>Te-127m</u>	<u>5.0E-08</u>	<u>1.0E-07</u>	1.8E-07	_
H-3	3.3E-08	2.8E-08	2.3E-08	
<u>Fe-59</u>	2.7E-08	<u>5.7E-08</u>	1.2E-07	_
<u>Y-91</u>	2.3E-08	<u>4.1E-08</u>	<u>5.1E-08</u>	_
<u>Te-129m</u>	1.9E-08	3.6E-08	<u>5.4E-08</u>	_
Am-241	1.7E-08	1.1E-08	6.1E-08	
<u>Am-243</u>	1.7E-08	<u>1.1E-08</u>	<u>5.9E-08</u>	_
Pu-239	1.6E-08	1.1E-08	5.4E-08	
Pu-240	1.6E-08	1.1E-08	5.4E-08	
Pu-238	1.5E-08	1.0E-08	5.1E-08	

Table X-2-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), Average ingestion)

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

	Expos	ure assessmen	t result	
		(mSv/year)		
Nuclide		Children		Remarks
	Adult	under	Infants	
		school age		
C-14	3.8E-07	3.3E-07	1.9E-07	
I-129	3.6E-07	2.7E-07	1.1E-07	
<u>Se-79</u>	<u>7.5E-08</u>	2.5E-07	2.2E-07	<u> </u>
Cd-113m	6.4E-08	5.4E-08	6.7E-08	
H-3	3.2E-08	2.8E-08	2.3E-08	
Am-241	1.7E-08	1.1E-08	6.1E-08	
Pu-239	1.6E-08	1.1E-08	5.4E-08	
Pu-240	1.6E-08	1.1E-08	5.4E-08	
Pu-238	1.5E-08	1.0E-08	5.1E-08	
Pu-241	1.1E-08	6.5E-09	2.6E-08	
Cm-243	8.7E-09	6.2E-09	3.6E-08	
Co-60	8.6E-09	2.2E-08	2.7E-08	
Cm-244	7.0E-09	5.4E-09	3.3E-08	
Ru-106	6.6E-09	1.2E-08	1.5E-08	
Tc-99	6.5E-09	1.1E-08	1.9E-08	
Ce-144	5.8E-09	1.0E-08	1.4E-08	
Ni-63	3.2E-09	4.9E-09	6.8E-09	

•		Curre	•		minia Dancini Nuclear Fower S			Revis	·	_ ,	Reason for Revision
Pu-241	1.1E-08	6.5E-09	2.6E-08			Eu-154	6.6E-10	1.1E-09	1.6E-09		
Cm-243	8.7E-09	6.2E-09	3.6E-08			Pm-147	6.2E-10	1.2E-09	1.7E-09		
Co-60	8.6E-09	2.2E-08	2.7E-08			Cs-137	4.3E-10	1.6E-10	1.4E-10		
<u>Zn-65</u>	8.0E-09	1.0E-08	1.5E-08	_		Mn-54	4.2E-10	5.7E-10	6.4E-10		Appropriate description due to t
Cm-244	7.0E-09	5.4E-09	3.3E-08	_		<u>Np-237</u>	4.2E-10	2.7E-10	1.5E-09	_	selection of nuclides to measured and assessed
Ru-106	6.6E-09	1.2E-08	1.5E-08			Eu-155	3.3E-10	5.6E-10	8.7E-10		measured and assessed
Tc-99	6.5E-09	1.1E-08	1.9E-08			Cs-134	2.5E-10	8.5E-11	7.0E-11		
Ce-144	5.8E-09	1.0E-08	1.4E-08			Sb-125	2.4E-10	3.7E-10	4.9E-10		
<u>Ag-110m</u>	3.7E-09	5.2E-09	6.4E-09	_		Te-125m	1.9E-10	3.6E-10	5.8E-10		
<u>Te-127</u>	3.5E-09	6.3E-09	6.2E-09	_		<u>U-234</u>	<u>5.9E-11</u>	<u>5.2E-11</u>	<u>8.6E-11</u>	_	
Ni-63	3.2E-09	4.9E-09	6.8E-09			<u>U-238</u>	<u>5.4E-11</u>	<u>4.7E-11</u>	<u>7.9E-11</u>	_	
<u>Pm-148</u>	1.9E-09	3.4E-09	<u>4.1E-09</u>	_		Sr-90	9.6E-12	8.1E-12	1.6E-11		
<u>Eu-152</u>	<u>1.2E-09</u>	<u>1.7E-09</u>	<u>2.7E-09</u>	_		Sm-151	3.2E-12	5.5E-12	9.8E-12		
<u>Te-125m</u>	8.9E-10	<u>1.6E-09</u>	<u>2.6E-09</u>	_		Y-90	9.3E-13	1.7E-12	2.1E-12		
<u>Cm-242</u>	<u>7.0E-10</u>	<u>1.1E-09</u>	<u>6.6E-09</u>	_		Total	1.0E-06	<u>1.1E-06</u>	1.0E-06		
Eu-154	6.6E-10	1.1E-09	1.6E-09								
Pm-147	6.2E-10	1.2E-09	1.7E-09								
<u>Te-123m</u>	<u>5.7E-10</u>	9.8E-10	<u>1.5E-09</u>	_							
Cs-137	4.3E-10	1.6E-10	1.4E-10								
Mn-54	4.2E-10	5.7E-10	6.4E-10								
<u>Te-129</u>	3.9E-10	<u>6.4E-10</u>	9.2E-10	<u>–</u>							
<u>Ce-141</u>	3.6E-10	<u>6.4E-10</u>	<u>7.9E-10</u>	_							
Eu-155	3.3E-10	5.6E-10	8.7E-10								
<u>Tb-160</u>	<u>3.1E-10</u>	<u>5.2E-10</u>	<u>6.1E-10</u>								
<u>Am-242m</u>	<u>2.9E-10</u>	<u>1.7E-10</u>	<u>9.1E-10</u>	_							
Cs-134	2.5E-10	8.5E-11	7.0E-11								
<u>Pm-148m</u>	<u>2.4E-10</u>	4.0E-10	4.3E-10								
Sb-125	2.4E-10	3.7E-10	4.9E-10								
<u>Co-58</u>	2.3E-10	<u>4.1E-10</u>	<u>4.6E-10</u>	-							
<u>Sb-124</u>	2.3E-10	3.9E-10	4.7E-10	_							
<u>Gd-153</u>	2.1E-10	3.7E-10	4.5E-10	_							
<u>Pm-146</u>	<u>1.8E-10</u>	2.8E-10	4.0E-10	_							
<u>Y-90</u>	<u>5.4E-11</u>	9.9E-11	<u>1.2E-10</u>	_							
<u>Pr-144</u>	<u>4.7E-11</u>	7.8E-11	<u>1.2E-10</u>	_							
<u>Nb-95</u>	3.2E-11	4.9E-11	<u>5.0E-11</u>	_							
<u>Rb-86</u>	3.1E-11	<u>5.4E-11</u>	<u>6.9E-11</u>	_							
<u>Ru-103</u>	<u>2.6E-11</u>	<u>4.2E-11</u>	<u>4.9E-11</u>	_							
<u>Cs-136</u>	<u>2.4E-11</u>	2.5E-11	2.5E-11								
<u>Ba-140</u>	<u>1.9E-11</u>	3.3E-11	4.6E-11								
Sr-90	9.6E-12	8.1E-12	1.6E-11								
Sm-151	3.2E-12	5.5E-12	9.8E-12								
<u>Sr-89</u>	<u>1.3E-12</u>	<u>2.3E-12</u>	3.7E-12	_							

		Curre	nt	
<u>Rh-103m</u>	<u>2.1E-13</u>	3.6E-13	<u>5.2E-13</u>	_
<u>Cs-135</u>	<u>4.2E-16</u>	<u>1.8E-16</u>	<u>1.7E-16</u>	_
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Pr-144m</u> <u>0.0E+00</u>		<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
Total	<u>2.8E-05</u>	<u>5.1E-05</u>	<u>6.7E-05</u>	

Table X-2-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

(Source term	Source term based on measured values (J1-C tank group), More ingestion) Exposure assessment result										
	Exposi										
Nuclide		(mSv/year) Children		Remarks							
ruciide	Adult	under	Infants	Kemarks							
		school age									
<u>Sn-119m</u>	<u>4.9E-05</u>	9.4E-05	<u>1.2E-04</u>	_							
<u>Sn-123</u>	<u>4.7E-05</u>	<u>8.9E-05</u>	<u>1.1E-04</u>	_							
<u>Sn-126</u>	<u>4.6E-06</u>	<u>8.0E-06</u>	<u>9.9E-06</u>	_							
I-129	1.7E-06	1.3E-06	5.4E-07								
<u>Cd-115m</u>	<u>1.5E-06</u>	<u>2.3E-06</u>	3.7E-06	_							
C-14	1.4E-06	1.3E-06	7.0E-07								
Cd-113m	3.4E-07	2.9E-07	3.4E-07								
<u>Te-127m</u>	2.2E-07	<u>4.5E-07</u>	<u>7.6E-07</u>	_							
<u>Fe-59</u>	<u>1.5E-07</u>	<u>3.1E-07</u>	<u>6.2E-07</u>	_							
Н-3	<u>1.3E-07</u>	1.1E-07	8.7E-08								
<u>Y-91</u>	<u>1.2E-07</u>	<u>2.2E-07</u>	<u>2.7E-07</u>	_							
Pu-239	8.5E-08	5.6E-08	2.8E-07								
Pu-240	8.5E-08	5.6E-08	2.8E-07								
Am-241	8.2E-08	5.5E-08	2.9E-07								
<u>Am-243</u>	8.2E-08	5.5E-08	2.8E-07	_							
<u>Te-129m</u>	<u>8.1E-08</u>	<u>1.6E-07</u>	2.3E-07	_							
Pu-238	7.8E-08	5.3E-08	2.6E-07								
Pu-241	5.9E-08	3.4E-08	1.3E-07								
<u>Zn-65</u>	4.8E-08	6.0E-08	8.6E-08	_							
Co-60	4.7E-08	1.2E-07	1.5E-07								
Cm-243	4.2E-08	3.1E-08	1.7E-07								
Cm-244	3.4E-08	2.7E-08	1.6E-07								
Ru-106	3.3E-08	5.9E-08	7.6E-08								
Tc-99	3.1E-08	5.5E-08	9.2E-08								
Ce-144	2.9E-08	5.3E-08	7.1E-08								
<u>Ag-110m</u>	1.8E-08	2.5E-08	3.0E-08	_							
<u>Te-127</u>	1.5E-08	2.8E-08	<u>2.7E-08</u>	_							
Ni-63	1.3E-08	2.1E-08	2.8E-08								
<u>Pm-148</u>	1.0E-08	1.8E-08	2.2E-08	_							

Table X-2-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

(Source term based on measured values (J1-C tank group), More ingestion) Exposure assessment result										
	Exposi									
Nuclide		(mSv/year) Children		Remarks						
Tracinae	Adult	under	Infants	Remarks						
		school age								
I-129	1.7E-06	1.3E-06	5.4E-07							
C-14	1.4E-06	1.3E-06	7.0E-07							
Cd-113m	3.4E-07	2.9E-07	3.4E-07							
<u>Se-79</u>	<u>2.8E-07</u>	<u>9.3E-07</u>	<u>8.0E-07</u>	_						
H-3	<u>1.2E-07</u>	1.1E-07	8.7E-08							
Pu-239	8.5E-08	5.6E-08	2.8E-07							
Pu-240	8.5E-08	5.6E-08	2.8E-07							
Am-241	8.2E-08	5.5E-08	2.9E-07							
Pu-238	7.8E-08	5.3E-08	2.6E-07							
Pu-241	5.9E-08	3.4E-08	1.3E-07							
Co-60	4.7E-08	1.2E-07	1.5E-07							
Cm-243	4.2E-08	3.1E-08	1.7E-07							
Cm-244	3.4E-08	2.7E-08	1.6E-07							
Ru-106	3.3E-08	5.9E-08	7.6E-08							
Tc-99	3.1E-08	5.5E-08	9.2E-08							
Ce-144	2.9E-08	5.3E-08	7.1E-08							
Ni-63	1.3E-08	2.1E-08	2.8E-08							
Eu-154	3.5E-09	5.8E-09	8.6E-09							
Pm-147	3.4E-09	6.2E-09	9.0E-09							
<u>Np-237</u>	2.5E-09	<u>1.6E-09</u>	8.8E-09	_						
Mn-54	2.4E-09	3.2E-09	3.6E-09							
Eu-155	1.8E-09	3.0E-09	4.6E-09							
Cs-137	1.6E-09	5.8E-10	5.1E-10							
Cs-134	9.1E-10	3.2E-10	2.5E-10							
Sb-125	8.4E-10	1.3E-09	1.7E-09							
<u>Te-125m</u>	<u>6.7E-10</u>	<u>1.3E-09</u>	2.0E-09	_						
<u>U-234</u>	2.9E-10	2.6E-10	<u>4.3E-10</u>	_						
<u>U-238</u>	<u>2.7E-10</u>	<u>2.4E-10</u>	3.9E-10	_						
Sr-90 4.3E-11		3.6E-11	7.0E-11							

-		Curre	•				Revis	Reference, Attachment-2, Attachment I-XIII and	Reason for Revision
Eu-152	6.3E-09	9.3E-09	1.4E-08	_	Sm-151	1.7E-11	2.9E-11	5.2E-11	Appropriate description due to the
<u>Te-125m</u>	3.9E-09	7.3E-09	1.1E-08	_	<u>Y-90</u>	4.1E-12	7.7E-12	9.4E-12	selection of nuclides to be measured and assessed
Eu-154	3.5E-09	5.8E-09	8.6E-09		Total	4.5E-06	4.5E-06	4.5E-06	measured and assessed
<u>Cm-242</u>	3.4E-09	5.5E-09	3.2E-08	_			•		
Pm-147	3.4E-09	6.2E-09	9.0E-09						
<u>Te-123m</u>	<u>2.5E-09</u>	4.4E-09	<u>6.6E-09</u>	_					
Mn-54	2.4E-09	3.2E-09	3.6E-09						
<u>Ce-141</u>	<u>1.8E-09</u>	3.3E-09	<u>4.0E-09</u>	_					
Eu-155	1.8E-09	3.0E-09	4.6E-09						
<u>Te-129</u>	<u>1.7E-09</u>	2.8E-09	<u>4.0E-09</u>	_					
<u>Tb-160</u>	<u>1.7E-09</u>	2.8E-09	3.3E-09	_					
Cs-137	1.6E-09	5.8E-10	5.1E-10						
<u>Am-242m</u>	<u>1.4E-09</u>	<u>8.4E-10</u>	<u>4.4E-09</u>	_					
<u>Pm-148m</u>	<u>1.3E-09</u>	<u>2.1E-09</u>	<u>2.3E-09</u>	_					
<u>Co-58</u>	<u>1.3E-09</u>	<u>2.2E-09</u>	<u>2.4E-09</u>	_					
<u>Gd-153</u>	<u>1.1E-09</u>	<u>2.0E-09</u>	<u>2.4E-09</u>	_					
<u>Pm-146</u>	<u>9.7E-10</u>	<u>1.5E-09</u>	<u>2.1E-09</u>	_					
Cs-134	9.1E-10	3.2E-10	2.5E-10						
Sb-125	8.4E-10	1.3E-09	1.7E-09						
<u>Sb-124</u>	8.1E-10	1.4E-09	1.6E-09	_					
<u>Y-90</u>	2.9E-10	5.3E-10	6.3E-10						
<u>Pr-144</u>	2.3E-10	3.9E-10	5.7E-10						
<u>Nb-95</u>	1.6E-10	2.5E-10	2.5E-10						
Ru-103 Rb-86	1.3E-10 1.3E-10	2.1E-10 2.3E-10	2.4E-10 2.8E-10						
<u>Cs-136</u>	8.9E-11		9.0E-11						
<u>Ba-140</u>	8.0E-11	9.2E-11 1.4E-10	1.9E-10	_					
Sr-90	4.3E-11	3.6E-11	7.0E-11						
Sm-151	1.7E-11	2.9E-11	5.2E-11						
<u>Sr-89</u>	6.0E-12	1.0E-11	1.6E-11						
Rh-103m	1.2E-12	2.0E-12	2.8E-12						
<u>Cs-135</u>	1.5E-15	6.5E-16	6.3E-16						
Rh-106	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide					
<u>Ba-137m</u>	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide					
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide					
Total	<u>1.1E-04</u>	2.0E-04	2.5E-04						
				m ingestion of seawater C tank group))				nent result from ingestion of seawater ed values (J1-C tank group))	

1		Curre				•		Revis		,	Reason for Revision
	Expos	ure assessmen	t result				Expos	ure assessmen	t result		
Nuclide		(mSv/year) Children	<u> </u>	Remarks		Nuclide		(mSv/year) Children		Remarks	
Nuclide	Adult	under	Infants	Remarks		Nuclide	Adult	under	Infants	Kemarks	
		school age						school age			
H-3	3.0E-07	5.2E-07	Exempted			H-3	3.0E-07	5.2E-07	Exempted		
I-129	2.3E-09	3.5E-09	Exempted			I-129	2.3E-09	3.5E-09	Exempted		
<u>Y-91</u>	<u>1.8E-09</u>	<u>6.6E-09</u>	Exempted	_		C-14	5.8E-10	9.9E-10	Exempted		Appropriate description due to the
<u>Sn-119m</u>	<u>8.5E-10</u>	3.3E-09	Exempted	_		Pu-239	4.4E-10	5.8E-10	Exempted		selection of nuclides to be measured and assessed
<u>Sn-123</u>	<u>8.3E-10</u>	3.1E-09	Exempted	_		Pu-240	4.4E-10	5.8E-10	Exempted		
<u>Te-127m</u>	<u>6.5E-10</u>	2.7E-09	Exempted	_		Pu-238	4.0E-10	5.4E-10	Exempted		
C-14	5.8E-10	9.9E-10	Exempted			Am-241	3.5E-10	4.7E-10	Exempted		
<u>Cd-115m</u>	<u>4.7E-10</u>	<u>1.4E-09</u>	<u>Exempted</u>	_		Pu-241	3.0E-10	3.4E-10	Exempted		
Pu-239	4.4E-10	5.8E-10	Exempted			<u>Se-79</u>	<u>2.7E-10</u>	<u>1.8E-09</u>	<u>Exempted</u>		
Pu-240	4.4E-10	5.8E-10	Exempted			Cs-137	2.7E-10	2.0E-10	Exempted		
Pu-238	4.0E-10	5.4E-10	Exempted			Cm-243	2.6E-10	3.9E-10	Exempted		
Am-241	3.5E-10	4.7E-10	Exempted			Cm-244	2.1E-10	3.3E-10	Exempted		
<u>Am-243</u>	3.5E-10	<u>4.7E-10</u>	Exempted	_		Ru-106	2.1E-10	7.5E-10	Exempted		
Pu-241	3.0E-10	3.4E-10	Exempted			<u>Np-237</u>	<u>1.9E-10</u>	<u>2.5E-10</u>	Exempted	_	
Cs-137	2.7E-10	2.0E-10	Exempted			Ce-144	1.8E-10	6.5E-10	Exempted		
Cm-243	2.6E-10	3.9E-10	Exempted			Cd-113m	1.2E-10	2.1E-10	Exempted		
<u>Te-129m</u>	<u>2.3E-10</u>	<u>9.0E-10</u>	<u>Exempted</u>	_		<u>U-234</u>	8.6E-11	<u>1.5E-10</u>	<u>Exempted</u>	_	
Cm-244	2.1E-10	3.3E-10	Exempted			Ni-63	8.3E-11	2.5E-10	Exempted		
Ru-106	2.1E-10	7.5E-10	Exempted			Cs-134	8.0E-11	5.5E-11	Exempted		
Ce-144	1.8E-10	6.5E-10	Exempted			<u>U-238</u>	7.9E-11	<u>1.4E-10</u>	<u>Exempted</u>	_	
Cd-113m	1.2E-10	2.1E-10	Exempted			Sr-90	5.6E-11	9.4E-11	Exempted		
Ni-63	8.3E-11	2.5E-10	Exempted			Tc-99	5.2E-11	1.9E-10	Exempted		
<u>Rb-86</u>	<u>8.2E-11</u>	<u>2.9E-10</u>	Exempted	_		Co-60	4.9E-11	2.4E-10	Exempted		
Cs-134	8.0E-11	5.5E-11	Exempted			Eu-154	1.3E-11	4.1E-11	Exempted		
<u>Pm-148</u>	<u>7.6E-11</u>	<u>2.7E-10</u>	Exempted	_		Pm-147	1.2E-11	4.3E-11	Exempted		
Sr-90	5.6E-11	9.4E-11	Exempted			Sb-125	9.6E-12	3.0E-11	Exempted		
Tc-99	5.2E-11	1.9E-10	Exempted			Te-125m	7.6E-12	2.9E-11	Exempted		
Co-60	4.9E-11	2.4E-10	Exempted			Y-90	5.4E-12	2.0E-11	Exempted		
<u>Te-127</u>	4.6E-11	1.7E-10	Exempted	_		Eu-155	3.6E-12	1.2E-11	Exempted		
<u>Sn-126</u>	4.4E-11	1.5E-10	Exempted	_		Mn-54	1.7E-12	4.5E-12	Exempted		
<u>Ba-140</u>	2.8E-11	9.8E-11	Exempted	_		Sm-151	6.1E-14	2.1E-13	Exempted		
<u>Cm-242</u>	<u>2.1E-11</u>	<u>6.8E-11</u>	Exempted	_		Total	3.1E-07	<u>5.4E-07</u>	Exempted		
<u>Zn-65</u>	2.0E-11	4.9E-11	Exempted	_							
<u>Eu-152</u>	1.7E-11	4.9E-11	Exempted	_							
<u>Tb-160</u>	1.4E-11	4.7E-11	Exempted	_							
Sb-124	1.3E-11	4.4E-11	Exempted	_							
Eu-154	1.3E-11	4.1E-11	Exempted								
Pm-147	1.2E-11	4.3E-11	Exempted								
Sb-125	9.6E-12	3.0E-11	Exempted								
•		•	•		•						

	•		Curre					t		Revise		tuomment 2,7xtuom		Reason for Revision
	<u>Fe-59</u>	8.1E-12	3.4E-11	Exempted										Appropriate description due to the
-	Te-125m	7.6E-12	2.9E-11	Exempted										selection of nuclides to be
•	<u>Sr-89</u>	7.3E-12	2.5E-11	Exempted	_									measured and assessed
	<u>Ag-110m</u>	7.0E-12	2.0E-11	Exempted										
•	<u>Cs-136</u>	6.8E-12	1.4E-11	Exempted										
	<u>Am-242m</u>	6.1E-12	7.3E-12	Exempted	_									
	<u>Te-123m</u>	5.9E-12	2.1E-11	Exempted	_									
	Y-90	5.4E-12	2.0E-11	Exempted										
	<u>Ce-141</u>	5.3E-12	2.0E-11	Exempted	_									
	<u>Te-129</u>	4.7E-12	<u>1.6E-11</u>	Exempted	_									
	<u>Pm-148m</u>	4.4E-12	<u>1.4E-11</u>	<u>Exempted</u>										
	Eu-155	3.6E-12	1.2E-11	Exempted										
	<u>Pm-146</u>	3.5E-12	<u>1.1E-11</u>	<u>Exempted</u>	_									
	<u>Gd-153</u>	3.2E-12	<u>1.1E-11</u>	<u>Exempted</u>	_									
	<u>Ru-103</u>	<u>2.3E-12</u>	<u>7.7E-12</u>	<u>Exempted</u>	_									
	<u>Pr-144</u>	<u>1.7E-12</u>	<u>5.9E-12</u>	<u>Exempted</u>	_									
	<u>Co-58</u>	<u>1.7E-12</u>	<u>6.0E-12</u>	Exempted	_									
	<u>Nb-95</u>	<u>1.7E-12</u>	<u>5.3E-12</u>	<u>Exempted</u>	_									
	Mn-54	1.7E-12	4.5E-12	Exempted										
	Sm-151	6.1E-14	2.1E-13	Exempted										
	<u>Rh-103m</u>	<u>1.2E-14</u>	4.1E-14	Exempted	_									
	<u>Cs-135</u>	<u>2.6E-16</u>	<u>2.2E-16</u>	Exempted	_									
	<u>Rh-106</u>	0.0E+00	0.0E+00	Exempted	Assessed with the									
					Parent nuclide Assessed with the									
	<u>Ba-137m</u>	<u>0.0E+00</u>	0.0E+00	Exempted	parent nuclide									
	<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Exempted	Assessed with the parent nuclide									
	Total	3.2E-07	<u>5.5E-07</u>	Exempted										
Table X					m inhalation of seawat	er spray	Table X-3-2	Ass	essment resu	ult of internal	exposure fro	m inhalation of seawa	ter spray	
[(Sour		ure assessmen		G tank group))]		(Sourc		are assessment	· · · · · · · · · · · · · · · · · · ·	G tank group))	7	
		2.1P00	(mSv/year)							(mSv/year)				
	Nuclide	Adult	Children under	Infants	Remarks		Nu	ıclide	Adult	Children under	Infants	Remarks		
		Adult	school age	mants					Aduit	school age	miants			
	H-3	7.3E-08	5.0E-08	3.4E-08			I	H-3	7.3E-08	5.0E-08	3.4E-08			
	Pu-239	5.1E-08	2.5E-08	1.1E-08			Pu	1-239	5.1E-08	2.5E-08	1.1E-08			
	Pu-240	5.1E-08	2.5E-08	1.1E-08			Pu	1-240	5.1E-08	2.5E-08	1.1E-08			
	Pu-238	4.6E-08	2.3E-08	1.1E-08			Pu	1-238	4.6E-08	2.3E-08	1.1E-08			
ļ	Am-241	4.1E-08	2.0E-08	9.8E-09			An	m-241	4.1E-08	2.0E-08	9.8E-09			
ļ	<u>Am-243</u>	<u>4.1E-08</u>	<u>2.0E-08</u>	9.8E-09	_		Pu	ı-241	3.5E-08	1.5E-08	5.4E-09			
	Pu-241	3.5E-08	1.5E-08	5.4E-09			Cn	m-243	2.9E-08	1.6E-08	8.7E-09			
	Cm-243	2.9E-08	1.6E-08	8.7E-09			Cn	m-244	2.4E-08	1.4E-08	8.1E-09			
	Cm-244	2.4E-08	1.4E-08	8.1E-09			<u>N</u> r	p-237	<u>2.1E-08</u>	<u>9.9E-09</u>	<u>5.3E-09</u>	_		

	Current				nation Flan for Faxasimia Danom F	1		Revis		-,	Reason for Revision
	Cm-242	2.5E-09	2.0E-09	1.5E-09		<u>U-234</u>	4.0E-09	3.1E-09	1.8E-09	_	Appropriate description due to the
	<u>Y-91</u>	1.6E-09	1.3E-09	1.0E-09	_	<u>U-238</u>	3.4E-09	2.7E-09	1.6E-09	_	selection of nuclides to be
	C-14	1.4E-09	1.0E-09	5.9E-10	_	C-14	1.4E-09	1.0E-09	5.9E-10	_	measured and assessed
	<u>Sn-119m</u>	1.3E-09	1.1E-09	7.8E-10	_	Ru-106	4.8E-10	4.0E-10	2.4E-10		
	Sn-123	7.7E-10	6.7E-10	4.9E-10	_	Ce-144	4.4E-10	4.6E-10	3.8E-10		
	<u>Am-242m</u>	<u>7.1E-10</u>	3.3E-10	1.6E-10	_	Tc-99	2.5E-10	1.8E-10	1.0E-10		
	<u>Te-127m</u>	6.6E-10	5.3E-10	3.6E-10	_	Cs-137	1.9E-10	1.4E-10	7.0E-11		
	Ru-106	4.8E-10	4.0E-10	2.4E-10		I-129	1.8E-10	1.2E-10	4.6E-11		
	Ce-144	4.4E-10	4.6E-10	3.8E-10		Ni-63	1.7E-10	1.4E-10	8.2E-11		
	<u>Cd-115m</u>	<u>2.7E-10</u>	<u>2.3E-10</u>	<u>2.1E-10</u>	_	<u>Se-79</u>	<u>1.5E-10</u>	<u>1.2E-10</u>	<u>6.7E-11</u>	_	
	Tc-99	2.5E-10	1.8E-10	1.0E-10		Cd-113m	1.4E-10	9.2E-11	5.0E-11		
	Cs-137	1.9E-10	1.4E-10	7.0E-11		Co-60	1.1E-10	8.0E-11	4.1E-11		
	I-129	1.8E-10	1.2E-10	4.6E-11		Eu-154	8.0E-11	5.7E-11	3.1E-11		
	Ni-63	1.7E-10	1.4E-10	8.2E-11		Sr-90	7.7E-11	5.1E-11	2.6E-11		
	<u>Te-129m</u>	<u>1.4E-10</u>	<u>1.2E-10</u>	8.8E-11	_	Pm-147	5.4E-11	4.7E-11	2.9E-11		
	Cd-113m	1.4E-10	9.2E-11	5.0E-11		Sb-125	2.5E-11	2.0E-11	1.1E-11		
	<u>Eu-152</u>	<u>1.2E-10</u>	<u>7.9E-11</u>	<u>4.1E-11</u>	_	Cs-134	2.0E-11	1.6E-11	9.1E-12		
	Co-60	1.1E-10	8.0E-11	4.1E-11		Eu-155	1.9E-11	1.5E-11	9.1E-12		
	Eu-154	8.0E-11	5.7E-11	3.1E-11		Te-125m	8.9E-12	6.5E-12	4.6E-12		
	Sr-90	7.7E-11	5.1E-11	2.6E-11		Mn-54	8.6E-13	8.5E-13	5.5E-13		
	<u>Sn-126</u>	<u>6.3E-11</u>	<u>5.5E-10</u>	3.5E-11	_	Y-90	7.2E-13	8.0E-13	8.1E-13		
	Pm-147	5.4E-11	4.7E-11	2.9E-11		Sm-151	6.0E-13	4.0E-13	2.1E-13		
	Sb-125	2.5E-11	2.0E-11	1.1E-11		Total	3.8E-07	<u>2.1E-07</u>	1.1E-07		
	Cs-134	2.0E-11	1.6E-11	9.1E-12							
	<u>Pm-146</u>	2.0E-11	<u>1.5E-11</u>	<u>7.8E-12</u>	_						
	Eu-155	1.9E-11	1.5E-11	9.1E-12							
	<u>Pm-148</u>	<u>1.5E-11</u>	<u>1.5E-11</u>	<u>1.3E-11</u>							
	<u>Ba-140</u>	<u>1.5E-11</u>	<u>1.2E-11</u>	<u>9.6E-12</u>	_						
	<u>Tb-160</u>	<u>1.5E-11</u>	<u>1.2E-11</u>	8.7E-12	_						
	<u>Sb-124</u>	<u>1.1E-11</u>	8.9E-12	<u>6.4E-12</u>	_						
	<u>Te-127</u>	9.1E-12	9.9E-12	<u>1.0E-11</u>	_						
	Te-125m	8.9E-12	6.5E-12	4.6E-12							
_	<u>Ag-110m</u>	7.2E-12	<u>6.2E-12</u>	3.6E-12	_						
_	<u>Ce-141</u>	<u>6.9E-12</u>	<u>5.0E-12</u>	3.7E-12	_						
	<u>Rb-86</u>	<u>6.6E-12</u>	9.5E-12	<u>1.1E-11</u>	_						
	<u>Gd-153</u>	<u>6.0E-12</u>	7.3E-12	<u>5.5E-12</u>	_						
	<u>Sr-89</u>	<u>5.4E-12</u>	4.5E-12	3.4E-12	_						
	<u>Te-123m</u>	<u>5.2E-12</u>	3.9E-12	2.6E-12	_						
	<u>Fe-59</u>	<u>4.3E-12</u>	3.4E-12	<u>2.9E-12</u>	_						
	<u>Pm-148m</u>	3.5E-12	2.9E-12	2.0E-12	_						
	<u>Zn-65</u>	<u>2.7E-12</u>	<u>2.7E-12</u>	<u>2.3E-12</u>	_						
	<u>Ru-103</u>	<u>2.3E-12</u>	<u>1.8E-12</u>	<u>1.3E-12</u>	_						

		Curre	nt	
<u>Cs-136</u>	1.5E-12	<u>1.3E-12</u>	1.0E-12	_
<u>Nb-95</u>	<u>1.3E-12</u>	<u>1.0E-12</u>	<u>7.0E-13</u>	_
<u>Co-58</u>	<u>1.2E-12</u>	9.8E-13	6.5E-13	_
Mn-54	8.6E-13	8.5E-13	5.5E-13	
Y-90	7.2E-13	8.0E-13	8.1E-13	
<u>Te-129</u>	<u>7.1E-13</u>	7.1E-13	<u>8.1E-13</u>	_
Sm-151	6.0E-13	4.0E-13	2.1E-13	
<u>Pr-144</u>	<u>1.5E-13</u>	1.7E-13	2.0E-13	_
Rh-103m	2.1E-15	2.0E-15	2.0E-15	_
<u>Cs-135</u>	2.7E-16	2.0E-16	<u>1.1E-16</u>	_
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Pr-144m</u>	<u>-144m</u> <u>0.0E+00</u>		<u>0.0E+00</u>	Assessed with the parent nuclide
Total	<u>4.0E-07</u>	<u>2.2E-07</u>	1.2E-07	

Table X-3-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-G tank group), Average ingestion)

	Expos	ure assessment	t result	
		(mSv/year)		- ·
Nuclide	Adult	Children under school age	Infants	Remarks
<u>Sn-119m</u>	3.7E-05	<u>7.1E-05</u>	9.2E-05	_
<u>Sn-123</u>	3.6E-05	<u>6.7E-05</u>	8.8E-05	_
<u>Sn-126</u>	<u>1.9E-06</u>	3.3E-06	<u>4.2E-06</u>	_
C-14	1.0E-06	8.8E-07	5.1E-07	
<u>Cd-115m</u>	<u>7.5E-07</u>	<u>1.1E-06</u>	<u>1.9E-06</u>	_
I-129	3.0E-07	2.3E-07	9.5E-08	
Cd-113m	2.0E-07	1.7E-07	2.0E-07	
<u>Te-127m</u>	<u>1.4E-07</u>	<u>2.8E-07</u>	<u>4.9E-07</u>	_
<u>Fe-59</u>	<u>6.8E-08</u>	<u>1.4E-07</u>	3.0E-07	_
<u>Te-129m</u>	4.9E-08	<u>9.5E-08</u>	<u>1.4E-07</u>	_
<u>Y-91</u>	4.8E-08	<u>8.8E-08</u>	<u>1.1E-07</u>	_
Am-241	4.4E-08	2.9E-08	1.6E-07	
<u>Am-243</u>	<u>4.4E-08</u>	<u>2.9E-08</u>	<u>1.5E-07</u>	_
Pu-239	4.2E-08	2.8E-08	1.4E-07	
Pu-240	4.2E-08	2.8E-08	1.4E-07	
Pu-238	3.9E-08	2.6E-08	1.3E-07	
H-3	3.3E-08	2.8E-08	2.3E-08	
Pu-241	2.9E-08	1.6E-08	6.6E-08	
Cm-243	2.3E-08	1.6E-08	9.3E-08	
Tc-99	2.1E-08	3.7E-08	6.4E-08	
Zn-65	2.1E-08	2.6E-08	3.8E-08	_

Table X-3-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-G tank group), Average ingestion)

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

	Expos	ure assessmen (mSv/year)	t result			
Nuclide	Adult	Children under school age	Infants	Remarks		
C-14	1.0E-06	8.8E-07	5.1E-07			
I-129	3.0E-07	2.3E-07	9.5E-08			
<u>Se-79</u>	<u>2.3E-07</u>	<u>7.5E-07</u>	<u>6.6E-07</u>	_		
Cd-113m	2.0E-07	1.7E-07	2.0E-07			
Am-241	4.4E-08	2.9E-08	1.6E-07			
Pu-239	4.2E-08	2.8E-08	1.4E-07			
Pu-240	4.2E-08	2.8E-08	1.4E-07			
Pu-238	3.9E-08	2.6E-08	1.3E-07			
H-3	3.2E-08	2.8E-08	2.3E-08	3		
Pu-241	2.9E-08	1.6E-08	6.6E-08			
Cm-243	2.3E-08	1.6E-08	9.3E-08			
Tc-99	2.1E-08	3.7E-08	6.4E-08			
Co-60	1.8E-08	4.6E-08	5.7E-08			
Cm-244	1.8E-08	1.4E-08	8.4E-08			
Ce-144	1.7E-08	3.0E-08	4.1E-08			
Ni-63	1.0E-08	1.5E-08	2.2E-08			
Ru-106	6.9E-09	1.2E-08	1.6E-08			
Cs-137	2.3E-09	8.3E-10	7.5E-10			
Eu-154	1.8E-09	3.0E-09	4.5E-09			
Pm-147	1.7E-09	3.2E-09	4.7E-09			

			Curre	nt					Revise	ed			Reason for Revision
(Co-60	1.8E-08	4.6E-08	5.7E-08			Mn-54	1.3E-09	1.7E-09	1.9E-09			Appropriate description due to the
C	Cm-244	1.8E-08	1.4E-08	8.4E-08			<u>Np-237</u>	<u>1.1E-09</u>	6.9E-10	3.9E-09	_		selection of nuclides to be measured and assessed
C	Ce-144	1.7E-08	3.0E-08	4.1E-08			Cs-134	6.7E-10	2.3E-10	1.9E-10			incusared and assessed
<u>P</u> :	<u>m-148</u>	<u>1.1E-08</u>	2.0E-08	2.4E-08	_		Eu-155	5.3E-10	9.0E-10	1.4E-09			
<u>Ag</u>	<u>g-110m</u>	1.0E-08	<u>1.5E-08</u>	1.8E-08	_		Sb-125	4.4E-10	6.9E-10	9.1E-10			
1	Ni-63	1.0E-08	1.5E-08	2.2E-08			<u>Te-125m</u>	3.5E-10	<u>6.7E-10</u>	<u>1.1E-09</u>	_		
<u>T</u>	<u>Γe-127</u>	9.9E-09	<u>1.8E-08</u>	<u>1.7E-08</u>	_		<u>U-234</u>	<u>1.5E-10</u>	<u>1.3E-10</u>	<u>2.2E-10</u>	_		
R	Ru-106	6.9E-09	1.2E-08	1.6E-08			<u>U-238</u>	<u>1.4E-10</u>	1.2E-10	2.0E-10	_		
<u>E</u>	Eu-152	<u>2.4E-09</u>	3.6E-09	<u>5.5E-09</u>	_		Sr-90	2.6E-11	2.2E-11	4.3E-11			
С	Cs-137	2.3E-09	8.3E-10	7.5E-10			Sm-151	8.9E-12	1.5E-11	2.7E-11			
Е	Eu-154	1.8E-09	3.0E-09	4.5E-09			<u>Y-90</u>	<u>2.5E-12</u>	<u>4.6E-12</u>	<u>5.8E-12</u>	_		
<u>C</u> :	<u>Cm-242</u>	<u>1.8E-09</u>	<u>2.9E-09</u>	<u>1.7E-08</u>	_		Total	<u>2.1E-06</u>	<u>2.4E-06</u>	<u>2.5E-06</u>			
P	m-147	1.7E-09	3.2E-09	4.7E-09									
<u>Te</u>	e-125m	<u>1.6E-09</u>	3.0E-09	<u>4.8E-09</u>	_								
N	Mn-54	1.3E-09	1.7E-09	1.9E-09									
<u>Te</u>	e-123m	<u>1.3E-09</u>	<u>2.2E-09</u>	3.4E-09	_								
<u></u>	<u>Ге-129</u>	<u>1.0E-09</u>	<u>1.7E-09</u>	2.4E-09	_								
<u>T</u>	<u>Гb-160</u>	<u>9.4E-10</u>	<u>1.6E-09</u>	<u>1.9E-09</u>	_								
An	<u>m-242m</u>	<u>7.6E-10</u>	<u>4.5E-10</u>	2.4E-09	_								
С	Cs-134	6.7E-10	2.3E-10	1.9E-10									
<u>C</u>	<u>Co-58</u>	<u>6.4E-10</u>	<u>1.1E-09</u>	<u>1.2E-09</u>	_								
<u>Pn</u>	<u>m-148m</u>	<u>6.4E-10</u>	<u>1.0E-09</u>	<u>1.1E-09</u>	_								
<u>S</u>	Sb-124	<u>6.0E-10</u>	<u>1.0E-09</u>	<u>1.2E-09</u>	_								
	Eu-155	5.3E-10	9.0E-10	1.4E-09									
	<u>m-146</u>	<u>5.2E-10</u>	8.1E-10	<u>1.1E-09</u>	_								
	<u>Ce-141</u>	<u>5.0E-10</u>	9.0E-10	<u>1.1E-09</u>	_								
	3d-153	<u>4.7E-10</u>	8.2E-10	<u>1.0E-09</u>	_								
	Sb-125	4.4E-10	6.9E-10	9.1E-10									
	<u>Y-90</u>	<u>1.4E-10</u>	<u>2.7E-10</u>	3.3E-10	_								
	Pr-144	<u>1.4E-10</u>	2.3E-10	3.4E-10	_								
	Nb-95	9.2E-11	<u>1.4E-10</u>	1.4E-10	_								
	Rb-86	8.8E-11	1.5E-10	2.0E-10	_								
	Ru-103	7.6E-11	1.2E-10	1.4E-10	_								
	Cs-136	<u>5.7E-11</u>	<u>5.8E-11</u>	5.8E-11	_								
	<u>Ba-140</u>	4.9E-11	8.4E-11	1.2E-10	_								
	Sr-90	2.6E-11	2.2E-11	4.3E-11									
	m-151	8.9E-12	1.5E-11	2.7E-11									
	<u>Sr-89</u>	3.4E-12	5.8E-12	9.4E-12	_								
	h-103m	6.2E-13	1.1E-12	1.5E-12	_								
<u>C</u>	<u>Cs-135</u>	2.2E-15	9.4E-16	9.3E-16	A ground with the								
	<u>Rh-106</u>	0.0E+00	<u>0.0E+00</u>	0.0E+00	Assessed with the parent nuclide								
Ba	<u>a-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the							 	

Current												
				parent nuclide								
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide								
Total	7.9E-05	1.5E-04	1.9E-04									

Table X-3-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

(Source tern		asured values ure assessmen		oup), More ingestion)
	Expos	(mSv/year)	i iesuii	
Nuclide	Adult	Children under school age	Infants	Remarks
<u>Sn-119m</u>	<u>1.4E-04</u>	<u>2.7E-04</u>	3.4E-04	_
<u>Sn-123</u>	<u>1.4E-04</u>	2.6E-04	3.3E-04	_
<u>Sn-126</u>	<u>7.3E-06</u>	<u>1.3E-05</u>	<u>1.6E-05</u>	_
<u>Cd-115m</u>	<u>4.0E-06</u>	<u>5.9E-06</u>	<u>9.7E-06</u>	_
C-14	3.9E-06	3.4E-06	1.9E-06	
I-129	1.4E-06	1.1E-06	4.5E-07	
Cd-113m	1.0E-06	8.8E-07	1.1E-06	
<u>Te-127m</u>	<u>6.0E-07</u>	<u>1.3E-06</u>	<u>2.1E-06</u>	_
<u>Fe-59</u>	3.7E-07	<u>7.7E-07</u>	<u>1.6E-06</u>	_
<u>Y-91</u>	2.6E-07	<u>4.7E-07</u>	<u>5.8E-07</u>	_
Pu-239	2.2E-07	1.4E-07	7.1E-07	
Pu-240	2.2E-07	1.4E-07	7.1E-07	
Am-241	2.1E-07	1.4E-07	7.5E-07	
<u>Am-243</u>	<u>2.1E-07</u>	<u>1.4E-07</u>	<u>7.3E-07</u>	_
<u>Te-129m</u>	2.1E-07	<u>4.2E-07</u>	<u>6.0E-07</u>	-
Pu-238	2.0E-07	1.4E-07	6.8E-07	
Pu-241	1.5E-07	8.6E-08	3.4E-07	
H-3	1.3E-07	1.1E-07	8.7E-08	
<u>Zn-65</u>	<u>1.2E-07</u>	<u>1.5E-07</u>	2.2E-07	_
Cm-243	1.1E-07	8.0E-08	4.5E-07	
Tc-99	1.0E-07	1.8E-07	3.0E-07	
Co-60	1.0E-07	2.5E-07	3.1E-07	
Cm-244	8.7E-08	6.9E-08	4.1E-07	
Ce-144	8.5E-08	1.6E-07	2.1E-07	
<u>Pm-148</u>	6.0E-08	<u>1.1E-07</u>	<u>1.3E-07</u>	_
<u>Ag-110m</u>	<u>5.0E-08</u>	<u>7.0E-08</u>	<u>8.4E-08</u>	
<u>Te-127</u>	4.3E-08	<u>7.8E-08</u>	<u>7.4E-08</u>	_
Ni-63	4.2E-08	6.5E-08	8.8E-08	
Ru-106	3.4E-08	6.1E-08	8.0E-08	
<u>Eu-152</u>	<u>1.3E-08</u>	1.9E-08	2.9E-08	_
Eu-154	9.8E-09	1.6E-08	2.4E-08	
Pm-147	9.2E-09	1.7E-08	2.5E-08	
<u>Cm-242</u>	8.7E-09	1.4E-08	8.2E-08	_

Table X-3-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

(Source tern		ure assessmen	`	oup), More ingestion)
	Expos	(mSv/year)	i iesuii	
Nuclide	Adult	Children under school age	Infants	Remarks
C-14	C-14 3.9E-06		1.9E-06	
I-129	1.4E-06	1.1E-06	4.5E-07	
Cd-113m	1.0E-06	8.8E-07	1.1E-06	
<u>Se-79</u>	8.5E-07	2.8E-06	2.4E-06	_
Pu-239	2.2E-07	1.4E-07	7.1E-07	
Pu-240	2.2E-07	1.4E-07	7.1E-07	
Am-241	2.1E-07	1.4E-07	7.5E-07	
Pu-238	2.0E-07	1.4E-07	6.8E-07	
Pu-241	1.5E-07	8.6E-08	3.4E-07	
H-3	1.2E-07	1.1E-07	8.7E-08	
Cm-243	1.1E-07	8.0E-08	4.5E-07	
Tc-99	1.0E-07	1.8E-07	3.0E-07	
Co-60	1.0E-07	2.5E-07	3.1E-07	
Cm-244	8.7E-08	6.9E-08	4.1E-07	
Ce-144	8.5E-08	1.6E-07	2.1E-07	
Ni-63	4.2E-08	6.5E-08	8.8E-08	
Ru-106	3.4E-08	6.1E-08	8.0E-08	
Eu-154	9.8E-09	1.6E-08	2.4E-08	
Pm-147	9.2E-09	1.7E-08	2.5E-08	
Cs-137	8.2E-09	3.1E-09	2.7E-09	
Mn-54	7.4E-09	9.9E-09	1.1E-08	
Np-237	6.4E-09	4.1E-09	2.3E-08	
Eu-155	2.8E-09	4.9E-09	7.4E-09	
Cs-134	2.4E-09	8.5E-10	6.8E-10	
Sb-125	1.6E-09	2.5E-09	3.2E-09	
<u>Te-125m</u>	<u>1.2E-09</u>	2.4E-09	3.7E-09	_
<u>U-234</u>	<u>7.5E-10</u>	<u>6.8E-10</u>	1.1E-09	_
<u>U-238</u>	6.9E-10	<u>6.2E-10</u>	1.0E-09	_
Sr-90	1.2E-10	9.8E-11	1.9E-10	
Sm-151	4.8E-11	8.1E-11	1.4E-10	
<u>Y-90</u>	<u>1.1E-11</u>	2.1E-11	2.5E-11	
Total	9.0E-06	9.9E-06	1.1E-05	

			Curre	•			Revised Revised	Reason for Revision
	Cs-137	8.2E-09	3.1E-09	2.7E-09				
	Mn-54	7.4E-09	9.9E-09	1.1E-08				
	Te-125m	7.1E-09	1.4E-08	2.1E-08				Appropriate description due to the selection of nuclides to be
	Te-123m	5.5E-09	9.6E-09	1.5E-08	_			measured and assessed
	Tb-160	5.1E-09	8.6E-09	9.9E-09				
	Te-129	4.4E-09	7.4E-09	1.0E-08				
	<u>Am-242m</u>	3.6E-09	2.2E-09	1.1E-08	_			
	<u>Co-58</u>	3.5E-09	6.1E-09	6.7E-09	_			
	<u>Pm-148m</u>	3.4E-09	5.5E-09	5.9E-09	_			
	Eu-155	2.8E-09	4.9E-09	7.4E-09				
	<u>Pm-146</u>	2.8E-09	4.3E-09	6.0E-09	_			
	<u>Ce-141</u>	2.5E-09	4.6E-09	<u>5.6E-09</u>	_			
	<u>Gd-153</u>	2.5E-09	<u>4.4E-09</u>	<u>5.2E-09</u>				
	Cs-134	2.4E-09	8.5E-10	6.8E-10				
	<u>Sb-124</u>	<u>2.1E-09</u>	3.6E-09	<u>4.3E-09</u>	_			
	Sb-125	1.6E-09	2.5E-09	3.2E-09				
	<u>Y-90</u>	<u>7.7E-10</u>	<u>1.4E-09</u>	1.7E-09	_			
	<u>Pr-144</u>	<u>6.8E-10</u>	<u>1.2E-09</u>	<u>1.7E-09</u>	_			
	<u>Nb-95</u>	<u>4.6E-10</u>	<u>7.2E-10</u>	<u>7.1E-10</u>	_			
	<u>Ru-103</u>	3.8E-10	<u>6.3E-10</u>	<u>7.1E-10</u>	_			
	<u>Rb-86</u>	3.6E-10	<u>6.5E-10</u>	<u>8.0E-10</u>	_			
	<u>Cs-136</u>	<u>2.1E-10</u>	<u>2.1E-10</u>	<u>2.1E-10</u>	_			
	<u>Ba-140</u>	<u>2.1E-10</u>	3.7E-10	<u>5.0E-10</u>	_			
	Sr-90	1.2E-10	9.8E-11	1.9E-10				
	Sm-151	4.8E-11	8.1E-11	1.4E-10				
	<u>Sr-89</u>	<u>1.5E-11</u>	2.6E-11	<u>4.1E-11</u>	_			
	<u>Rh-103m</u>	<u>3.4E-12</u>	<u>5.8E-12</u>	<u>8.1E-12</u>	_			
_	<u>Cs-135</u>	<u>8.1E-15</u>	3.5E-15	3.3E-15				
	<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide			
	<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide			
	<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide			
	Total	3.0E-04	<u>5.6E-04</u>	<u>7.1E-04</u>				
X-2. Assessment For the following Tables X-4 to 6 sh	exposure ass	essments show	wn in chapter	7. "Assessmo	ent regarding environme	ental protection",	X-2. Assessment result regarding environmental protection For the following exposure assessments shown in chapter 7. "Assessment regarding environmental protection", Tables X-4 to 6 show the assessment result of each nuclide.	
Source term based i. K4 triti ii. J1- triti iii. J1-	d on measured tank group (Sium: 0.29) C tank group ium: 0.35)	values of 64 to Sum of the ration (Sum of the ration)	nuclides os to regulato itios to regula	ory concentrati	on limits of <u>63</u> nuclides tion limits of <u>63</u> nuclide tion limits of <u>63</u> nuclide	es other than	Source term based on measured values of 31 nuclides i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28) ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)) iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)	

Table X-4	Assessment result of environmental protection
(Source ter	rm based on measured values (K4 tank group))

Current

	(Source terri	n based on me	asured values	(K4 tank group))
	Exposure as	sessment resu		
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
<u>Fe-59</u>	1.2E-05	<u>1.2E-05</u>	<u>1.3E-05</u>	_
<u>Sn-123</u>	1.6E-06	<u>1.5E-06</u>	1.7E-06	_
<u>Pm-148</u>	<u>1.3E-06</u>	<u>1.2E-06</u>	<u>1.7E-06</u>	_
<u>Sn-126</u>	<u>6.9E-07</u>	<u>6.6E-07</u>	<u>6.4E-07</u>	_
Co-60	6.5E-07	6.5E-07	7.1E-07	
<u>Pm-146</u>	2.9E-07	2.8E-07	3.1E-07	_
<u>Y-91</u>	1.4E-07	<u>8.4E-08</u>	<u>6.3E-07</u>	_
<u>Eu-152</u>	1.3E-07	<u>1.2E-07</u>	<u>1.3E-07</u>	_
<u>Tb-160</u>	1.2E-07	<u>1.2E-07</u>	<u>1.3E-07</u>	_
Ce-144	7.8E-08	4.6E-08	7.8E-08	
<u>Pm-148m</u>	<u>6.6E-08</u>	<u>6.4E-08</u>	<u>7.2E-08</u>	_
Eu-154	6.1E-08	5.7E-08	6.1E-08	
Ru-106	5.4E-08	5.4E-08	6.4E-08	
<u>Cd-115m</u>	<u>4.9E-08</u>	<u>2.2E-07</u>	9.3E-09	_
<u>Sn-119m</u>	4.3E-08	<u>4.1E-08</u>	3.0E-08	_
C-14	4.0E-08	3.3E-08	2.7E-08	
Mn-54	2.3E-08	2.1E-08	2.3E-08	
<u>Gd-153</u>	<u>1.2E-08</u>	<u>1.1E-08</u>	<u>1.4E-08</u>	_
<u>Nb-95</u>	<u>1.2E-08</u>	<u>1.2E-08</u>	<u>1.2E-08</u>	_
<u>Ce-141</u>	<u>1.1E-08</u>	<u>1.1E-08</u>	1.2E-08	_
Eu-155	7.7E-09	7.5E-09	7.7E-09	
H-3	4.7E-09	4.7E-09	1.8E-09	
<u>Co-58</u>	<u>4.6E-09</u>	4.6E-09	4.6E-09	_
Cs-137	2.0E-09	1.9E-09	2.0E-09	
<u>Zn-65</u>	1.3E-09	2.6E-09	1.3E-09	_
<u>Ba-140</u>	<u>9.3E-10</u>	1.3E-09	1.7E-09	_
<u>Te-129m</u>	<u>9.1E-10</u>	<u>9.2E-10</u>	8.4E-09	_
Sb-125	7.0E-10	6.6E-10	8.7E-10	
<u>Am-243</u>	<u>5.8E-10</u>	<u>7.1E-10</u>	<u>6.4E-10</u>	_
Cs-134	5.8E-10	5.4E-10	5.7E-10	
<u>Cs-136</u>	<u>5.0E-10</u>	<u>5.0E-10</u>	<u>5.0E-10</u>	_
<u>Te-127m</u>	4.3E-10	4.3E-10	4.1E-09	_
Cd-113m	4.1E-10	1.8E-09	3.4E-11	
<u>Ag-110m</u>	<u>4.0E-10</u>	<u>2.2E-09</u>	3.5E-10	_
<u>Ru-103</u>	3.9E-10	3.9E-10	4.0E-10	_
Cm-243	3.2E-10	8.3E-10	5.2E-10	
<u>Te-127</u>	3.2E-10	3.2E-10	2.9E-09	_

Table X-4 Assessment result of environmental protection (Source term based on measured values (K4 tank group))

Revised

	,	sessment resu		(K4 tank group))
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Co-60	6.5E-07	6.5E-07	7.1E-07	
Ce-144	7.8E-08	4.6E-08	7.8E-08	
Eu-154	6.1E-08	5.7E-08	6.1E-08	
Ru-106	5.4E-08	5.4E-08	6.4E-08	
C-14	4.0E-08	3.3E-08	2.7E-08	
Mn-54	2.3E-08	2.1E-08	2.3E-08	
Eu-155	7.7E-09	7.5E-09	7.7E-09	
H-3	4.7E-09	4.7E-09	1.8E-09	
<u>Se-79</u>	3.4E-09	3.4E-09	1.5E-10	_
Cs-137	2.0E-09	1.9E-09	2.0E-09	
Sb-125	7.0E-10	6.6E-10	8.7E-10	
Cs-134	5.8E-10	5.4E-10	5.7E-10	
Cd-113m	4.1E-10	1.8E-09	3.4E-11	
Cm-243	3.2E-10	8.3E-10	5.2E-10	
Te-125m	1.9E-10	2.0E-10	1.7E-09	
Pm-147	9.7E-11	1.3E-09	9.0E-10	
Am-241	6.3E-11	2.0E-10	6.4E-11	
Ni-63	4.5E-11	1.1E-09	3.3E-10	
Sr-90	4.3E-11	<u>2.4E-10</u>	4.2E-11	
Pu-238	3.8E-11	2.6E-11	6.3E-11	
Pu-240	3.6E-11	2.4E-11	5.9E-11	
Pu-239	3.6E-11	2.4E-11	5.9E-11	
Тс-99	2.5E-11	5.6E-09	1.6E-08	
I-129	1.1E-11	6.4E-09	2.8E-09	
Cm-244	4.1E-12	5.2E-10	2.0E-10	
Pu-241	1.6E-12	1.1E-12	2.7E-12	
<u>Np-237</u>	3.1E-13	<u>5.8E-12</u>	<u>7.5E-13</u>	_
<u>U-234</u>	<u>1.2E-13</u>	<u>4.7E-13</u>	<u>1.1E-12</u>	_
<u>U-238</u>	<u>1.1E-13</u>	4.2E-13	9.9E-13	
Sm-151	9.1E-14	1.9E-12	7.9E-13	
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide Sr-90
Total	<u>9.3E-07</u>	9.0E-07	<u>1.0E-06</u>	

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

		C	Current				R	evised		Reason for Revision
<u>Rb-86</u>	<u>2.7E-10</u>	2.0E-10	<u>4.8E-10</u>	_						Appropriate description due to the
Te-125m	1.9E-10	2.0E-10	1.7E-09							selection of nuclides to be measured and assessed
Pm-147	9.7E-11	1.3E-09	9.0E-10							incasured and assessed
Sb-124	<u>8.5E-11</u>	8.0E-11	<u>1.0E-10</u>	_						
Am-241	6.3E-11	2.0E-10	6.4E-11							
Ni-63	4.5E-11	1.1E-09	3.3E-10							
Sr-90	4.3E-11	<u>1.6E-10</u>	4.2E-11							
Pu-238	3.8E-11	2.6E-11	6.3E-11							
Pu-240	3.6E-11	2.4E-11	5.9E-11							
Pu-239	3.6E-11	2.4E-11	5.9E-11							
Тс-99	2.5E-11	5.6E-09	1.6E-08							
I-129	1.1E-11	6.4E-09	2.8E-09							
<u>Sr-89</u>	<u>1.1E-11</u>	3.7E-11	<u>1.1E-11</u>	_						
<u>Te-123m</u>	<u>7.3E-12</u>	<u>7.4E-12</u>	<u>4.4E-11</u>	_						
<u>Cm-242</u>	<u>4.3E-12</u>	<u>5.5E-10</u>	<u>2.1E-10</u>	_						
Cm-244	4.1E-12	5.2E-10	2.0E-10							
<u>Am-242m</u>	3.0E-12	3.3E-12	<u>5.2E-12</u>	_						
Pu-241	1.6E-12	1.1E-12	2.7E-12							
Sm-151	9.1E-14	1.9E-12	7.9E-13							
<u>Cs-135</u>	<u>1.2E-16</u>	<u>6.4E-17</u>	<u>9.5E-17</u>	_						
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide						
<u>Rh-103m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
<u>Te-129</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
<u>Ba-137m</u>	0.0E+00	<u>0.0E+00</u>	0.0E+00	Assessed with the parent nuclide						
<u>Pr-144</u>	0.0E+00	<u>0.0E+00</u>	0.0E+00	Assessed with the parent nuclide						
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide						
Total	<u>1.7E-05</u>	<u>1.7E-05</u>	1.9E-05							
	Toble V 5 A	ssassmant rasi	ult of environr	nental protection		Table X-5Δ	ssessment res	ult of environmen	atal protection	
				J1-C tank group))				sured values (J1-		
37 111		sessment resul	lt (mGy/day)		NT 111	Exposure as	sessment resu		D 1	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks	Nuclide	Flatfish	Crab	Brown seaweed	Remarks	
<u>Fe-59</u>	<u>1.4E-05</u>	<u>1.4E-05</u>	<u>1.5E-05</u>	_	Ce-144	1.6E-07	9.5E-08	1.6E-07		
<u>Sn-119m</u>	<u>2.5E-06</u>	<u>2.3E-06</u>	<u>1.7E-06</u>	_	Eu-154	1.3E-07	1.2E-07	1.3E-07		
<u>Sn-123</u>	<u>2.0E-06</u>	<u>2.0E-06</u>	<u>2.1E-06</u>	_	Co-60	1.1E-07	1.1E-07	1.2E-07		
<u>Sn-126</u>	<u>1.7E-06</u>	<u>1.6E-06</u>	<u>1.6E-06</u>	_	Mn-54	3.1E-08	2.8E-08	3.1E-08		
<u>Eu-152</u>	3.1E-07	<u>2.9E-07</u>	3.1E-07	_	Eu-155	1.8E-08	1.8E-08	1.8E-08		
<u>Y-91</u>	2.5E-07	<u>1.5E-07</u>	<u>1.1E-06</u>	_	C-14	1.1E-08	9.2E-09	7.4E-09		

		C	Current						R	evised			Reason for Revision
Ce-144	1.6E-07	9.5E-08	1.6E-07				Ru-106	1.1E-08	1.1E-08	1.3E-08			
<u>Tb-160</u>	1.4E-07	1.4E-07	<u>1.5E-07</u>	_			H-3	4.7E-09	4.7E-09	1.8E-09			Appropriate description due to the selection of nuclides to be
<u>Pm-148</u>	<u>1.4E-07</u>	1.3E-07	<u>1.9E-07</u>	_			Cm-243	3.9E-09	1.0E-08	6.3E-09			measured and assessed
Eu-154	1.3E-07	1.2E-07	1.3E-07				<u>Se-79</u>	<u>7.9E-10</u>	<u>7.9E-10</u>	3.4E-11	_		
Co-60	1.1E-07	1.1E-07	1.2E-07				Am-241	7.6E-10	2.5E-09	7.8E-10			
<u>Pm-148m</u>	8.8E-08	8.5E-08	<u>9.5E-08</u>	_			Pu-238	4.7E-10	3.2E-10	7.6E-10			
<u>Cd-115m</u>	<u>4.8E-08</u>	<u>2.1E-07</u>	<u>9.1E-09</u>	_			Cd-113m	4.5E-10	2.0E-09	3.7E-11			
<u>Pm-146</u>	<u>4.7E-08</u>	<u>4.5E-08</u>	<u>4.9E-08</u>	_			Pu-240	4.4E-10	3.0E-10	7.1E-10			
Mn-54	3.1E-08	2.8E-08	3.1E-08				Pu-239	4.3E-10	3.0E-10	7.1E-10			
<u>Ce-141</u>	2.7E-08	<u>2.6E-08</u>	<u>2.8E-08</u>	_			Cs-134	2.3E-10	2.1E-10	2.2E-10			
<u>Gd-153</u>	<u>2.3E-08</u>	<u>2.1E-08</u>	<u>2.7E-08</u>	_			Cs-137	2.1E-10	2.0E-10	2.1E-10			
Eu-155	1.8E-08	1.8E-08	1.8E-08				Sb-125	1.1E-10	1.1E-10	1.4E-10			
<u>Nb-95</u>	<u>1.4E-08</u>	<u>1.4E-08</u>	<u>1.4E-08</u>	_			Pm-147	9.5E-11	1.3E-09	8.8E-10			
C-14	1.1E-08	9.2E-09	7.4E-09				Cm-244	4.9E-11	6.3E-09	2.4E-09			
Ru-106	1.1E-08	1.1E-08	1.3E-08				Ni-63	4.0E-11	9.6E-10	3.0E-10			
<u>Am-243</u>	<u>7.1E-09</u>	<u>8.6E-09</u>	<u>7.8E-09</u>	_			Te-125m	3.1E-11	3.2E-11	2.7E-10			
<u>Co-58</u>	<u>5.5E-09</u>	<u>5.4E-09</u>	<u>5.4E-09</u>	_			Pu-241	1.6E-11	1.1E-11	2.7E-11			
H-3	4.7E-09	4.7E-09	1.8E-09				Tc-99	9.8E-12	2.2E-09	6.5E-09			
Cm-243	3.9E-09	1.0E-08	6.3E-09				<u>Np-237</u>	3.8E-12	<u>7.0E-11</u>	<u>9.1E-12</u>	_		
<u>Zn-65</u>	<u>1.9E-09</u>	3.8E-09	<u>1.8E-09</u>	_			Sr-90	1.6E-12	<u>9.1E-12</u>	1.6E-12			
<u>Te-127m</u>	<u>1.5E-09</u>	<u>1.5E-09</u>	<u>1.4E-08</u>	_			I-129	1.5E-12	8.5E-10	3.7E-10			
<u>Te-127</u>	<u>1.1E-09</u>	<u>1.1E-09</u>	<u>1.0E-08</u>	_			<u>U-234</u>	<u>1.4E-12</u>	<u>5.7E-12</u>	<u>1.3E-11</u>	_		
<u>Te-129m</u>	<u>9.2E-10</u>	<u>9.4E-10</u>	<u>8.5E-09</u>	_			<u>U-238</u>	<u>1.3E-12</u>	<u>5.1E-12</u>	<u>1.2E-11</u>	_		
Am-241	7.6E-10	2.5E-09	7.8E-10				Sm-151	2.6E-13	5.5E-12	2.2E-12			
<u>Ag-110m</u>	<u>7.2E-10</u>	4.0E-09	<u>6.2E-10</u>	_			Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the pare nuclide Sr-90	nt	
<u>Ru-103</u>	<u>4.8E-10</u>	<u>4.8E-10</u>	<u>4.9E-10</u>	_			Total	4.9.E-07	4.3.E-07	5.1.E-07	Huchde <u>S1-90</u>		
Pu-238	4.7E-10	3.2E-10	7.6E-10			ı					1		
<u>Ba-140</u>	<u>4.6E-10</u>	<u>6.3E-10</u>	<u>8.5E-10</u>	_									
Cd-113m	4.5E-10	2.0E-09	3.7E-11										
Pu-240	4.4E-10	3.0E-10	7.1E-10										
Pu-239	4.3E-10	3.0E-10	7.1E-10										
Cs-134	2.3E-10	2.1E-10	2.2E-10										
Cs-137	2.1E-10	2.0E-10	2.1E-10										
<u>Sb-124</u>	<u>2.0E-10</u>	<u>1.9E-10</u>	<u>2.4E-10</u>	_									
<u>Cs-136</u>	<u>1.8E-10</u>	<u>1.8E-10</u>	<u>1.8E-10</u>	_									
<u>Rb-86</u>	<u>1.6E-10</u>	<u>1.2E-10</u>	3.0E-10	_									
Sb-125	1.1E-10	1.1E-10	1.4E-10										
Pm-147	9.5E-11	1.3E-09	8.8E-10		_								
Cm-242	5.2E-11	6.7E-09	2.5E-09										
Cm-244	4.9E-11	6.3E-09	2.4E-09										
Ni-63	4.0E-11	9.6E-10	3.0E-10										
Te-125m	3.1E-11	3.2E-11	2.7E-10										

Comparison rable of amendments in the implementation rain for rakasinina								
	Current							
<u>Te-123m</u>	<u>1.7E-11</u>	<u>1.7E-11</u>	<u>1.0E-10</u>	_				
Pu-241	1.6E-11	1.1E-11	2.7E-11					
<u>Am-242m</u>	1.0E-11	<u>1.1E-11</u>	1.8E-11	_				
Tc-99	9.8E-12	2.2E-09	6.5E-09					
Sr-90	1.6E-12	<u>5.9E-12</u>	1.6E-12					
I-129	1.5E-12	8.5E-10	3.7E-10					
<u>Sr-89</u>	<u>1.3E-12</u>	<u>4.7E-12</u>	<u>1.3E-12</u>	_				
Sm-151	2.6E-13	5.5E-12	2.2E-12					
Cs-135	1.3E-17	7.1E-18	1.1E-17					
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide				
<u>Rh-103m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
<u>Te-129</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
<u>Pr-144</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide				
Total	<u>2.2E-05</u>	<u>2.2E-05</u>	2.3E-05					

Table X-6 Assessment result of environmental protection (Source term based on measured values (J1-G tank group))

	Exposure as	sessment resu			
Nuclide	Flatfish	Crab	Brown seaweed	Remarks	
<u>Fe-59</u>	3.6E-05	3.6E-05	3.8E-05	_	
<u>Sn-119m</u>	<u>7.1E-06</u>	<u>6.8E-06</u>	<u>5.0E-06</u>	_	
<u>Sn-123</u>	<u>5.9E-06</u>	<u>5.7E-06</u>	<u>6.1E-06</u>	_	
<u>Sn-126</u>	<u>2.7E-06</u>	<u>2.6E-06</u>	<u>2.5E-06</u>	_	
<u>Pm-148</u>	<u>8.1E-07</u>	<u>7.8E-07</u>	<u>1.1E-06</u>	_	
<u>Eu-152</u>	<u>6.3E-07</u>	<u>5.9E-07</u>	<u>6.3E-07</u>	_	
<u>Y-91</u>	<u>5.3E-07</u>	3.2E-07	<u>2.4E-06</u>	_	
Ce-144	4.8E-07	2.8E-07	4.8E-07		
<u>Tb-160</u>	<u>4.4E-07</u>	<u>4.4E-07</u>	<u>4.7E-07</u>	_	
Eu-154	3.6E-07	3.4E-07	3.6E-07		
Co-60	2.4E-07	2.4E-07	2.6E-07		
<u>Pm-148m</u>	2.3E-07	2.2E-07	2.5E-07	_	
<u>Pm-146</u>	1.3E-07	1.3E-07	1.4E-07	_	
<u>Cd-115m</u>	1.2E-07	<u>5.5E-07</u>	2.4E-08	_	
Mn-54	9.3E-08	8.5E-08	9.3E-08		
<u>Gd-153</u>	<u>5.1E-08</u>	<u>4.7E-08</u>	<u>5.9E-08</u>	_	
<u>Nb-95</u>	4.0E-08	3.9E-08	<u>4.1E-08</u>	_	
Ce-141	3.8E-08	3.7E-08	3.9E-08		

Table X-6 Assessment result of environmental protection (Source term based on measured values (J1-G tank group))

Revised

Exposure assessment result (mGy/day)							
	Exposure as	sessment resu					
Nuclide	Flatfish	Crab	Brown seaweed	Remarks			
Ce-144	4.8E-07	2.8E-07	4.8E-07				
Eu-154	3.6E-07	3.4E-07	3.6E-07				
Co-60	2.4E-07	2.4E-07	2.6E-07				
Mn-54	9.3E-08	8.5E-08	9.3E-08				
C-14	3.0E-08	2.5E-08	2.0E-08				
Eu-155	3.0E-08	2.9E-08	3.0E-08				
Ru-106	1.1E-08	1.1E-08	1.3E-08				
Cm-243	1.0E-08	2.6E-08	1.6E-08				
H-3	4.7E-09	4.7E-09	1.8E-09				
<u>Se-79</u>	<u>2.4E-09</u>	2.4E-09	<u>1.0E-10</u>	_			
Am-241	2.0E-09	6.4E-09	2.0E-09				
Cd-113m	1.4E-09	6.2E-09	1.1E-10				
Pu-238	1.2E-09	8.2E-10	2.0E-09				
Pu-240	1.1E-09	7.6E-10	1.8E-09				
Pu-239	1.1E-09	7.6E-10	1.8E-09				
Cs-137	1.1E-09	1.0E-09	1.1E-09				
Cs-134	6.0E-10	5.7E-10	6.0E-10				
Pm-147	2.6E-10	3.5E-09	2.4E-09				

Reason for Revision

Appropriate description due to the selection of nuclides to be

172

		C	Current					R	evised					Reason for Revision
C-14	3.0E-08	2.5E-08	2.0E-08			Sb-125	2.1E-10	2.0E-10	2.6E-10					
Eu-155	3.0E-08	2.9E-08	3.0E-08			Ni-63	1.3E-10	3.0E-09	9.4E-10					A management of a societion days to
<u>Am-243</u>	1.8E-08	2.2E-08	2.0E-08	_		Cm-244	1.3E-10	1.6E-08	6.2E-09					Appropriate description due to selection of nuclides to
<u>Co-58</u>	1.5E-08	1.5E-08	1.5E-08	_		Te-125m	5.7E-11	6.0E-11	5.0E-10					measured and assessed
Ru-106	1.1E-08	1.1E-08	1.3E-08			Pu-241	4.1E-11	2.8E-11	6.8E-11					
Cm-243	1.0E-08	2.6E-08	1.6E-08			Tc-99	3.2E-11	7.3E-09	2.1E-08					
<u>Zn-65</u>	4.9E-09	9.8E-09	4.8E-09	_		<u>Np-237</u>	9.7E-12	1.8E-10	2.3E-11		_			
H-3	4.7E-09	4.7E-09	1.8E-09			Sr-90	4.4E-12	2.5E-11	4.3E-12					
<u>Te-127m</u>	4.3E-09	4.3E-09	4.0E-08	_		<u>U-234</u>	3.7E-12	1.5E-11	3.5E-11		_			
<u>Te-127</u>	3.0E-09	3.0E-09	2.8E-08	_		<u>U-238</u>	3.3E-12	1.3E-11	3.1E-11		_			
<u>Te-129m</u>	2.4E-09	2.4E-09	2.2E-08	_		I-129	1.2E-12	7.1E-10	3.1E-10					
<u>Ag-110m</u>	2.0E-09	<u>1.1E-08</u>	1.7E-09	_		Sm-151	7.1E-13	1.5E-11	6.2E-12					
Am-241	2.0E-09	6.4E-09	2.0E-09			Y-90	0.0E+00	0.0E+00	0.0E+00			he paren	t	
<u>Ru-103</u>	1.4E-09	1.4E-09	1.4E-09	_		Total	1.3E-06	1.1E-06	1.3E-06	nuclide S1	<u>90</u>		_	
Cd-113m	1.4E-09	6.2E-09	1.1E-10		l l	Total	1.5E-00	1.1E-00	1.3E-00					
Pu-238	1.2E-09	8.2E-10	2.0E-09											
<u>Ba-140</u>	<u>1.2E-09</u>	<u>1.6E-09</u>	<u>2.2E-09</u>	_										
Pu-240	1.1E-09	7.6E-10	1.8E-09											
Pu-239	1.1E-09	7.6E-10	1.8E-09											
Cs-137	1.1E-09	1.0E-09	1.1E-09											
Cs-134	6.0E-10	5.7E-10	6.0E-10											
<u>Sb-124</u>	<u>5.3E-10</u>	<u>5.0E-10</u>	<u>6.4E-10</u>	_										
<u>Rb-86</u>	<u>4.7E-10</u>	3.5E-10	<u>8.4E-10</u>	_										
<u>Cs-136</u>	<u>4.2E-10</u>	<u>4.2E-10</u>	<u>4.2E-10</u>	_										
Pm-147	2.6E-10	3.5E-09	2.4E-09											
Sb-125	2.1E-10	2.0E-10	2.6E-10											
<u>Cm-242</u>	<u>1.3E-10</u>	<u>1.7E-08</u>	<u>6.5E-09</u>	_										
Ni-63	1.3E-10	3.0E-09	9.4E-10											
Cm-244	1.3E-10	1.6E-08	6.2E-09											
Te-125m	5.7E-11	6.0E-11	5.0E-10											
Pu-241	4.1E-11	2.8E-11	6.8E-11											
<u>Te-123m</u>	3.7E-11	<u>3.8E-11</u>	<u>2.2E-10</u>	_										
Tc-99	3.2E-11	7.3E-09	2.1E-08											
<u>Am-242m</u>	<u>2.7E-11</u>	3.0E-11	<u>4.8E-11</u>	_										
Sr-90	4.4E-12	<u>1.6E-11</u>	4.3E-12											
<u>Sr-89</u>	3.4E-12	<u>1.2E-11</u>	3.3E-12	_										
I-129	1.2E-12	7.1E-10	3.1E-10											
Sm-151	7.1E-13	1.5E-11	6.2E-12											
<u>Cs-135</u>	<u>6.9E-17</u>	3.8E-17	<u>5.6E-17</u>	_										
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide										
<u>Rh-103m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide										

		Current		
<u>Rh-106</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Te-129</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Ba-137m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Pr-144</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
<u>Pr-144m</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	<u>0.0E+00</u>	Assessed with the parent nuclide
Total	5.6E-05	5.5E-05	5.9E-05	

Attachment XI Conservativeness of the external exposure dose conversion factor

The dose conversion factor used for the dose assessment of external exposure is quoted from the Handbook for Determining Environmental Impacts of Decommissioning Work (hereinafter called "Decommissioning Handbook"). It has some defects: for example, its target is only the gamma radiation and conversion factors are not prepared for some of the $\underline{64}$ nuclides. For the unprepared conversion factors, conservativeness is secured by quoting the most conservative conversion factor for each of the $\beta\gamma$ and α nuclides, Co-60 and Am-241, respectively. For verification, comparison was performed using the dose conversion factor of external exposure created overseas.

As the target of comparison, we used Federal Guidance Report No.15, "External Exposure to Radionuclides in Air, Water and Soil" (Environmental Protection Agency, 2019; hereinafter called "FGR15") [XI-1] provided by the U.S. Environmental Protection Agency for radiation protection of U.S. citizens. FGR15 shows the dose conversion factor for the calculation of external exposure of humans from radioactive materials on the ground surface and in the soil, air, and water, and the target nuclides include all of the 64 nuclides subject to the assessment of ALPS treated water, so we attempted an assessment using the dose conversion factor shown in FGR15.

(Omission)

Table XI-1 Dose conversion factor for the effective dose from the radiation from the sea surface using FGR15

	Dose conversion factor	
Nuclide	for the effective dose	Remarks
Tvacilae	$((Sv/s)/(Bq/m^3))$	Teenan as
11.2		
H-3	3.1E-27	
C-14	1.4E-21	
Mn-54	4.0E-17	
<u>Fe-59</u>	<u>6.0E-17</u>	_
<u>Co-58</u>	<u>4.6E-17</u>	_
Co-60	1.3E-16	
Ni-63	3.9E-24	
<u>Zn-65</u>	<u>2.9E-17</u>	_
<u>Rb-86</u>	<u>4.9E-18</u>	_
<u>Sr-89</u>	<u>2.5E-19</u>	_
Sr-90	5.4E-20	
Y-90	4.7E-19	
<u>Y-91</u>	<u>4.2E-19</u>	_
<u>Nb-95</u>	3.6E-17	_
Tc-99	1.5E-20	

Attachment XI Conservativeness of the external exposure dose conversion factor

The dose conversion factor used for the dose assessment of external exposure is quoted from the Handbook for Determining Environmental Impacts of Decommissioning Work (hereinafter called "Decommissioning Handbook"). It has some defects: for example, its target is only the gamma radiation and conversion factors are not prepared for some of the nuclides <u>subject to be assessed</u>. For the unprepared conversion factors, conservativeness is secured by quoting the most conservative conversion factor for each of the $\beta\gamma$ and α nuclides, Co-60 and Am-241, respectively. For verification, comparison was performed using the dose conversion factor of external exposure created overseas

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be measured and assessed

As the target of comparison, we used Federal Guidance Report No.15, "External Exposure to Radionuclides in Air, Water and Soil" (Environmental Protection Agency, 2019; hereinafter called "FGR15") [XI-1] provided by the U.S. Environmental Protection Agency for radiation protection of U.S. citizens. FGR15 shows the dose conversion factor for the calculation of external exposure of humans from radioactive materials on the ground surface and in the soil, air, and water, and the target nuclides include all of the nuclides subject to the assessment of ALPS treated water, so we attempted an assessment using the dose conversion factor shown in FGR15.

(Omission)

Table XI-1 Dose conversion factor for the effective dose from the radiation from the sea surface using FGR15

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks
H-3	3.1E-27	
C-14	1.4E-21	
Mn-54	4.0E-17	
Co-60	1.3E-16	
Ni-63	3.9E-24	
<u>Se-79</u>	<u>1.7E-21</u>	_
Sr-90	5.4E-20	
Y-90	4.7E-19	
Tc-99	1.5E-20	
Ru-106	1.0E-17	The progeny nuclide Rh-106 is considered
Cd-113m	5.2E-20	
Sb-125	1.9E-17	
Te-125m	3.0E-19	
I-129	2.6E-19	
Cs-134	7.3E-17	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

	•	Curren	t	Revised	Reason for Revision
	<u>Ru-103</u>	2.2E-17	_	Cs-137 2.8E-17 The progeny nuclide Ba-137 is considered	Appropriate description due to the
	Ru-106	<u>2.8E-25</u>		Ce-144 3.1E-18 The progeny nuclide Pr-144, Pr-144m are considered	selection of nuclides to be measured and assessed
	<u>Rh-103m</u>	<u>5.1E-21</u>	_	Pm-147 4.7E-21	
	<u>Rh-106</u>	1.0E-17	_	Sm-151 3.1E-23	
	<u>Ag-110m</u>	<u>1.3E-16</u>	_	Eu-154 6.1E-17	
	Cd-113m	5.2E-20		Eu-155 2.0E-18	
	<u>Cd-115m</u>	<u>1.9E-18</u>	_	<u>U-234</u> <u>5.8E-21</u> —	
_	<u>Sn-119m</u>	<u>8.3E-20</u>	 -	U-238 The progeny nuclide Th-234, Pa-234m are considered	
	<u>Sn-123</u>	<u>5.6E-19</u>	The progeny nuclide Sb-126m is considered	Np-237 9.7E-18 The progeny nuclide Pa-233 is considered The progeny nuclide Pa-233 is considered	
	<u>Sn-126</u>	<u>7.4E-17</u>	The progeny nuclide 50 120m is considered	Pu-238 3.3E-21	
	<u>Sb-124</u>	<u>9.3E-17</u>	_		
	Sb-125	1.9E-17		5102.21	
	<u>Te-123m</u>	<u>5.5E-18</u>			
	Te-125m	3.0E-19		3.12.23	
	<u>Te-127</u>	<u>2.8E-19</u>	<u> </u>	0.0212	
	<u>Te-127m</u>	9.9E-20		100000000000000000000000000000000000000	
	<u>Te-129</u>	<u>2.9E-18</u>		Cm-244 3.9E-21	
	<u>Te-129m</u>	<u>1.5E-18</u>			
	I-129	2.6E-19			
	Cs-134	7.3E-17			
	<u>Cs-135</u>	<u>1.2E-20</u>	_		
	<u>Cs-136</u>	<u>1.0E-16</u>	_		
	Cs-137	<u>5.2E-20</u>			
	<u>Ba-137m</u>	<u>2.8E-17</u>	_		
	<u>Ba-140</u>	<u>1.2E-16</u>	The progeny nuclide La-140 is considered		
	<u>Ce-141</u>	<u>2.9E-18</u>	_		
	Ce-144	<u>6.8E-19</u>			
	<u>Pr-144</u>	<u>2.2E-18</u>	_		
	<u>Pr-144m</u>	<u>2.4E-19</u>	_		
	<u>Pm-146</u>	3.4E-17	_		
	Pm-147	4.7E-21			
	<u>Pm-148</u>	<u>2.9E-17</u>	_		
	<u>Pm-148m</u>	<u>9.3E-17</u>	_		
	Sm-151	3.1E-23			
	<u>Eu-152</u>	<u>5.6E-17</u>	_		
	Eu-154	6.1E-17			
	Eu-155	2.0E-18			
	<u>Gd-153</u>	<u>2.8E-18</u>	_		
	<u>Tb-160</u>	<u>5.5E-17</u>	_		
	Pu-238	3.3E-21			
	Pu-239	3.6E-21			
	Pu-240	3.2E-21			

	Current	
Pu-241	5.7E-23	
Am-241	6.0E-19	
<u>Am-242m</u>	<u>5.5E-19</u>	The progeny nuclide Am-242 is considered
<u>Am-243</u>	<u>8.6E-18</u>	The progeny nuclide Np-239 is considered
<u>Cm-242</u>	3.8E-21	
Cm-243	5.0E-18	
Cm-244	3.9E-21	

Table XI-2 Dose conversion factor for the effective dose from the radiation from hulls using FGR15

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m²))	Remarks
Н-3	6.7E-22	
C-14	6.1E-19	
Mn-54	5.3E-16	
<u>Fe-59</u>	<u>7.3E-16</u>	_
<u>Co-58</u>	<u>6.2E-16</u>	_
Co-60	1.5E-15	
Ni-63	8.0E-20	
<u>Zn-65</u>	3.6E-16	_
<u>Rb-86</u>	<u>1.6E-16</u>	_
<u>Sr-89</u>	<u>8.9E-17</u>	_
Sr-90	6.5E-18	
Y-90	1.5E-16	
<u>Y-91</u>	<u>9.4E-17</u>	_
<u>Nb-95</u>	<u>4.9E-16</u>	_
Tc-99	2.0E-18	
<u>Ru-103</u>	<u>3.2E-16</u>	_
Ru-106	<u>1.7E-20</u>	
<u>Rh-103m</u>	<u>4.3E-20</u>	_
<u>Rh-106</u>	<u>3.4E-16</u>	_
<u>Ag-110m</u>	<u>1.7E-15</u>	_
Cd-113m	6.3E-18	
<u>Cd-115m</u>	<u>1.1E-16</u>	_
<u>Sn-119m</u>	<u>9.6E-19</u>	_
<u>Sn-123</u>	<u>8.1E-17</u>	_
<u>Sn-126</u>	<u>1.1E-15</u>	The progeny nuclide Sb-126m is considered
<u>Sb-124</u>	<u>1.2E-15</u>	_
Sb-125	2.7E-16	
<u>Te-123m</u>	<u>7.7E-17</u>	_
Te-125m	4.1E-18	
<u>Te-127</u>	<u>1.5E-17</u>	_

Table XI-2 Dose conversion factor for the effective dose from the radiation from hulls using FGR15

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

	Dose conversion factor for	
Nuclide	the effective dose	Remarks
	$((Sv/s)/(Bq/m^2))$	
H-3	6.7E-22	
C-14	6.1E-19	
Mn-54	5.3E-16	
Co-60	1.5E-15	
Ni-63	8.0E-20	
<u>Se-79</u>	<u>6.8E-19</u>	_
Sr-90	6.5E-18	
Y-90	1.5E-16	
Tc-99	2.0E-18	
Ru-106	<u>3.4E-16</u>	The progeny nuclide Rh-106 is considered
Cd-113m	6.3E-18	
Sb-125	2.7E-16	
Te-125m	4.1E-18	
I-129	4.4E-18	
Cs-134	1.0E-15	
Cs-137	4.0E-16	The progeny nuclide Ba-137 is considered
Ce-144	<u>2.2E-16</u>	The progeny nuclide Pr-144, Pr-144m are considered
Pm-147	9.4E-19	
Sm-151	1.1E-19	
Eu-154	7.9E-16	
Eu-155	3.1E-17	
<u>U-234</u>	<u>6.4E-20</u>	_
<u>U-238</u>	<u>1.4E-16</u>	The progeny nuclide Th-234, Pa-234m are considered
<u>Np-237</u>	<u>1.4E-16</u>	The progeny nuclide Pa-233 is considered
Pu-238	2.1E-20	
Pu-239	4.2E-20	
Pu-240	2.2E-20	
Pu-241	1.7E-21	
Am-241	9.9E-18	

		Current	t			Rev	vised	Reason for Revision
	<u>Te-127m</u>	1.7E-18	_		Cm-243	7.1E-17		Appropriate description due to the
	<u>Te-129</u>	1.1E-16	_		Cm-244	3.1E-20		selection of nuclides to be measured and assessed
	<u>Te-129m</u>	5.1E-17	_			•		measured and assessed
	I-129	4.4E-18						
	Cs-134	1.0E-15						
	<u>Cs-135</u>	<u>1.6E-18</u>	_					
	<u>Cs-136</u>	<u>1.3E-15</u>	_					
	Cs-137	<u>7.9E-18</u>						
	<u>Ba-137m</u>	<u>3.9E-16</u>	_					
	<u>Ba-140</u>	<u>1.6E-15</u>	The progeny nuclide La-140 is considered					
	<u>Ce-141</u>	<u>4.5E-17</u>	_					
	Ce-144	<u>1.1E-17</u>						
	<u>Pr-144</u>	<u>2.0E-16</u>	_					
	<u>Pr-144m</u>	3.5E-18	_					
	<u>Pm-146</u>	<u>4.8E-16</u>	_					
	Pm-147	9.4E-19						
	<u>Pm-148</u>	<u>4.6E-16</u>	_					
	<u>Pm-148m</u>	<u>1.3E-15</u>	_					
	Sm-151	1.1E-19						
	<u>Eu-152</u>	<u>7.2E-16</u>	_					
	Eu-154	7.9E-16						
	Eu-155	3.1E-17						
	<u>Gd-153</u>	<u>4.3E-17</u>	_					
	<u>Tb-160</u>	<u>7.1E-16</u>	_					
	Pu-238	2.1E-20						
	Pu-239	4.2E-20						
	Pu-240	2.2E-20						
_	Pu-241	1.7E-21						
_	Am-241	9.9E-18	TI 242 242 : 11 1					
<u> </u>	<u>Am-242m</u>	<u>1.4E-17</u>	The progeny nuclide Am-242 is considered					
<u> </u>	<u>Am-243</u>	<u>1.3E-16</u>	The progeny nuclide Np-239 is considered					
	<u>Cm-242</u>	<u>2.6E-20</u>	_					
	Cm-243	7.1E-17						
	Cm-244	3.1E-20						
Table	XI-3 Dose conversion	n factor for the effective dos work using F	se from seawater during swimming and underwater GR15	Table	XI-3 Dose conversion		e dose from seawater during swimming and underwating FGR15	er
	Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks		Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks	
	H-3	6.2E-27			H-3	6.2E-27		
	C-14	2.8E-21			C-14	2.8E-21		
					Mn-54	8.0E-17		

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

	Cu	rrent			Revised	Reason for Revision
Mn-54	8.0E-17		Co-60	2.5E-16		
<u>Fe-59</u>	1.2E-16	_	Ni-63	7.8E-24		Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	9.2E-17	_	<u>Se-79</u>	3.3E-21	_	measured and assessed
Co-60	2.5E-16		Sr-90	1.1E-19		
Ni-63	7.8E-24		Y-90	9.5E-19		
<u>Zn-65</u>	5.7E-17	_	Тс-99	3.1E-20		
<u>Rb-86</u>	9.8E-18	_	Ru-106	2.1E-17	The progeny nuclide Rh-106 is considered	
<u>Sr-89</u>	<u>5.1E-19</u>	_	Cd-113m	1.0E-19		
Sr-90	1.1E-19		Sb-125	3.8E-17		
Y-90	9.5E-19		Te-125m	6.0E-19		
<u>Y-91</u>	<u>8.4E-19</u>	_	I-129	5.1E-19		
<u>Nb-95</u>	<u>7.3E-17</u>	_	Cs-134	1.5E-16		
Тс-99	3.1E-20		Cs-137	<u>5.6E-17</u>	The progeny nuclide Ba-137 is considered	
<u>Ru-103</u>	<u>4.5E-17</u>	_	Ce-144	<u>6.1E-18</u>	The progeny nuclide Pr-144, Pr-144m are	
Ru-106	<u>5.7E-25</u>		Pm-147	9.4E-21	considered	
<u>Rh-103m</u>	<u>1.0E-20</u>	<u> </u>	Sm-151	6.1E-23		
<u>Rh-106</u>	<u>2.1E-17</u>	_	Eu-154	1.2E-16		
<u>Ag-110m</u>	<u>2.7E-16</u>	<u> </u>	Eu-155	3.9E-18		
Cd-113m	1.0E-19		<u>U-234</u>	1.2E-20		
<u>Cd-115m</u>	3.8E-18	<u> </u>			The progeny nuclide Th-234, Pa-234m are	
<u>Sn-119m</u>	<u>1.7E-19</u>	<u> </u>	<u>U-238</u>	<u>2.9E-18</u>	considered	
<u>Sn-123</u>	<u>1.1E-18</u>	_	<u>Np-237</u>	<u>1.9E-17</u>	The progeny nuclide Pa-233 is considered	
<u>Sn-126</u>	<u>1.5E-16</u>	The progeny nuclide Sb-126m is considered	Pu-238	6.6E-21		
<u>Sb-124</u>	<u>1.9E-16</u>	_	Pu-239	7.3E-21		
Sb-125	3.8E-17		Pu-240	6.5E-21		
<u>Te-123m</u>	<u>1.1E-17</u>	<u> </u>	Pu-241	1.1E-22		
Te-125m	6.0E-19		Am-241	1.2E-18		
<u>Te-127</u>	<u>5.6E-19</u>	_	Cm-243	1.0E-17		
<u>Te-127m</u>	<u>2.0E-19</u>	_	Cm-244	7.9E-21		
<u>Te-129</u>	<u>5.7E-18</u>	_				
<u>Te-129m</u>	<u>3.1E-18</u>	_				
I-129	5.1E-19					
Cs-134	1.5E-16					
<u>Cs-135</u>	<u>2.3E-20</u>	_				
<u>Cs-136</u>	<u>2.1E-16</u>	<u> </u>				
Cs-137	<u>1.0E-19</u>					
<u>Ba-137m</u>	<u>5.5E-17</u>					
<u>Ba-140</u>	<u>2.5E-16</u>	The progeny nuclide La-140 is considered				
<u>Ce-141</u>	<u>5.8E-18</u>					
Ce-144	<u>1.4E-18</u>					
<u>Pr-144</u>	<u>4.3E-18</u>	_				
<u>Pr-144m</u>	<u>4.8E-19</u>	_				

55

•		rrent
<u>Pm-146</u>	<u>6.8E-17</u>	_
Pm-147	9.4E-21	
<u>Pm-148</u>	<u>5.8E-17</u>	_
<u>Pm-148m</u>	<u>1.9E-16</u>	_
Sm-151	6.1E-23	
<u>Eu-152</u>	<u>1.1E-16</u>	_
Eu-154	1.2E-16	
Eu-155	3.9E-18	
<u>Gd-153</u>	<u>5.6E-18</u>	_
<u>Tb-160</u>	<u>1.1E-16</u>	_
Pu-238	6.6E-21	
Pu-239	7.3E-21	
Pu-240	6.5E-21	
Pu-241	1.1E-22	
Am-241	1.2E-18	
<u>Am-242m</u>	1.1E-18	The progeny nuclide Am-242 is considered
<u>Am-243</u>	1.7E-17	The progeny nuclide Np-239 is considered
<u>Cm-242</u>	7.5E-21	_
Cm-243	1.0E-17	
Cm-244	7.9E-21	

Table XI-4 Dose conversion factor for the effective dose from the radiation from beach sand using FGR15

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks
H-3	3.4E-23	
C-14	3.1E-20	
Mn-54	2.6E-17	
<u>Fe-59</u>	<u>3.9E-17</u>	_
<u>Co-58</u>	3.0E-17	_
Co-60	8.3E-17	
Ni-63	4.1E-21	
<u>Zn-65</u>	<u>1.9E-17</u>	_
<u>Rb-86</u>	<u>4.4E-18</u>	_
<u>Sr-89</u>	<u>1.2E-18</u>	_
Sr-90	2.6E-19	
Y-90	2.3E-18	
<u>Y-91</u>	<u>1.4E-18</u>	_
<u>Nb-95</u>	<u>2.4E-17</u>	_
Tc-99	1.0E-19	
<u>Ru-103</u>	<u>1.4E-17</u>	_
Ru-106	8.6E-22	

Table XI-4 Dose conversion factor for the effective dose from the radiation from beach sand using FGR15

Revised

	Dose conversion factor	
Nuclide	for the effective dose	Remarks
	$((Sv/s)/(Bq/m^3))$	
H-3	3.4E-23	
C-14	3.1E-20	
Mn-54	2.6E-17	
Co-60	8.3E-17	
Ni-63	4.1E-21	
<u>Se-79</u>	3.5E-20	_
Sr-90	2.6E-19	
Y-90	2.3E-18	
Tc-99	1.0E-19	
Ru-106	1.0E-17	The progeny nuclide Rh-106 is considered
Cd-113m	2.5E-19	
Sb-125	1.2E-17	
Te-125m	5.1E-20	
I-129	7.9E-20	
Cs-134	4.8E-17	
Cs-137	1.8E-17	The progeny nuclide Ba-137 is considered
Ce-144	4.7E-18	The progeny nuclide Pr-144, Pr-144m ar considered

The Japanese version shall prevail.

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

		rrent	•		evised	Reason for Revision
<u>Rh-103m</u>	<u>6.6E-22</u>	_	Pm-147	4.8E-20		Appropriate description due to the
<u>Rh-106</u>	1.0E-17	_	Sm-151	5.5E-21		selection of nuclides to be measured and assessed
<u>Ag-110m</u>	8.7E-17	_	Eu-154	3.9E-17		measured and assessed
Cd-113m	2.5E-19		Eu-155	9.5E-19		
<u>Cd-115m</u>	2.3E-18	_	<u>U-234</u>	1.9E-21	_	
<u>Sn-119m</u>	1.2E-20	_	<u>U-238</u>	2 (F. 10	The progeny nuclide Th-234, Pa-234m are	
<u>Sn-123</u>	<u>1.3E-18</u>	_	<u>Np-237</u>	2.6E-18	<u>considered</u> The progeny nuclide Pa-233 is considered	
<u>Sn-126</u>	<u>4.8E-17</u>	The progeny nuclide Sb-126m is considered	Pu-238	5.8E-18		
<u>Sb-124</u>	<u>6.1E-17</u>	_	Pu-239	5.3E-22		
Sb-125	1.2E-17		Pu-240	1.5E-21		
<u>Te-123m</u>	3.1E-18	_	Pu-241	5.5E-22		
Te-125m	5.1E-20		Am-241	7.5E-23		
<u>Te-127</u>	4.6E-19	_	Cm-243	2.2E-19		
<u>Te-127m</u>	2.9E-20		Cm-244	2.9E-18 1.0E-21		
<u>Te-129</u>	<u>2.7E-18</u>	_] Cili 244	1.UE-21		
<u>Te-129m</u>	<u>1.3E-18</u>	_]			
I-129	7.9E-20					
Cs-134	4.8E-17					
<u>Cs-135</u>	<u>8.4E-20</u>	_				
<u>Cs-136</u>	6.6E-17	_				
Cs-137	<u>2.6E-19</u>					
<u>Ba-137m</u>	1.8E-17	_				
<u>Ba-140</u>	<u>8.3E-17</u>	The progeny nuclide La-140 is considered]			
<u>Ce-141</u>	<u>1.8E-18</u>	_				
Ce-144	<u>4.2E-19</u>]			
<u>Pr-144</u>	<u>4.2E-18</u>	_				
<u>Pr-144m</u>	<u>8.7E-20</u>	_				
<u>Pm-146</u>	<u>2.2E-17</u>	_				
Pm-147	4.8E-20					
<u>Pm-148</u>	<u>2.0E-17</u>	_]			
<u>Pm-148m</u>	<u>6.0E-17</u>	_]			
Sm-151	5.5E-21]			
<u>Eu-152</u>	<u>3.6E-17</u>]			
Eu-154	3.9E-17]			
Eu-155	9.5E-19]			
<u>Gd-153</u>	<u>1.2E-18</u>	_				
<u>Tb-160</u>	<u>3.5E-17</u>	_]			
Pu-238	5.3E-22]			
Pu-239	1.5E-21]			
Pu-240	5.5E-22]			
Pu-241	7.5E-23]			
Am-241	2.2E-19					
			_			

56

-	Curre	ent
<u>Am-242m</u>	<u>1.2E-18</u>	The progeny nuclide Am-242 is considered
<u>Am-243</u>	<u>4.8E-18</u>	The progeny nuclide Np-239 is considered
<u>Cm-242</u>	<u>5.9E-22</u>	_
Cm-243	2.9E-18	
Cm-244	1.0E-21	

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

XI-3. Exposure assessment result

Table XI-6 shows comparison with the assessment result of Table 6-1-22 in the results of the external exposure dose assessments of the following three cases.

Source term based on the composition of nuclides of the measured value

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of <u>63</u> nuclides other than tritium: 0.29)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of $\underline{63}$ nuclides other than tritium: $\underline{0.35}$)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of <u>63</u> nuclides other than tritium: 0.22)

<u>In all assessments</u>, the <u>result</u> using the conversion factor in the Decommissioning Handbook <u>was larger than</u> those using the conversion factor in FGR15. <u>In the assessment using the</u> conversion factor <u>of</u> the Decommissioning Handbook, <u>the assessment results are considered to be conservative because</u> conservative conversion factors such as Co-60 <u>were used for the nuclides for which conversion factors were not calculated</u>.

Table XI-6 Comparison with the external exposure dose assessment result using the dose conversion factor of FGR15

Source		Sour	rce term based	on measured va	lues		
term	i. K4 tar	ık group	ii. J1-C ta	nk group	i. K4 tank group		
Dose conversio n factor	Decommissio ning Handbook	FGR15	Decommissio ning Handbook	FGR15	Decommissio ning Handbook	FGR15	
Seawater surface	6.5E-09 9.4E-10		1.7E-08 3.5E-10		4.7E-08	<u>8.4E-10</u>	
Hull	4.8E-09	1.7E-09	1.2E-08	8.9E-10	3.3E-08	2.1E-09	
Swimming	4.5E-09	4.6E-10	<u>1.2E-08</u>	<u>1.7E-10</u>	3.2E-08	4.1E-10	
Beach sand	7.8E-06	<u>1.4E-06</u>	<u>2.1E-05</u>	5.7E-07	<u>5.6E-05</u>	1.4E-06	

(Omission)

Attachment XII Impact of the assessment range of concentrations in seawater used for the assessment of exposures

(Omission)

Table XII-2 Concentration in the seawater used for the assessment

(Source term based on measured values (K4 tank group))

XI-3. Exposure assessment result

Table XI-6 shows comparison with the assessment result of Table 6-1-22 in the results of the external exposure dose assessments of the following three cases.

Revised

Source term based on the composition of nuclides of the measured value

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of $\frac{30}{20}$ nuclides other than tritium: $\frac{0.28}{0.28}$)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of <u>30</u> nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of <u>30</u> nuclides other than tritium: 0.12)

Overall, the <u>assessment</u> using the conversion factor in the Decommissioning Handbook <u>had similar results as</u> those using the conversion factor in FGR15. <u>This is thought to be due to the fact that the number of the nuclides for which</u> conversion factors were not shown in the Decommissioning Handbook <u>was reduced due to the selection of nuclides</u> to be measured and assessed, and the use of conservative conversion factors such as Co-60 was reduced.

Table XI-6 Comparison with the external exposure dose assessment result using the dose conversion factor of FGR15

Source		Sour	rce term based of	on measured va	alues		
term	i. K4 tan	k group	ii. J1-C ta	nk group	iii. J1-G tank group		
Dose conversio n factor			Decommissioni ng Handbook	FGR15	Decommissioni ng Handbook	FGR15	
Seawater surface	7.6E-10	<u>6.3E-10</u>	2.3E-10	1.3E-10	4.8E-10	2.8E-10	
Hull	<u>7.2E-10</u>	<u>1.1E-09</u>	2.2E-10	3.1E-10	<u>4.6E-10</u>	<u>5.5E-10</u>	
Swimming	<u>5.2E-10</u>	3.1E-10	<u>1.6E-10</u>	6.2E-11	3.2E-10	1.4E-10	
Beach sand	9.1E-07	5.7E-07	2.7E-07	1.2E-07	<u>5.6E-07</u>	2.6E-07	

(Omission)

Attachment XII Impact of the assessment range of concentrations in seawater used for the assessment of exposures

(Omission)

57

Table XII-2 Concentration in the seawater used for the assessment

(Source term based on measured values (K4 tank group))

		C	urrent				_	R	evised				Reason for Revision
		Concentrat	tion in the seawater	used for the assessr	ment (Bq/L)			Concentra	tion in the seawater	used for the assessr	ment (Bq/L)		
Target nuclide	Annual volume of discharge (Bq)	Average of all layers within 5km×5km	Average of the top layers within 5km×5km	Average of all layers within 20km×10km	Average of the top layers within 20km×10km	Target nuclide	Annual volume of discharge (Bq)	Average of all layers within 5km×5km	Average of the top layers within 5km×5km	Average of all layers within 20km×10km	Average of the top layers within 20km×10km		
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01	H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01		
C-14	1.7E+09	1.3E-05	1.9E-05	3.8E-06	8.7E-06	C-14	1.7E+09	1.3E-05	1.9E-05	3.8E-06	8.7E-06		
Mn-54	7.8E+05	6.0E-09	8.5E-09	1.7E-09	3.9E-09	Mn-54	7.8E+05	6.0E-09	8.5E-09	1.7E-09	3.9E-09		
<u>Fe-59</u>	2.0E+06	1.5E-08	2.1E-08	4.3E-09	9.8E-09	Co-60	5.1E+07	3.9E-07	5.6E-07	1.1E-07	2.5E-07		Appropriate description due to the selection of nuclides to be
<u>Co-58</u>	9.3E+05	7.2E-09	1.0E-08	2.0E-09	4.6E-09	Ni-63	2.5E+08	2.0E-06	2.8E-06	5.6E-07	1.3E-06	=	measured and assessed
Co-60	5.1E+07	3.9E-07	5.6E-07	1.1E-07	2.5E-07	<u>Se-79</u>	1.7E+08	1.3E-06	1.9E-06	3.8E-07	8.7E-07		
Ni-63	2.5E+08	2.0E-06	2.8E-06	5.6E-07	1.3E-06	Sr-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07	=	
<u>Zn-65</u>	<u>1.7E+06</u>	1.3E-08	1.9E-08	3.8E-09	8.7E-09	Y-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07	=	
<u>Rb-86</u>	2.2E+07	1.7E-07	2.4E-07	4.8E-08	1.1E-07	Tc-99	8.1E+07	6.3E-07	8.8E-07	1.8E-07	4.1E-07		
<u>Sr-89</u>	1.2E+07	8.9E-08	1.3E-07	2.5E-08	5.8E-08	Ru-106	1.9E+08	1.4E-06	2.0E-06	4.0E-07	9.3E-07		
Sr-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07	Cd-113m	2.1E+06	1.6E-08	2.3E-08	4.5E-09	1.0E-08		
Y-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07	Sb-125	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07		
<u>Y-91</u>	2.5E+08	2.0E-06	2.8E-06	5.6E-07	1.3E-06	Te-125m	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07		
<u>Nb-95</u>	<u>1.2E+06</u>	8.9E-09	1.3E-08	2.5E-09	5.8E-09	I-129	2.4E+08	1.9E-06	2.7E-06	5.3E-07	1.2E-06		
Tc-99	8.1E+07	6.3E-07	8.8E-07	1.8E-07	4.1E-07	Cs-134	5.2E+06	4.0E-08	5.7E-08	1.1E-08	2.6E-08		
<u>Ru-103</u>	<u>1.2E+06</u>	8.9E-09	1.3E-08	2.5E-09	5.8E-09	Cs-137	4.9E+07	3.8E-07	5.3E-07	1.1E-07	2.4E-07		
Ru-106	1.9E+08	1.4E-06	2.0E-06	4.0E-07	9.3E-07	Ce-144	7.3E+06	5.6E-08	8.0E-08	1.6E-08	3.6E-08		
<u>Rh-103m</u>	1.2E+06	8.9E-09	1.3E-08	2.5E-09	5.8E-09	Pm-147	2.2E+07	1.7E-07	2.4E-07	4.8E-08	1.1E-07		
<u>Rh-106</u>	1.9E+08	1.4E-06	2.0E-06	4.0E-07	9.3E-07	Sm-151	1.0E+05	8.1E-10	1.1E-09	2.3E-10	5.2E-10		
<u>Ag-110m</u>	6.5E+05	5.0E-09	7.1E-09	1.4E-09	3.2E-09	Eu-154	1.4E+06	1.1E-08	1.5E-08	3.0E-09	6.9E-09		
Cd-113m	2.1E+06	1.6E-08	2.3E-08	4.5E-09	1.0E-08	Eu-155	3.8E+06	3.0E-08	4.2E-08	8.3E-09	1.9E-08		
<u>Cd-115m</u>	7.4E+07	5.7E-07	8.1E-07	1.6E-07	3.7E-07	<u>U-234</u>	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Sn-119m</u>	2.0E+07	1.5E-07	2.1E-07	4.3E-08	9.8E-08	<u>U-238</u>	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10	=	
<u>Sn-123</u>	1.4E+08	1.1E-06	1.5E-06	3.0E-07	6.9E-07	<u>Np-237</u>	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10	=	
<u>Sn-126</u>	3.1E+06	2.4E-08	3.4E-08	6.8E-09	1.6E-08	Pu-238	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Sb-124</u>	<u>1.1E+06</u>	8.5E-09	1.2E-08	2.4E-09	5.5E-09	Pu-239	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
Sb-125	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07	Pu-240	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Te-123m</u>	<u>1.1E+06</u>	8.2E-09	1.2E-08	2.3E-09	5.3E-09	Pu-241	3.2E+06	2.5E-08	3.5E-08	7.1E-09	1.6E-08		
Te-125m	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07	Am-241	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Te-127</u>	3.7E+07	2.9E-07	4.0E-07	8.1E-08	1.9E-07	Cm-243	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Te-127m</u>	3.7E+07	2.9E-07	4.0E-07	8.1E-08	1.9E-07	Cm-244	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10		
<u>Te-129</u>	3.7E+07	2.9E-07	4.0E-07	8.1E-08	1.9E-07	Target e	exposure	From fishing	From sea surface	From fishing nets	From sea surface		
<u>Te-129m</u>	3.7E+07	2.9E-07	4.0E-07	8.1E-08	1.9E-07	asses	sment	nets	From hulls	Ingestion of	From hulls		
I-129	2.4E+08	1.9E-06	2.7E-06	5.3E-07	1.2E-06			Ingestion of		seafood			
Cs-134	5.2E+06	4.0E-08	5.7E-08	1.1E-08	2.6E-08			seafood					
<u>Cs-135</u>	2.9E+02	2.2E-12	3.2E-12	6.3E-13	1.4E-12								
<u>Cs-136</u>	3.5E+06	2.7E-08	3.8E-08	7.6E-09	1.7E-08								
Cs-137	4.9E+07	3.8E-07	5.3E-07	1.1E-07	2.4E-07								

58

Col	Current								
<u>Ba-137m</u>	4.9E+07	3.8E-07	5.3E-07	1.1E-07	2.4E-07				
<u>Ba-140</u>	1.1E+07	8.5E-08	1.2E-07	2.4E-08	5.5E-08				
<u>Ce-141</u>	2.9E+06	2.2E-08	3.2E-08	6.3E-09	1.4E-08				
Ce-144	7.3E+06	5.6E-08	8.0E-08	1.6E-08	3.6E-08				
<u>Pr-144</u>	7.3E+06	5.6E-08	8.0E-08	1.6E-08	3.6E-08				
<u>Pr-144m</u>	7.3E+06	5.6E-08	8.0E-08	1.6E-08	3.6E-08				
<u>Pm-146</u>	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08				
Pm-147	2.2E+07	1.7E-07	2.4E-07	4.8E-08	1.1E-07				
<u>Pm-148</u>	5.8E+07	4.5E-07	6.3E-07	1.3E-07	2.9E-07				
<u>Pm-148m</u>	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.9E-09				
Sm-151	1.0E+05	8.1E-10	1.1E-09	2.3E-10	5.2E-10				
<u>Eu-152</u>	3.2E+06	2.5E-08	3.5E-08	7.1E-09	1.6E-08				
Eu-154	1.4E+06	1.1E-08	1.5E-08	3.0E-09	6.9E-09				
Eu-155	3.8E+06	3.0E-08	4.2E-08	8.3E-09	1.9E-08				
<u>Gd-153</u>	3.7E+06	2.9E-08	4.0E-08	8.1E-09	1.9E-08				
<u>Tb-160</u>	3.2E+06	2.5E-08	3.5E-08	7.1E-09	1.6E-08				
Pu-238	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
Pu-239	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
Pu-240	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
Pu-241	3.2E+06	2.5E-08	3.5E-08	7.1E-09	1.6E-08				
Am-241	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
<u>Am-242m</u>	4.5E+03	3.5E-11	4.9E-11	9.9E-12	<u>2.3E-11</u>				
<u>Am-243</u>	7.3E+04	<u>5.6E-10</u>	8.0E-10	<u>1.6E-10</u>	3.6E-10				
<u>Cm-242</u>	7.3E+04	<u>5.6E-10</u>	8.0E-10	<u>1.6E-10</u>	3.6E-10				
Cm-243	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
Cm-244	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10				
Target exposu	re assessment	From fishing nets Ingestion of seafood	From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls				

Table XII-3 Concentration in the seawater used for the assessment (Source term based on measured values (J1-C tank group))

		Concentration in the seawater used for the assessment (Bq/L)								
	Annual volume	Average of all	Average of the	Average of all	Average of the					
Target nuclide	of discharge	layers within	top layers	layers within	top layers					
	(Bq)	5km×5km	within	20km×10km	within					
			5km×5km		20km×10km					
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01					
C-14	4.8E+08	3.7E-06	5.3E-06	1.1E-06	2.4E-06					
Mn-54	1.0E+06	7.9E-09	1.1E-08	2.2E-09	5.1E-09					
<u>Fe-59</u>	2.3E+06	<u>1.8E-08</u>	2.5E-08	<u>5.1E-09</u>	<u>1.2E-08</u>					
<u>Co-58</u>	<u>1.1E+06</u>	8.5E-09	<u>1.2E-08</u>	2.4E-09	5.5E-09					
Co-60	8.9E+06	6.8E-08	9.7E-08	1.9E-08	4.4E-08					

Table XII-3 Concentration in the seawater used for the assessment (Source term based on measured values (J1-C tank group))

Revised

		Concentration in the seawater used for the assessment (Bq/L)							
	Annual volume	Average of all	Average of the	Average of all	Average of the				
Target nuclide	of discharge	layers within	top layers	layers within	top layers				
	(Bq)) 5km×5km within		20km×10km	within				
			5km×5km		20km×10km				
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01				
C-14	4.8E+08	3.7E-06	5.3E-06	1.1E-06	2.4E-06				
Mn-54	1.0E+06	7.9E-09	1.1E-08	2.2E-09	5.1E-09				
Co-60	8.9E+06	6.8E-08	9.7E-08	1.9E-08	4.4E-08				
Ni-63	2.3E+08	1.8E-06	2.5E-06	5.0E-07	1.1E-06				
<u>Se-79</u>	4.0E+07	3.1E-07	<u>4.4E-07</u>	<u>8.8E-08</u>	<u>2.0E-07</u>				

Reason for Revision

Appropriate description due to the selection of nuclides to be

183

measured and assessed

		C	urrent		
Ni-63	2.3E+08	1.8E-06	2.5E-06	5.0E-07	1.1E-06
<u>Zn-65</u>	2.5E+06	1.9E-08	2.8E-08	5.5E-09	1.3E-08
<u>Rb-86</u>	1.3E+07	1.0E-07	1.5E-07	2.9E-08	6.7E-08
<u>Sr-89</u>	1.4E+06	1.1E-08	1.6E-08	3.2E-09	7.2E-09
Sr-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
Y-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
<u>Y-91</u>	4.6E+08	3.5E-06	<u>5.0E-06</u>	<u>1.0E-06</u>	<u>2.3E-06</u>
<u>Nb-95</u>	1.3E+06	1.0E-08	1.5E-08	<u>2.9E-09</u>	6.7E-09
Тс-99	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
<u>Ru-103</u>	<u>1.4E+06</u>	<u>1.1E-08</u>	<u>1.6E-08</u>	<u>3.1E-09</u>	<u>7.1E-09</u>
Ru-106	3.8E+07	2.9E-07	4.1E-07	8.2E-08	1.9E-07
<u>Rh-103m</u>	1.4E+06	<u>1.1E-08</u>	1.6E-08	<u>3.1E-09</u>	7.1E-09
<u>Rh-106</u>	3.8E+07	2.9E-07	4.1E-07	<u>8.2E-08</u>	1.9E-07
<u>Ag-110m</u>	1.2E+06	8.9E-09	1.3E-08	<u>2.5E-09</u>	5.8E-09
Cd-113m	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
<u>Cd-115m</u>	7.2E+07	5.6E-07	7.9E-07	1.6E-07	3.6E-07
<u>Sn-119m</u>	1.1E+09	8.7E-06	1.2E-05	2.5E-06	<u>5.6E-06</u>
<u>Sn-123</u>	1.8E+08	1.4E-06	1.9E-06	3.9E-07	8.9E-07
<u>Sn-126</u>	7.8E+06	6.0E-08	8.5E-08	1.7E-08	3.9E-08
<u>Sb-124</u>	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Sb-125	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
<u>Te-123m</u>	2.5E+06	1.9E-08	2.7E-08	5.4E-09	1.2E-08
Te-125m	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
<u>Te-127</u>	1.3E+08	9.7E-07	1.4E-06	2.8E-07	6.3E-07
<u>Te-127m</u>	1.3E+08	1.0E-06	<u>1.4E-06</u>	<u>2.9E-07</u>	6.6E-07
<u>Te-129</u>	3.8E+07	2.9E-07	4.1E-07	<u>8.2E-08</u>	1.9E-07
<u>Te-129m</u>	3.8E+07	2.9E-07	4.1E-07	<u>8.2E-08</u>	1.9E-07
I-129	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Cs-134	2.0E+06	1.6E-08	2.2E-08	4.4E-09	1.0E-08
<u>Cs-135</u>	3.2E+01	2.5E-13	3.5E-13	<u>7.0E-14</u>	<u>1.6E-13</u>
<u>Cs-136</u>	<u>1.3E+06</u>	<u>9.7E-09</u>	<u>1.4E-08</u>	<u>2.8E-09</u>	<u>6.3E-09</u>
Cs-137	5.1E+06	3.9E-08	5.6E-08	1.1E-08	2.5E-08
<u>Ba-137m</u>	<u>5.1E+06</u>	<u>3.9E-08</u>	<u>5.6E-08</u>	<u>1.1E-08</u>	<u>2.5E-08</u>
<u>Ba-140</u>	<u>5.4E+06</u>	<u>4.1E-08</u>	<u>5.9E-08</u>	<u>1.2E-08</u>	<u>2.7E-08</u>
<u>Ce-141</u>	<u>7.0E+06</u>	<u>5.4E-08</u>	<u>7.6E-08</u>	<u>1.5E-08</u>	3.5E-08
Ce-144	1.5E+07	1.2E-07	1.7E-07	3.3E-08	7.6E-08
<u>Pr-144</u>	1.5E+07	<u>1.2E-07</u>	<u>1.7E-07</u>	<u>3.3E-08</u>	<u>7.6E-08</u>
<u>Pr-144m</u>	1.5E+07	<u>1.2E-07</u>	<u>1.7E-07</u>	3.3E-08	<u>7.6E-08</u>
<u>Pm-146</u>	<u>1.8E+06</u>	<u>1.4E-08</u>	<u>2.0E-08</u>	<u>3.9E-09</u>	9.0E-09
Pm-147	2.1E+07	1.7E-07	2.3E-07	4.7E-08	1.1E-07
<u>Pm-148</u>	<u>6.2E+06</u>	<u>4.8E-08</u>	<u>6.7E-08</u>	<u>1.3E-08</u>	<u>3.1E-08</u>
<u>Pm-148m</u>	1.3E+06	1.0E-08	1.4E-08	2.8E-09	6.4E-09

		R	evised		
Sr-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
Y-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
Tc-99	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Ru-106	3.8E+07	2.9E-07	4.1E-07	8.2E-08	1.9E-07
Cd-113m	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Sb-125	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
Te-125m	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
I-129	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Cs-134	2.0E+06	1.6E-08	2.2E-08	4.4E-09	1.0E-08
Cs-137	5.1E+06	3.9E-08	5.6E-08	1.1E-08	2.5E-08
Ce-144	1.5E+07	1.2E-07	1.7E-07	3.3E-08	7.6E-08
Pm-147	2.1E+07	1.7E-07	2.3E-07	4.7E-08	1.1E-07
Sm-151	3.0E+05	2.3E-09	3.2E-09	6.4E-10	1.5E-09
Eu-154	3.0E+06	2.3E-08	3.2E-08	6.4E-09	1.5E-08
Eu-155	9.1E+06	7.0E-08	1.0E-07	2.0E-08	4.6E-08
<u>U-234</u>	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
<u>U-238</u>	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
<u>Np-237</u>	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-238	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-239	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-240	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-241	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Am-241	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-243	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-244	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Target e	xposure	From fishing	From sea surface	From fishing nets	From sea surfac
assess	sment	nets	From hulls	Ingestion of	From hulls
		Ingestion of seafood		seafood	

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

		C	urrent		
Sm-151	3.0E+05	2.3E-09	3.2E-09	6.4E-10	1.5E-09
<u>Eu-152</u>	7.5E+06	5.8E-08	8.2E-08	1.6E-08	3.8E-08
Eu-154	3.0E+06	2.3E-08	3.2E-08	6.4E-09	1.5E-08
Eu-155	9.1E+06	7.0E-08	1.0E-07	2.0E-08	4.6E-08
<u>Gd-153</u>	7.0E+06	<u>5.4E-08</u>	7.6E-08	1.5E-08	3.5E-08
<u>Tb-160</u>	3.8E+06	2.9E-08	<u>4.1E-08</u>	8.2E-09	<u>1.9E-08</u>
Pu-238	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-239	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-240	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-241	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Am-241	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
<u>Am-242m</u>	1.6E+04	1.2E-10	1.7E-10	3.5E-11	<u>7.9E-11</u>
<u>Am-243</u>	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
<u>Cm-242</u>	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-243	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-244	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Target exposu	are assessment	From fishing nets Ingestion of seafood	From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls

Table XII-4 Concentration in the seawater used for the assessment (Source term based on measured value (J1-G tank group))

		Concentrat	ion in the seawater	used for the assessn	nent (Bq/L)
	Annual volume	Average of all	Average of the	Average of all	Average of the
Target nuclide	of discharge	layers within	top layers	layers within	top layers
	(Bq)	5km×5km	within	20km×10km	within
			5km×5km		20km×10km
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01
C-14	1.3E+09	1.0E-05	1.4E-05	2.8E-06	6.5E-06
Mn-54	3.1E+06	2.4E-08	3.4E-08	6.8E-09	1.5E-08
<u>Fe-59</u>	<u>5.9E+06</u>	<u>4.5E-08</u>	<u>6.4E-08</u>	<u>1.3E-08</u>	<u>2.9E-08</u>
<u>Co-58</u>	3.0E+06	2.3E-08	3.3E-08	6.6E-09	<u>1.5E-08</u>
Co-60	1.9E+07	1.4E-07	2.0E-07	4.1E-08	9.4E-08
Ni-63	7.2E+08	5.5E-06	7.8E-06	1.6E-06	3.6E-06
<u>Zn-65</u>	<u>6.5E+06</u>	<u>5.0E-08</u>	<u>7.1E-08</u>	<u>1.4E-08</u>	<u>3.3E-08</u>
<u>Rb-86</u>	3.8E+07	3.0E-07	<u>4.2E-07</u>	<u>8.4E-08</u>	<u>1.9E-07</u>
<u>Sr-89</u>	3.7E+06	2.8E-08	4.0E-08	8.0E-09	<u>1.8E-08</u>
Sr-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Y-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
<u>Y-91</u>	9.8E+08	<u>7.6E-06</u>	<u>1.1E-05</u>	<u>2.1E-06</u>	<u>4.9E-06</u>
<u>Nb-95</u>	3.8E+06	3.0E-08	4.2E-08	8.4E-09	<u>1.9E-08</u>
Tc-99	1.1E+08	8.2E-07	1.2E-06	2.3E-07	5.3E-07
<u>Ru-103</u>	<u>4.2E+06</u>	<u>3.2E-08</u>	<u>4.5E-08</u>	<u>9.1E-09</u>	<u>2.1E-08</u>

Table XII-4 Concentration in the seawater used for the assessment (Source term based on measured value (J1-G tank group))

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

		Concentrat	ion in the seawater	used for the assessr	ment (Bq/L)
	Annual volume	Average of all	Average of the	Average of all	Average of the
Target nuclide	of discharge	layers within	top layers	layers within	top layers
	(Bq)	5km×5km	within	20km×10km	within
			5km×5km		20km×10km
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01
C-14	1.3E+09	1.0E-05	1.4E-05	2.8E-06	6.5E-06
Mn-54	3.1E+06	2.4E-08	3.4E-08	6.8E-09	1.5E-08
Co-60	1.9E+07	1.4E-07	2.0E-07	4.1E-08	9.4E-08
Ni-63	7.2E+08	5.5E-06	7.8E-06	1.6E-06	3.6E-06
<u>Se-79</u>	1.2E+08	9.4E-07	<u>1.3E-06</u>	<u>2.7E-07</u>	<u>6.1E-07</u>
Sr-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Y-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Tc-99	1.1E+08	8.2E-07	1.2E-06	2.3E-07	5.3E-07
Ru-106	3.9E+07	3.0E-07	4.3E-07	8.5E-08	2.0E-07
Cd-113m	7.0E+06	5.4E-08	7.6E-08	1.5E-08	3.5E-08
Sb-125	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
Te-125m	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
I-129	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
Cs-134	5.5E+06	4.2E-08	6.0E-08	1.2E-08	2.7E-08

		C	urrent		
Ru-106	3.9E+07	3.0E-07	4.3E-07	8.5E-08	2.0E-07
<u>Rh-103m</u>	<u>4.2E+06</u>	3.2E-08	4.5E-08	9.1E-09	<u>2.1E-08</u>
Rh-106	3.9E+07	3.0E-07	4.3E-07	8.5E-08	2.0E-07
<u>Ag-110m</u>	3.3E+06	2.5E-08	3.6E-08	7.1E-09	1.6E-08
Cd-113m	7.0E+06	5.4E-08	7.6E-08	1.5E-08	3.5E-08
<u>Cd-115m</u>	1.9E+08	1.4E-06	2.0E-06	4.1E-07	9.4E-07
<u>Sn-119m</u>	3.3E+09	2.5E-05	3.6E-05	7.1E-06	1.6E-05
<u>Sn-123</u>	5.1E+08	4.0E-06	5.6E-06	1.1E-06	2.6E-06
<u>Sn-126</u>	1.2E+07	9.4E-08	1.3E-07	<u>2.7E-08</u>	<u>6.1E-08</u>
<u>Sb-124</u>	6.8E+06	5.3E-08	7.5E-08	1.5E-08	3.4E-08
Sb-125	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
<u>Te-123m</u>	5.5E+06	4.2E-08	6.0E-08	1.2E-08	2.7E-08
Te-125m	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
<u>Te-127</u>	3.5E+08	2.7E-06	3.8E-06	7.6E-07	1.8E-06
<u>Te-127m</u>	3.7E+08	2.8E-06	4.0E-06	8.0E-07	1.8E-06
<u>Te-129</u>	9.8E+07	7.6E-07	1.1E-06	2.1E-07	4.9E-07
<u>Te-129m</u>	9.8E+07	7.6E-07	1.1E-06	2.1E-07	4.9E-07
I-129	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
Cs-134	5.5E+06	4.2E-08	6.0E-08	1.2E-08	2.7E-08
<u>Cs-135</u>	1.7E+02	1.3E-12	1.9E-12	3.7E-13	8.6E-13
<u>Cs-136</u>	2.9E+06	2.3E-08	3.2E-08	6.4E-09	1.5E-08
Cs-137	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
<u>Ba-137m</u>	2.7E+07	2.1E-07	2.9E-07	<u>5.9E-08</u>	1.3E-07
<u>Ba-140</u>	1.4E+07	1.1E-07	1.5E-07	3.0E-08	6.9E-08
<u>Ce-141</u>	9.8E+06	7.6E-08	1.1E-07	2.1E-08	4.9E-08
Ce-144	4.5E+07	3.5E-07	4.9E-07	9.8E-08	2.2E-07
<u>Pr-144</u>	4.5E+07	3.5E-07	4.9E-07	9.8E-08	2.2E-07
<u>Pr-144m</u>	4.5E+07	3.5E-07	4.9E-07	9.8E-08	2.2E-07
<u>Pm-146</u>	<u>5.1E+06</u>	4.0E-08	5.6E-08	1.1E-08	2.6E-08
Pm-147	5.9E+07	4.5E-07	6.4E-07	1.3E-07	2.9E-07
<u>Pm-148</u>	3.7E+07	2.8E-07	4.0E-07	8.0E-08	1.8E-07
<u>Pm-148m</u>	3.3E+06	2.6E-08	3.6E-08	<u>7.3E-09</u>	1.7E-08
Sm-151	8.1E+05	6.3E-09	8.9E-09	1.8E-09	4.1E-09
<u>Eu-152</u>	1.5E+07	1.2E-07	1.7E-07	3.4E-08	<u>7.7E-08</u>
Eu-154	8.1E+06	6.3E-08	8.9E-08	1.8E-08	4.1E-08
Eu-155	1.5E+07	1.1E-07	1.6E-07	3.2E-08	7.3E-08
<u>Gd-153</u>	1.5E+07	<u>1.2E-07</u>	<u>1.7E-07</u>	3.4E-08	<u>7.7E-08</u>
<u>Tb-160</u>	<u>1.1E+07</u>	8.8E-08	<u>1.2E-07</u>	2.5E-08	<u>5.7E-08</u>
Pu-238	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-239	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-240	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-241	8.1E+07	6.3E-07	8.9E-07	1.8E-07	4.1E-07

		R	Levised		
Cs-137	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
Ce-144	4.5E+07	3.5E-07	4.9E-07	9.8E-08	2.2E-07
Pm-147	5.9E+07	4.5E-07	6.4E-07	1.3E-07	2.9E-07
Sm-151	8.1E+05	6.3E-09	8.9E-09	1.8E-09	4.1E-09
Eu-154	8.1E+06	6.3E-08	8.9E-08	1.8E-08	4.1E-08
Eu-155	1.5E+07	1.1E-07	1.6E-07	3.2E-08	7.3E-08
<u>U-234</u>	2.3E+06	<u>1.8E-08</u>	<u>2.5E-08</u>	<u>5.0E-09</u>	<u>1.1E-08</u>
<u>U-238</u>	2.3E+06	1.8E-08	<u>2.5E-08</u>	5.0E-09	<u>1.1E-08</u>
<u>Np-237</u>	2.3E+06	<u>1.8E-08</u>	<u>2.5E-08</u>	<u>5.0E-09</u>	<u>1.1E-08</u>
Pu-238	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-239	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-240	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-241	8.1E+07	6.3E-07	8.9E-07	1.8E-07	4.1E-07
Am-241	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Cm-243	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Cm-244	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Target 6	exposure	From fishing	From sea surface	From fishing nets	From sea surface
asses	sment	nets	From hulls	Ingestion of	From hulls
		Ingestion of		seafood	
		seafood			

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

		C	urrent		
Am-241	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
<u>Am-242m</u>	<u>4.2E+04</u>	3.2E-10	<u>4.5E-10</u>	9.1E-11	<u>2.1E-10</u>
<u>Am-243</u>	2.3E+06	1.8E-08	2.5E-08	5.0E-09	<u>1.1E-08</u>
<u>Cm-242</u>	2.3E+06	<u>1.8E-08</u>	<u>2.5E-08</u>	<u>5.0E-09</u>	<u>1.1E-08</u>
Cm-243	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Cm-244	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Target exposu	Target exposure assessment		From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls

XII-2. Assessment results

Moreover, when the assessment area is set to 20 km \times 10 km, the <u>result is 0.00002 (2E-05) to 0.0003 (3E-04)</u> mSv/year, which is slightly lower than that of 10 km \times 10 km.

In all cases, the results remained significantly smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value. In addition, for infants whose effective dose factor and the assessment value of internal exposure are high, the assessment result of internal exposure from ingestion of seafood is 0.000087 (8.7E-05) to 0.0022 (2.2E-03) mSv/year with the assessment area set to 5 km × 5 km, which is about 3 times higher than 0.000029 (2.9E-05) to 0.00071 (7.1E-04) mSv/year with $10 \text{ km} \times 10 \text{ km}$.

Moreover, when the assessment area is set to $20 \text{ km} \times 10 \text{ km}$, the result is $\underline{0.000025}$ (2.5E-05) to 0.00061 (6.1E-04) mSv/year, which is lower than that of $10 \text{ km} \times 10 \text{ km}$.

Table XII-5 Human exposure assessment result (Source term based on measured values (K4 tank group))

Assessed case			< 10 km	5 km >	< 5 km	20 km >	< 10 km	
			Average	Large	Average Large			
	Sea surface	<u>6.51</u>	E-09	<u>1.3F</u>	E-08	<u>6.0F</u>	E-09	
	Hull	4.8E-09		9.5E	E-09	4.4E-09		
External exposure (mSv/year)	posure During		E-09	4.5E	E-09	<u>4.5E-09</u>		
	Beach sand	<u>7.81</u>	E-06	<u>7.8F</u>	E-06	<u>7.8E-06</u>		
	Fishing net	<u>1.6F</u>	E-06	<u>4.9F</u>	E-06	1.4E-06		
Internal			E-07	3.3E	E-07			
exposure (mSv/year)	Inhalation of spray	9.31	E-08	9.3 <u>F</u>	E-08	9.3E-08		

XII-2. Assessment results

Tables XII-5 to 10 show the assessment results. When the assessment result with the assessment area set to 10 km \times 10 km, the assessment results are 0.000002 (2E-06) to 0.00002 (2E-05) mSv/year when the assessment area is 5 km \times 5 km, the value were 0.000004 (4E-06) to 0.00006 (6E-05) mSv/ year, which are two to three times higher. Moreover, when the assessment area is set to 20 km \times 10 km, the results ranged from 0.00002 (2E-06) to 0.00002 (2E-05) mSv/year, almost same as the case of 10 km \times 10 km.

Revised

Reason for Revision

Appropriate description due to the selection of nuclides to be

measured and assessed

In all cases, the results remained significantly smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value. Even for infants, whose effective dose factor and the assessment value of internal exposure are intended to high, the assessment result of internal exposure from ingestion of seafood is not exceeded value of adult and, 0.000001 (1.0E-06) to 0.00002 (2.0E-05) mSv/year with the assessment area set to 5 km × 5 km, which is 2 to 3 times higher than 0.000031 (3.1E-06) to 0.000037 (3.7E-05) mSv/year with 10 km × 10 km.

Moreover, when the assessment area is set to $20 \text{ km} \times 10 \text{ km}$, the result is $\underline{0.00000087 (8.7\text{E}-07) \text{ to } 0.00001} (1.0\text{E}-05) \text{ mSv/year}$, which is lower than that of $10 \text{ km} \times 10 \text{ km}$.

Table XII-5 Human exposure assessment result (Source term based on measured values (K4 tank group))

Assessed case	Assessment area of the concentrati on	10km>	<10km	5km>	<5km	20km>	<10km	
	Ingestion of seafood	Ingestion of Average Large		Average	Large	Average Large		
	Sea surface	7.6E-10		<u>1.5F</u>	E- <u>09</u>	<u>7.01</u>	E-10	
	Hull	7.2E-10		<u>1.4F</u>	E-09	6.6E-10		
External exposure (mSv/year)	During swimming	<u>5.21</u>	E-10	<u>5.2F</u>	E-10	<u>5.2E-10</u>		
	Beach sand	<u>9.11</u>	E-07	<u>9.11</u>	E-07	9.1E-07		
	Fishing net	<u>1.8I</u>	E-07	<u>5.4E-07</u>		1.5E-07		
Internal	Ingestion of water	3.3E-07		3.3E	E-07	3.3E-07		
(mSv/year)	xposure Sv/year) Inhalation of spray		9.1E-08		9.1E-08		E-08	

	Сотра	inson ruote	Curre	•	mentation	i Pian for Fukusnim		Vacical 1 0 W	ver Station	as specified	d Tucicai	Revis		, Attacimi	iciit-2, 11tu	terrificht 1	ZIII unu I	Reason for Revision
		Ingestion of seafood	1.5E-05 6.1E-05	4.6E-05	1.9E-04	1.3E-05 5.2E-05				seafood Ingestion of	4.7E-06	2.0E-05	1.4E-05	6.2E-05	4.0E-06	1.8E-05		Appropriate description due to the selection of nuclides to be measured and assessed
		otal v/year)	3E-05 7E-05	<u>6E-05</u>	2E-04	2E-05 6E-05				Total v/year)	<u>6E-06</u>	<u>2E-05</u>	<u>2E-05</u>	<u>6E-05</u>	<u>5E-06</u>	<u>2E-05</u>		
Table XII-6	Hu	man exposure	e assessment result (So	ource term	based on m	neasured values (J1-C t	ank group))	Table XII-6	5 Hu	ıman exposure	e assessme	nt result (S	ource term based on measured values (J1-C tank group					
	Assessed case	Assessment range of the concentrati on	10 km × 10 km		× 5 km	20 km × 10 km	3 177		Assessed case	Assessment area of the concentrati on	10km	×10km		<5km	20km×	,	<i>C</i> 1//	
		Ingestion of seafood	Average Large	Average	Large	Average Large				Ingestion of seafood	Average	Large	Average	Large	Average	Large		
		Sea surface	1.7E-08	3.5]	E-08	1.6E-08				Sea surface	2.3	E-10	<u>4.61</u>	E-10	<u>2.1E</u>	<u>-10</u>		
		Hull	<u>1.2E-08</u>	2.5]	E-08	1.1E-08				Hull	2.2	E-10	<u>4.51</u>	E-10	<u>2.1E</u>	<u>-10</u>		
	External exposure (mSv/year)	During swimming	1.2E-08	1.21	E-08	1.2E-08			External exposure (mSv/year)	During swimming	1.6	E-10	<u>1.61</u>	E-10	<u>1.6E</u>	<u>-10</u>		
		Beach sand	2.1E-05	2.11	E-05	2.1E-05				Beach sand	2.7	E-07	<u>2.71</u>	E-07	2.7E	<u>5-07</u>		
		Fishing net	4.3E-06	1.3]	E-05	3.7E-06				Fishing net	5.3	E-08	<u>1.61</u>	E-07	4.6E	2-08		
		Ingestion of water	3.1E-07	3.11	E-07	3.1E-07				Ingestion of water	3.1	E-07	3.11	E -07	3.1E	5-07		
	Internal exposure (mSv/year)	Inhalation of spray	2.0E-07	2.01	E-07	2.0E-07			Internal exposure (mSv/year)	innaiation of	1.9	E-07	<u>1.91</u>	E-07	<u>1.9E</u>	<u>2-07</u>		
		Ingestion of seafood	2.8E-05 1.1E-04	8.5E-05	3.2E-04	2.4E-05 9.2E-05				seafood Ingestion of	1.0E-06	4.5E-06	3.2E-06	1.4E-05	9.0E-07	3.9E-06		
		otal v/year)	5E-05 <u>1E-04</u>	<u>1E-04</u>	<u>4E-04</u>	5E-05 1E-04				Total v/year)	<u>2E-06</u>	<u>5E-06</u>	<u>4E-06</u>	<u>1E-05</u>	<u>2E-06</u>	<u>5E-06</u>		
Table XII-7	Hıı	man exnosure	assessment result (So	ource term	hased on m	neasured values (J1-G t	ank oroun))	Table XII-7	7 Hı	ıman exposure	e assessme	nt result (So	ource term l	pased on m	easured val	1es (I1-G ta	ank oroun))	
The International Control of the Internationa	Assessed case	Assessment range of the concentratio	10 km × 10 km		× 5 km	20 km × 10 km	<i>9. (ut))</i>		Assessed case	Assessment area of the	10km	×10km		<5km	20km×		5. ~ up/)	
		Ingestion of seafood	Average Large	Average	Large	Average Large				Ingestion of seafood	Average	Large	Average	Large	Average	Large		
	External exposure	Sea surface	<u>4.7E-08</u>	9.41	E-08	<u>4.3E-08</u>			External exposure	Sea surface	4.8	E-10	9.51	E-10	<u>4.4E</u>	2-10		
	(mSv/year)	Hull	3.3E-08	6.61	<u>E-08</u>	3.0E-08			(mSv/year)	Hull	4.6	E-10	<u>9.11</u>	E-10	<u>4.2E</u>	<u>-10</u>		
				•						•	•		•		•			

			Curre	ent									Revis	ed					Reason for Revision
	During swimming	3.2F	E-08	3.2E	-08	3.2F	E-08				During swimming	3 / H = 111		3.2E	E-10	3.2E-10 5.6E-07			Appropriate description due to selection of nuclides to measured and assessed
	Beach sand	<u>5.6E</u>	E-05	5.6E	<u>-05</u>	<u>5.6E</u>	E-05				Beach sand	<u>5.6E</u>	E-07	<u>5.6E-07</u>					
	Fishing net	<u>1.2F</u>	E-05	3.5E	<u>-05</u>	<u>9.9F</u>	E-06			-	Fishing net 1.1		<u>1.1E-07</u>		3.3E-07		E-08		
	Ingestion of water	3.2E	E-07	3.2E	<u>-07</u>	3.2E	E-07				Ingestion of water	3.1E	3.1E-07 3.1E-07		3.11	E-07			
Internal exposure (mSv/year)	Inhalation of spray	<u>4.0F</u>	E-07	4.0E	<u>-07</u>	<u>4.0F</u>	E-07		ez	Internal exposure (mSv/year)	Inhalation of spray	3.8E-07		3.8E-07		3.81	E-07		
	Ingestion of seafood	7.9E-05	3.0E-04	2.4E-04	9.1E-04	6.7E-05	2.6E-04			-	seafood Ingestion of	2.1E-06	9.0E-06	<u>6.4E-06</u>	2.7E-05	1.8E-06	7.7E-06		
	otal v/year)	<u>1E-04</u>	<u>4E-04</u>	<u>3E-04</u>	<u>1E-03</u>	<u>1E-04</u>	<u>3E-04</u>				otal /year)	<u>3E-06</u>	<u>1E-05</u>	<u>8E-06</u>	<u>3E-05</u>	<u>3E-06</u>	<u>9E-06</u>		
I-8 Ag Assessed case	Assessment range of the concentration	10 km	osure asses (K4 tank g	group))	× 5 km		d on measu	d values Ta	able XII-8	Ag assessed case	Assessmen area of the concentration	t 10km	osure assess (K4 tank g n×10km	group))	lt (Source		l on measur	ed values	
	Ingestion of seafood	Average	Large	Average	Large	Average	Large				Ingestion of seafood	f Average	Large	Average	Large	Average	Large		
Internal exposure	Adult	3.3	3E-07	3.3	E-07	3.3	3E-07			nternal xposure	Adult	under 5.7F.07		3.3E-07 5.7E-07		3.	3E-07		
from ingestion of water	Child unde school age		7E-07	5.7	E-07	5.7	7E-07		ing	from gestion of water	Child under school age					5.7E-07			
(mSv/year)	Infant		_		_		_			Sv/year)	Infant		_		_		_	_	
Internal exposure	Adult	9	<u>3E-08</u>	9.3	E-08	9.3	3E-08			nternal xposure	Adult	9.	1E-08	<u>9.1</u>	<u> E-08</u>	<u>9.</u>	1E-08		
from inhalation of	Child unde school age		2E-08	6.2	E-08	6.2	2E-08		inha	from alation of	Child under		0E-08	<u>6.0</u>	<u>)E-08</u>	<u>6.</u>	<u>0E-08</u>		
spray (mSv/year)	Infant	4.0	<u>0E-08</u>	4.0	<u>E-08</u>	4.0	<u>0E-08</u>	spray (mSv/yea		Infant	3.9E-08		3.9E-08		3.9E-08				
								l											

exposure from

ingestion of seafood

Child under school age

Infant

2.4E-05

9.4E-05

2.9E-05 1.1E-04

<u>7.2E-05</u>

8.7E-05

2.9E-04

3.3E-04

2.0E-05

2.5E-05

8.1E-05

<u>9.3E-05</u>

Internal

exposure from ingestion of seafood

Child under school age

Infant

4.6E-06

<u>2.9E-06</u>

2.0E-05

1.2E-05

1.4E-05

8.8E-06

6.1E-05

3.7E-05

3.9E-06

2.5E-06

1.7E-05

1.0E-05

Compar	ison radic o	or amendi	Currer	•	Cittation	Tan for T	ukusnima Daiichi N	dereal 1 c	Swer Station a	s specifical	Nuclear 1	Revise		Attaciiiic	III-2, Atta	CHIHCHT 1-	AIII and I	Reason for Revision
Table XII-9 Age	-specific inte		sure assess		(Source t	erm based	on measured values	Table X	II-9 Age	e-specific inte		sure assessi 1-C tank g		(Source to	erm based	on measur	ed values	
Assessed	Assessment range of the concentrati on		× 10 km	5 km >	< 5 km	20 km	× 10 km		Assessed case	Assessment area of the concentrati on		×10km	5km>	<5km	20km	×10km		
	Ingestion of seafood	Average	Large	Average	Large	Average	Large			Ingestion of seafood	Average	Large	Average	Large	Average	Large		
Internal exposure	Adult	3.1	E-07	3.11	E-07	3.11	E-07		Internal exposure	Adult	3.1]	E-07	3.11	E-07	3.1]	E-07		
from ingestion of water	Child under school age	5.4	<u>E-07</u>	<u>5.4I</u>	E-07	<u>5.41</u>	E-07		from ingestion of water	Child under school age	5.3]	E-07	<u>5.31</u>	E-07	5.3]	E-07		Appropriate description due to the selection of nuclides to be measured and assessed
(mSv/year)	Infant	-	_	_	_	-	_		(mSv/year)	Infant	-	_	_	_	-	_		measured and assessed
Internal exposure	Adult	2.0	<u>E-07</u>	<u>2.01</u>	E-07	2.01	E-07		Internal exposure	Adult	<u>1.91</u>	E-07	<u>1.91</u>	E-07	<u>1.91</u>	<u>E-07</u>		
from inhalation of	Child under school age	1.1	E-07	1.1H	E-07	1.11	E-07		from inhalation of	Child under school age	1.11	E-07	1.1H	E-07	1.11	E-07		
spray (mSv/year)	Infant	6.5	<u>E-08</u>	<u>6.51</u>	E-08	<u>6.5</u>]	E-08		spray (mSv/year)	Infant	6.3	E-08	<u>6.31</u>	E-08	6.3	E-08		
Internal	Adult	2.8E-05	1.1E-04	8.5E-05	3.2E-04	2.4E-05	9.2E-05		Internal	Adult	1.0E-06	4.5E-06	3.2E-06	<u>1.4E-05</u>	9.0E-07	3.9E-06		
exposure from ingestion of	Child under school age	5.1E-05	2.0E-04	1.6E-04	6.0E-04	4.4E-05	1.7E-04		exposure from ingestion of	Child under school age	1.1E-06	4.5E-06	3.2E-06	1.4E-05	9.0E-07	3.9E-06		
seafood	Infant	6.7E-05	2.5E-04	2.0E-04	<u>7.6E-04</u>	<u>5.7E-05</u>	2.2E-04		seafood	Infant	1.0E-06	4.5E-06	3.1E-06	1.4E-05	8.7E-07	3.9E-06		
Table XII-10 Age	e-specific inte		sure assess		(Source t	erm based	on measured values	Table X	II-10 Age	e-specific inte		sure assess		(Source to	erm based	on measur	ed values	
Assessed case	Assessment range of the concentratio		× 10 km	5 km >	5 km	20 km	× 10 km		Assessed	Assessment area of the concentrati		×10km	5km>	5km	20km	×10km		
	Ingestion of seafood	Average	Large	Average	Large	Ingestion of seafood	Average		case	Ingestion of seafood	Average	Large	Average	Large	Average	Large		
Internal	Adult	3.2	<u>E-07</u>	3.2H	E-07	3.21	E-07		Internal	Adult	3.11	E-07	<u>3.11</u>	E-07	3.11	E-07		
exposure from ingestion of water	Child under school age	5.5	E-07	<u>5.5I</u>	E-07	<u>5.51</u>	E-07		exposure from ingestion of water	Child under school age	<u>5.41</u>	E-07	<u>5.4I</u>	E-07	5.41	E-07		
(mSv/year)	Infant	-	_	_	_	-	_		(mSv/year)	Infant	-	_	_	_	-	_		
Internal exposure from inhalation of	Adult	4.0	E-07	4.0I	E-07	4.01	E-07		Internal exposure from inhalation of	Adult	3.83	E-07	<u>3.8I</u>	E-07	3.83	E-07		
spray (mSv/year)	Child under school age	2.2	<u>E-07</u>	<u>2.21</u>	E-07	2.21	E-07		spray (mSv/year)	Child under school age	2.1]	E-07	<u>2.11</u>	E-07	2.11	E-07		
na Iananasa varsion sk																		

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment I-XIII and Reference A-G)

			Curren	t			
	Infant	<u>1.2F</u>	E-07	<u>1.21</u>	E-07	<u>1.2E</u>	E-07
Internal	Adult	<u>7.9E-05</u>	3.0E-04	2.4E-04	<u>9.1E-04</u>	<u>6.7E-05</u>	2.6E-04
xposure from ingestion of seafood	Child under school age	1.5E-04	<u>5.6E-04</u>	4.4E-04	1.7E-03	1.2E-04	4.8E-04
(mSv/year)	Infant	1.9E-04	7.1E-04	5.8E-04	2.2E-03	1.6E-04	6.1E-04

(Not currently listed)

Reference A Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws

(Omission)

For discharge of ALPS treated water into the sea we are currently planning, the following conditions are to be verified:

- (1) The sum of the ratios to regulatory concentrations limits of <u>63</u> nuclides excluding tritium falls below 1 in the facility for measurement and confirmation before dilution with seawater;
- (2) The sum of the ratios to regulatory concentrations limits of <u>64</u> nuclides excluding tritium falls below 1 in the discharge vertical shaft after dilution with seawater.

In (2), the water shall be diluted with seawater 100 or more times so that the tritium concentration falls below 1,500Bq/L. If the tritium concentration can be diluted by 100 times up to 1,500Bq/L, the sum of the ratios to regulatory concentrations limits of radioactive materials at the discharge vertical shaft will be up to

(Sum of the ratios to regulatory concentrations limits of 63 nuclides) + (Regulatory concentration ratio of tritium) $= \frac{R_{\bigcirc,63}}{100} + \frac{1,500}{60.000} = \frac{1}{100} + \frac{1}{40} = 0.035$

(Omission)

Reference C Setting of Management Values and Exposure Assessment of Hypothetical ALPS Treated Water

In discharge of ALPS treated water into the sea, sufficient safety is secured by verifying that the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium (62 nuclides to removal by ALPS and C-14) is less than 1 and diluting with seawater 100 or more times at the time of discharge so that the tritium concentration greatly falls below the regulatory concentration limit, but migration in the environment varies among nuclides, so the impact on exposure is different even among nuclides with the same regulatory concentrations limit. We decided to individually manage eight nuclides important in terms of exposure in order to limit this uncertainty of the source term and reduce the impacts on the external environment further. The management values were set by the following procedure.

- 1. Selection of nuclides important in terms of exposure
- 2. Setting of the management values of the selected nuclides

If any concentration exceeding the set management value is detected, we do not discharge the water and transfer it to secondary treatment. However, these eight nuclides shall be reviewed as needed based on the review result of

Revised Infant 1.1E-07 1.1E-07 1.1E-07 2.1E-06 9.0E-06 6.4E-06 1.8E-06 Adult 2.7E-05 7.7E-06 Internal exposure from Child under 2.4E-06 9.9E-06 7.2E-06 8.5E-06 ingestion of 3.0E-05 2.0E-06 school age seafood (mSv/year) 2.5E-06 1.1E-05 7.7E-06 3.4E-05 2.2E-06 9.5E-06 Infant

Attachment XIII Application of uncertainty in the analysis of ALPS treated water

(Newly described)

Reference A Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws

(Omission)

For discharge of ALPS treated water into the sea we are currently planning, the following conditions are to be verified:

- (1) The sum of the ratios to regulatory concentrations limits of nuclides excluding tritium falls below 1 in the facility for measurement and confirmation before dilution with seawater;
- (2) The sum of the ratios to regulatory concentrations limits of nuclides excluding tritium falls below 1 in the discharge vertical shaft after dilution with seawater.

In (2), the water shall be diluted with seawater 100 or more times so that the tritium concentration falls below 1,500Bq/L. If the tritium concentration can be diluted by 100 times up to 1,500Bq/L, the sum of the ratios to regulatory concentrations limits of radioactive materials at the discharge vertical shaft will be up to

(Sum of the ratios to regulatory concentrations limits of nuclides other than tritium) + (Regulatory concentration ratio of tritium)

$$= \frac{R_{(1)}}{100} + \frac{1,500}{60,000} = \frac{1}{100} + \frac{1}{40} = 0.035$$

(Omission)

Reference C Setting of <u>previous management values and exposure assessment of hypothetical ALPS treated</u> water

In discharge of ALPS treated water into the sea, sufficient safety is secured by verifying that the sum of the ratios to regulatory concentrations limits of <u>nuclides</u> other than tritium is less than 1 and diluting with seawater 100 or more times at the time of discharge so that the tritium concentration greatly falls below the regulatory concentration limit, but migration in the environment varies among nuclides, so the impact on exposure is different even among nuclides with the same regulatory concentrations limit. <u>In the assessment of design stage</u>, we proposed individual manage eight nuclides important <u>for</u> exposure in order to limit this uncertainty of the source term and reduce the impacts on the external environment further.

On the other hand, in this assessment of construction stage, the source term was newly redefined with 31 nuclides and accordingly, it was decided to set the management values based on the amount of radioactivity discharged.

The previous management values were set by the following procedure.

- 1. Selection of nuclides important in terms of exposure
- Setting of the <u>previous</u> management values of the selected nuclides

If any concentration exceeding the set <u>previous</u> management value is detected, we do not discharge the water and transfer it to secondary treatment. However, these eight nuclides shall be reviewed as needed based on the review

Appropriate description due to the selection of nuclides to be measured and assessed

New description for the selection of nuclides to be measured and

assessed

Reason for Revision

Appropriate description due to the

selection of nuclides to measured and assessed

Comparison Table of amendments in the implementation Fian for Fukusinna Danem Ne	delear rower station as specified Nuclear Facility (Reference, Attachment-2, Attachment 1-XIII and F	Cicicic A-O)
		1
Current	Revised	Reason for Revision

C1. Selection of nuclides subject to management

nuclides subject to measurement before future discharge.

(Omission)

d. Exposure assessment result and selection of nuclides subject to management

Table C-3 shows the assessment result of internal exposure of adults from each nuclide discharged at the regulatory concentration limit in descending order of the value. We selected the eight nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit as nuclides subject to management, which are nuclides with significant impacts on the exposure assessment.

As for external exposure from beach sand, there are some nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit, but as shown in Table C-4, the dose conversion factor of Co-60 is used for all of these nuclides and the actual impact on external exposure is much smaller than Co-60 considering the energy and discharge rate of photons discharged by each nuclide, so such nuclides are deemed not to be subject to management.

e. Confirmation regarding environmental protection

Consideration had focused on the impact of human exposure, but this time we confirmed whether there is any nuclide subject to management from the viewpoint of environmental protection.

Specifically, we assessed the impact of exposure of each nuclide on marine plants and animals by the assessment method shown in 7-2. "Assessment method" using the source term of a. Table C-5 shows the assessment results in descending order of the value.

The nuclide with the greatest impact of exposure is Fe-59, but it is lower than the lower limit value of the derived consideration reference level (DCRL). We judged that there was no nuclide to be added as a management target from the viewpoint of environmental protection because Fe-59 had been subject to management for reduction of human exposure and the assessment values of the other nuclides are an order of magnitude smaller than that of Fe-59

(Omission)

Table C-3 Internal exposure assessment result from ingestion of seafood in the case of discharge of each nuclide at the regulatory concentration limit (adult) (Selected 8 nuclides exceeding 0.001 mSv/year as management

			targets)	
> 1	Target nuclide	Regulatory concentration	Internal exposure	Regulatory concentration limit
No.		limit		
1	Sn-126	6.0E+04	2.6E-02	Operation and management targets
2	Sn-123	2.0E+03	2.3E-02	Operation and management targets
3	Sn-119m	1.0E+03	1.9E-02	Operation and management targets
4	Fe-59	4.0E+02	5.6E-03	Operation and management targets
5	Cd-115m	1.0E+03	1.4E-03	Operation and management targets
6	C-14	2.0E+02	1.3E-03	Operation and management targets
7	Cd-113m	6.0E+03	1.3E-03	Operation and management targets
8	Ag-110m	2.0E+02	1.0E-03	Operation and management targets
9	Zn-65	3.0E+02	8.4E-04	
10	Mn-54	3.0E+02	5.2E-04	
11	Co-58	3.0E+01	2.5E-04	
12	Co-60	3.0E+02	2.3E-04	
13	Тс-99	3.0E+02	2.1E-04	
14	Te-129m	1.0E+03	1.4E-04	

result of nuclides subject to measurement before future discharge.

C1. Selection of nuclides subject to previous management

(Omission)

d. Exposure assessment result and selection of nuclides subject to previous management

Table C-3 shows the assessment result of internal exposure of adults from each nuclide discharged at the regulatory concentration limit in descending order of the value. We selected the eight nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit as nuclides subject to previous management, which are nuclides with significant impacts on the exposure assessment.

As for external exposure from beach sand, there are some nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit, but as shown in Table C-4, the dose conversion factor of Co-60 is used for all of these nuclides and the actual impact on external exposure is much smaller than Co-60 considering the energy and discharge rate of photons discharged by each nuclide, so such nuclides are deemed not to be subject to previous management.

e. Confirmation regarding environmental protection

Consideration had focused on the impact of human exposure, but this time we confirmed whether there is any nuclide subject to <u>previous</u> management from the viewpoint of environmental protection.

Specifically, we assessed the impact of exposure of each nuclide on marine plants and animals by the assessment method shown in 7-2. "Assessment method" using the source term of a. Table C-5 shows the assessment results in descending order of the value.

The nuclide with the greatest impact of exposure is Fe-59, but it is lower than the lower limit value of the derived consideration reference level (DCRL). We judged that there was no nuclide to be added as a <u>previous</u> management target from the viewpoint of environmental protection because Fe-59 had been subject to <u>previous</u> management for reduction of human exposure and the assessment values of the other nuclides are an order of magnitude smaller than that of Fe-59.

(Omission)

Table C-3 Internal exposure assessment result from ingestion of seafood in the case of discharge of each nuclide at the regulatory concentration limit (adult) (Selected 8 nuclides exceeding 0.001 mSv/year as previous

management targets) Regulatory Ingestion of seafood Target concentration No. Internal exposure dose Remarks Nuclide limit (mSv/year) (Bq/L) Previous operation and management targets Sn-126 2.6E-02 6.0E + 04Previous operation and management targets 2 Sn-123 2.3E-02 2.0E+03 Previous operation and management targets 3 Sn-119m 1.9E-02 1.0E+03 <u>Previous operation and management targets</u> 4 Fe-59 5.6E-03 4.0E+02 <u>Previous operation and management targets</u> 5 Cd-115m 1.0E+03 1.4E-03 Previous operation and management targets C-14 6 1.3E-03 2.0E+02 <u>Previous operation and management targets</u> 7 Cd-113m 6.0E+03 1.3E-03 <u>Previous operation</u> and management targets 8 Ag-110m 1.0E-03 2.0E+02 9 Zn-65 3.0E+02 8.4E-04 10 Mn-54 3.0E+02 5.2E-04 11 Co-58 3.0E+01 2.5E-04 12 Co-60 3.0E+02 2.3E-04 13 Tc-99 3.0E+02 2.1E-04 14 Te-129m 1.0E+03 1.4E-04

The Japanese version shall prevail.

Appropriate description due to the selection of nuclides to be

measured and assessed

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

Current	Revised	Reason for Revision
15 Te-127 1.0E+03 1.3E-04	15 Te-127 1.0E+03 1.3E-04	
16 Te-123m 1.0E+03 1.3E-04	16 Te-123m 1.0E+03 1.3E-04	
17 Eu-155 1.0E+02 1.3E-04	17 Eu-155 1.0E+02 1.3E-04	
18 Te-125m 2.0E+05 1.2E-04	18 Te-125m 2.0E+05 1.2E-04	
19 Pm-148m 3.0E+05 1.1E-04	19 Pm-148m 3.0E+05 1.1E-04	
20 Eu-152 3.0E+02 1.1E-04	20 Eu-152 3.0E+02 1.1E-04	
21 Te-127m 4.0E+01 1.1E-04	21 Te-127m 4.0E+01 1.1E-04	
22 Gd-153 3.0E+02 1.1E-04	22 Gd-153 3.0E+02 1.1E-04	
23 Pm-146 2.0E+03 1.1E-04	23 Pm-146 2.0E+03 1.1E-04	
24 Pm-148 4.0E+02 1.1E-04	24 Pm-148 4.0E+02 1.1E-04	
25 Eu-154 2.0E+02 1.1E-04	25 Eu-154 2.0E+02 1.1E-04	
26 I-129 3.0E+02 1.1E-04	26 I-129 3.0E+02 1.1E-04	
27 Sm-151 8.0E+02 1.0E-04	27 Sm-151 8.0E+02 1.0E-04	
28 Pm-147 6.0E+02 1.0E-04	28 Pm-147 6.0E+02 1.0E-04	
29 Am-241 9.0E+02 1.0E-04	29 Am-241 9.0E+02 1.0E-04	
30 Am-243 5.0E+03 1.0E-04	30 Am-243 5.0E+03 1.0E-04	
31 Am-242m 3.0E+02 9.7E-05	31 Am-242m 3.0E+02 9.7E-05	
32 Pu-239 1.0E+04 8.4E-05	32 Pu-239 1.0E+04 8.4E-05	
33 Pu-240 3.0E+02 8.4E-05	33 Pu-240 3.0E+02 8.4E-05	
34 Ce-144 9.0E+00 8.4E-05	34 Ce-144 9.0E+00 8.4E-05	
35 Pu-241 6.0E+01 8.1E-05	35 Pu-241 6.0E+01 8.1E-05	
36 Pu-238 6.0E+02 7.8E-05	36 Pu-238 6.0E+02 7.8E-05	
37 Ni-63 3.0E+02 7.7E-05	37 Ni-63 3.0E+02 7.7E-05	
38 Cm-243 9.0E+01 6.3E-05	38 Cm-243 9.0E+01 6.3E-05	
39 Cm-244 8.0E+05 5.9E-05	39 Cm-244 8.0E+05 5.9E-05	
40 Ce-141 3.0E+02 5.7E-05	40 Ce-141 3.0E+02 5.7E-05	
41 Cm-242 1.0E+03 5.0E-05	41 Cm-242 1.0E+03 5.0E-05	
42 Tb-160 2.0E+02 4.9E-05	42 Tb-160 2.0E+02 4.9E-05	
43 Nb-95 2.0E+04 2.7E-05	43 Nb-95 2.0E+04 2.7E-05	
44 Sb-125 4.0E+04 2.4E-05	44 Sb-125 4.0E+04 2.4E-05	
45 Sb-124 9.0E+02 2.0E-05	45 Sb-124 9.0E+02 2.0E-05	
46 Ru-103 3.0E+03 2.0E-05	46 Ru-103 3.0E+03 2.0E-05	
47 Ru-106 3.0E+02 1.9E-05	47 Ru-106 3.0E+02 1.9E-05	
48 Y-91 5.0E+02 1.7E-05	48 Y-91 5.0E+02 1.7E-05	
49 Cs-135 8.0E+03 6.2E-06	49 Cs-135 8.0E+03 6.2E-06	
50 Cs-137 6.0E+02 6.1E-06	50 Cs-137 6.0E+02 6.1E-06	
51 Cs-134 4.0E+02 5.9E-06	51 Cs-134 4.0E+02 5.9E-06	
52 Cs-136 3.0E+03 4.7E-06	52 Cs-136 3.0E+03 4.7E-06	
53 Te-129 3.0E+03 3.0E-06	53 Te-129 3.0E+03 3.0E-06	
54 Y-90 5.0E+02 2.0E-06	54 Y-90 5.0E+02 2.0E-06	
55 Ba-140 4.0E+00 9.8E-07	55 Ba-140 4.0E+00 9.8E-07	
56 Pr-144 4.0E+00 6.7E-07	56 Pr-144 4.0E+00 6.7E-07	

	Compan		Current	plementation Plan for Fukushima Dailchi F	Vaciour 1	ower station c	is specified rucie	Revised	<u> </u>	Reason for Revi
57	Rb-86	4.0E+00	6.3E-07		57	Rb-86	4.0E+00	6.3E-07		
58	Sr-90	2.0E+02	2.9E-07		58	Sr-90	2.0E+02	2.9E-07		
59	Sr-89	5.0E+00	2.7E-07		59	Sr-89	5.0E+00	2.7E-07		
60	Rh-103m	5.0E+00	1.8E-07		60	Rh-103m	5.0E+00	1.8E-07		
61	H-3	5.0E+00	1.3E-07		61	H-3	5.0E+00	1.3E-07		
62			0.0E+00	Assessed with the parent nuclide	62				Assessed with the parent nuclide	
63	Rh-106	6.0E+01	0.0E+00 0.0E+00	Assessed with the parent nuclide	63	Rh-106	6.0E+01	0.0E±00	Assessed with the parent nuclide	
64	Ba-137m Pr-144m	6.0E+00 7.0E+00	0.0E+00	Assessed with the parent nuclide	64	Ba-137m Pr-144m	6.0E+00 7.0E+00		Assessed with the parent nuclide	
Table (C-4 Res	sult of the external e	at the regulatory co	nt from beach sand in the case of discharge of oncentration limit	Table		esult of the external	I	rom beach sand in the case of discha	arge of
	Nuclide	Regulatory	Nuclide	Regulatory concentration limit			Regulatory	Beach sand exposure		
		concentration				Nuclide	concentration limit	(mSv/year)	Remarks	
1		limit		Pull I and a second	1		(Bq/L)	-		50.00
1	Te-127	5.0E+03	1.0E-02	For the dose conversion factor, refer to the value of Co-60		Te-127	5.0E+03	1.0E-02	For the dose conversion factor, refer to the value of	
3	Eu-155	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of Co-60 For the dose conversion factor, refer to the value of Co-60	3	Eu-155	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of	
3	Gd-153	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of Co-60	1	Gd-153	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of	
5	<u>Sn-119m</u> Nb-95	2.0E+03	4.1E-03	For the dose conversion factor, refer to the value of Co-60	5	<u>Sn-119m</u> Nb-95	2.0E+03	4.1E-03	For the dose conversion factor, refer to the value of	
6	Ru-103	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60	6	Ru-103	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of	
7	Ce-141	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60	7	Ce-141	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of	
8		1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60	8		1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of	
9	Pm-146	9.0E+02	1.9E-03	For the dose conversion factor, refer to the value of Co-60	0	Pm-146	9.0E+02	1.9E-03	For the dose conversion factor, refer to the value of	
10	Te-123m	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of Co-60	10	Te-123m	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of	
11	Cs-135 Pm-148m	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of Co-60	11	Cs-135 Pm-148m	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of	
12	Tb-160	5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of Co-60	12	Tb-160	5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of	
13		5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of Co-60	13		5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of	
14	Co-58	1.0E+03	8.4E-04	To the dose conversion factor, refer to the value of Co-ou	14	Co-58	1.0E+03	8.4E-04	To the dose conversion factor, refer to the value of	1 CO-00
15	Sn-123	4.0E+02	8.3E-04		15	Sn-123	4.0E+02	8.3E-04		
16	Mn-54 Rb-86	1.0E+03	7.0E-04	For the dose conversion factor, refer to the value of Co-60	16	Mn-54 Rb-86	1.0E+03	7.0E-04	For the dose conversion factor, refer to the value of	f Co-60
17		3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	17		3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
18	Sr-89	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	18	Sr-89	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
19	Y-91	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	19	Y-91	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
20	Ag-110m Cd-115m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	20	Ag-110m Cd-115m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
21		3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	21		3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
22	Sb-124	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	22	Sb-124	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
23	Te-127m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60 For the dose conversion factor, refer to the value of Co-60	23	Te-127m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
	Te-129m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60 For the dose conversion factor, refer to the value of Co-60	24	Te-129m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
24	Cs-136	3.0E+02	6.2E-04	,	1	Cs-136	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	
25	Ba-140	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	25	Ba-140	3.0E+02	6.2E-04	,	
26	Pm-148	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60	26	Pm-148	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of	1 CO-00
27	Eu-152	6.0E+02	5.5E-04		27	Eu-152	6.0E+02	5.5E-04		
28	Co-60	2.0E+02	4.1E-04			Co-60	2.0E+02	4.1E-04		
29	Eu-154	4.0E+02	4.0E-04		29	Eu-154	4.0E+02	4.0E-04		

			Current					Revised	ce, Attachment-2, Attachment 1-Afff and N
30	Sb-125	8.0E+02	2.9E-04		30	Sb-125	8.0E+02	2.9E-04	
31	Zn-65	2.0E+02	9.7E-05		31	Zn-65	2.0E+02	9.7E-05	
32	Cs-134	6.0E+01	8.2E-05		32	Cs-134	6.0E+01	8.2E-05	
33	Cs-137	9.0E+01	4.8E-05		33	Cs-137	9.0E+01	4.8E-05	
34	Ru-106	1.0E+02	1.9E-05		34	Ru-106	1.0E+02	1.9E-05	
35	Pu-241	2.0E+02	1.8E-05		35	Pu-241	2.0E+02	1.8E-05	
36	Ce-144	2.0E+02	8.8E-06		36	Ce-144	2.0E+02	8.8E-06	
37	Te-125m	9.0E+02	7.5E-06		37	Te-125m	9.0E+02	7.5E-06	
38	Sn-126	2.0E+02	4.6E-06		38	Sn-126	2.0E+02	4.6E-06	
39	Cm-243	6.0E+00	8.2E-07	For the dose conversion factor, refer to the value of Am-243	39	Cm-243	6.0E+00	8.2E-07	For the dose conversion factor, refer to the value of Am-243
40	Am-243	5.0E+00	6.8E-07		40	Am-243	5.0E+00	6.8E-07	
41	Sr-90	3.0E+01	1.6E-07		41	Sr-90	3.0E+01	1.6E-07	
42	I-129	9.0E+00	5.1E-08		42	I-129	9.0E+00	5.1E-08	
43	Pm-147	3.0E+03	4.6E-08		43	Pm-147	3.0E+03	4.6E-08	
44	Am-242m	5.0E+00	4.4E-08		44	Am-242m	5.0E+00	4.4E-08	
45	Am-241	5.0E+00	3.7E-08		45	Am-241	5.0E+00	3.7E-08	
46	Fe-59	4.0E+02	2.8E-08		46	Fe-59	4.0E+02	2.8E-08	
47	Tc-99	1.0E+03	2.8E-08		47	Тс-99	1.0E+03	2.8E-08	
48	Sm-151	8.0E+03	2.2E-08		48	Sm-151	8.0E+03	2.2E-08	
49	Cm-242	6.0E+01	9.8E-09		49	Cm-242	6.0E+01	9.8E-09	
50	Cd-113m	4.0E+01	7.2E-09		50	Cd-113m	4.0E+01	7.2E-09	
51	Cm-244	7.0E+00	1.1E-09		51	Cm-244	7.0E+00	1.1E-09	
52	Pu-238	4.0E+00	6.3E-10		52	Pu-238	4.0E+00	6.3E-10	
53	Pu-240	4.0E+00	6.2E-10		53	Pu-240	4.0E+00	6.2E-10	
54	Pu-239	4.0E+00	3.7E-10		54	Pu-239	4.0E+00	3.7E-10	
55	H-3	6.0E+04	0.0E+00		55	H-3	6.0E+04	0.0E+00	
56	C-14	2.0E+03	0.0E+00		56	C-14	2.0E+03	0.0E+00	
57	Ni-63	6.0E+03	0.0E+00		57	Ni-63	6.0E+03	0.0E+00	
58	Y-90	3.0E+02	0.0E+00	Assessed with the parent nuclide	58	Y-90	3.0E+02	0.0E+00	Assessed with the parent nuclide
59	Rh-103m	2.0E+05	0.0E+00	Assessed with the parent nuclide	59	Rh-103m	2.0E+05	0.0E+00	Assessed with the parent nuclide
60	Rh-106	3.0E+05	0.0E+00	Assessed with the parent nuclide	60	Rh-106	3.0E+05	0.0E+00	Assessed with the parent nuclide
61	Te-129	1.0E+04	0.0E+00	Assessed with the parent nuclide	61	Te-129	1.0E+04	0.0E+00	Assessed with the parent nuclide
62	Ba-137m	8.0E+05	0.0E+00	Assessed with the parent nuclide	62	Ba-137m	8.0E+05	0.0E+00	Assessed with the parent nuclide
63	Pr-144	2.0E+04	0.0E+00	Assessed with the parent nuclide	63	Pr-144	2.0E+04	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	4.0E+04	0.0E+00	Assessed with the parent nuclide	64	Pr-144m	4.0E+04	0.0E+00	Assessed with the parent nuclide
*Nuclide	es subject to man	agement are hatched			*Nuclid		ious management are	hatched	

Table C-5 Result of the environmental protection assessment in the case of discharge of each nuclide at the regulatory concentration limit

		Regulatory	Exposure as	ssessment result	(mGy/day)	
	Nuclide	concentration limit (Bq/L)	Flatfish	Crab	Brown seaweed	Remarks
1	Fe-59	4.0E+02	5.4E-01	5.4E-01	5.8E-01	

*Nuclides subject to <u>previous</u> management are hatched

Table C-5 Result of the environmental protection assessment in the case of discharge of each nuclide at the regulatory concentration limit

Nuclide concentration limit Flatfish Crab Brown Remarks	
	3
1 Fe-59 4.0E+02 5.4E-01 5.4E-01 5.8E-01	

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

2		1			rent	an for Laxushinia Danem 1			1	-	rised		,	Reason for Revision	
3	2	Sn-126	2.0E+02	9.7E-03	9.3E-03 9.0E-03		2	Sn-126	2.0E+02	9.7E-03	9.3E-03	9.0E-03			
S		Pm-148m	5.0E+02				3	Pm-148m	5.0E+02			8.1E-03			
S	4	Mn-54	1.0E+03	6.6E-03	6.0E-03 6.6E-03		4	Mn-54	1.0E+03	6.6E-03	6.0E-03	6.6E-03			
To be Sign 22 Albert Sign 32 Albert Sign 43 Albert Sign 44 Albert Sig	5	Eu-152	6.0E+02	5.4E-03	5.1E-03 5.4E-03		5	Eu-152	6.0E+02	5.4E-03	5.1E-03	5.4E-03			
S 16-151 105 22 32500 32500 22500 2550	6	Pm-146	9.0E+02	5.1E-03	4.9E-03 5.4E-03		6	Pm-146	9.0E+02	5.1E-03	4.9E-03	5.4E-03			
No.	7	Tb-160	5.0E+02	4.2E-03	4.2E-03 4.5E-03		7	Tb-160	5.0E+02	4.2E-03	4.2E-03	4.5E-03			
16 G-4-15 3.06 0.2 2.06 2.06 1.40 1	8	Eu-154	4.0E+02	3.8E-03	3.6E-03 3.8E-03		8	Eu-154	4.0E+02	3.8E-03	3.6E-03	3.8E-03			
17	9	Nb-95	1.0E+03	2.3E-03	2.3E-03 2.4E-03		9	Nb-95	1.0E+03	2.3E-03	2.3E-03	2.4E-03			
Page 15	10	Gd-153	3.0E+03	2.2E-03	2.0E-03 2.5E-03		10	Gd-153	3.0E+03	2.2E-03	2.0E-03	2.5E-03			
13	11	Pm-148	3.0E+02	1.5E-03	1.4E-03 2.0E-03		11	Pm-148	3.0E+02	1.5E-03	1.4E-03	2.0E-03			
14	12	Eu-155	3.0E+03	1.3E-03	1.3E-03 1.3E-03		12	Eu-155	3.0E+03	1.3E-03	1.3E-03	1.3E-03			
15 No1196 2.08-03 9.08-04 9.18-04 8.78-04 16 Cc-114 1.08-03 8.60-04 8.28-04 8.28-04 17 Cc-60 2.08-02 5.08-04 5.08-04 4.77-04 17 Cc-60 2.08-02 5.08-04 5.08-04 4.77-04 17 Cc-60 2.08-02 5.08-04 5.08-04 4.77-04 18 Cc-114 2.07-02 4.77-04 2.77-04 4.77-04 18 Cc-114 2.07-02 4.77-04 2.77-04 4.77-04 18 Cc-114 2.07-02 4.77-04 4.77-04 18 Cc-114 2.07-02 4.77-04 4.77-04 18 Cc-114 2.07-02 4.77-04 4.77-04 18 Cc-114 2.07-02 4.77-05 5.07-05 5.08-04 5	13	Co-58	1.0E+03	1.1E-03	1.1E-03 1.1E-03		13	Co-58	1.0E+03	1.1E-03	1.1E-03	1.1E-03			
16	14	Sn-123	4.0E+02	1.0E-03	9.7E-04 1.0E-03		14	Sn-123	4.0E+02	1.0E-03	9.7E-04	1.0E-03			
17	15	Sn-119m	2.0E+03	9.6E-04	9.1E-04 6.7E-04		15	Sn-119m	2.0E+03	9.6E-04	9.1E-04	6.7E-04			
18	16	Ce-141	1.0E+03	8.6E-04	8.2E-04 8.9E-04		16	Ce-141	1.0E+03	8.6E-04	8.2E-04	8.9E-04			
19	17	Co-60	2.0E+02	5.6E-04	5.6E-04 6.1E-04		17	Co-60	2.0E+02	5.6E-04	5.6E-04	6.1E-04			
20	18	Ce-144	2.0E+02	4.7E-04	2.7E-04 4.7E-04		18	Ce-144	2.0E+02	4.7E-04	2.7E-04	4.7E-04			
21	19	Ru-103	1.0E+03	7.4E-05	7.4E-05 7.6E-05		19	Ru-103	1.0E+03	7.4E-05	7.4E-05	7.6E-05			
22 Y-91 3.0E-02 3.6E-05 2.2E-05 1.6E-04	20	Cd-115m	3.0E+02	4.4E-05	1.9E-04 8.3E-06		20	Cd-115m	3.0E+02	4.4E-05	1.9E-04	8.3E-06			
23	21	Ag-110m	3.0E+02	4.1E-05	2.3E-04 3.5E-05		21	Ag-110m	3.0E+02	4.1E-05	2.3E-04	3.5E-05			
24	22	Y-91	3.0E+02	3.6E-05	2.2E-05 1.6E-04		22	Y-91	3.0E+02	3.6E-05	2.2E-05	1.6E-04			
25 Cs-136 3.0F+02 9.5F+06 9.4F+06	23	Zn-65	2.0E+02	3.3E-05	6.6E-05 3.2E-05		23	Zn-65	2.0E+02	3.3E-05	6.6E-05	3.2E-05			
26 Te-127 5.0E+03 9.4E+06 9.4E+06 8.7E+05 27 Am-243 5.0E+00 8.8E+06 1.1E+05 9.7E+06 28 Ru+106 1.0E+02 6.4E+06 7.6E+06 29 Cm-243 6.0E+00 5.8E+06 1.5E+05 9.4E+06 9.4E+06 7.6E+06 29 Cm-243 6.0E+00 5.8E+06 1.5E+05 9.4E+06 9.4E+06 7.6E+06 1.5E+06 9.4E+06 9.4E+06 6.4E+06 7.7E+06 1.0E+05 9.4E+06 9.4E+06<	24	C-14	2.0E+03	1.0E-05	8.4E-06 6.7E-06		24	C-14	2.0E+03	1.0E-05	8.4E-06	6.7E-06			
27 Am-243 5.0E+00 8.8E-06 1.1E-05 9.7E-06 28 Ru-106 1.0E+02 6.4E-06 6.4E-06 7.6E-06 29 Cm-243 6.0E+00 5.8E-06 1.5E-05 9.4E-06 30 Ba-140 3.0E+02 5.6E-06 7.7E-06 1.0E-05 31 8b-124 3.0E+02 5.6E-06 4.8E-06 6.1E-06 32 8b-125 8.0E+02 3.2E-06 3.0E-06 4.0E-06 33 Pm-147 3.0E+03 3.2E-06 3.0E-06 4.0E-06 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.5E-06 3.5E-05 2.7E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-05 3.5E-06 37 Cs-134 6.0E+01 1.5E-06 1.5E-06 1.5E-06 38 Te-125m 9.0E+02 3.1E-06 1.5E-06 3.5E-06 39 Am-241 5.0E+00	25	Cs-136	3.0E+02	9.5E-06	9.4E-06 9.4E-06		25	Cs-136	3.0E+02	9.5E-06	9.4E-06	9.4E-06			
28 Ru-106 1.0E+02 6.4E-06 7.6E-06 29 Cm-243 6.0E+00 5.8E-06 1.5E-05 9.4E-06 30 Ba-140 3.0E+02 5.6E-06 7.7E-06 1.0E-05 31 Sb-124 3.0E+02 5.1E-06 4.8E-06 6.1E-06 32 Sb-125 8.0E+02 3.2E-06 3.0E-06 4.0E-06 33 Pm-147 3.0E+03 3.2E-06 3.9E-05 2.7E-05 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.6E-06 1.5E-05 3.3E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-05 3.3E-05 37 Cs-134 6.0E+01 1.5E-06 1.5E-06 1.5E-06 38 Te-125m 9.0E+02 1.0E-06 1.0E-06 1.5E-06 39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07	26	Te-127	5.0E+03	9.4E-06	9.4E-06 8.7E-05		26	Te-127	5.0E+03	9.4E-06	9.4E-06	8.7E-05			
29 Cm-243 6.0E+00 5.8E-06 1.5E-05 9.4E-06 30 Ba-140 3.0E+02 5.6E-06 7.7E-06 1.0E-05 31 Sb-124 3.0E+02 5.1E-06 4.8E-06 6.1E-06 32 Sb-125 8.0E+02 3.2E-06 3.0E-06 4.0E-06 33 Pm-147 3.0E+03 2.9E-06 3.9E-05 2.7E-05 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.6E-06 1.5E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-06 37 Cx-134 6.0E+01 1.5E-06 1.5E-06 38 Te-125m 9.0E+02 1.0E-06 1.6E-06 1.5E-06 39 Am-241 5.0E+00 9.0E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06	27	Am-243	5.0E+00	8.8E-06	1.1E-05 9.7E-06		27	Am-243	5.0E+00	8.8E-06	1.1E-05	9.7E-06			
30 Ba-140 3.0E+02 5.6E+06 7.7E+06 1.0E+05 30 Ba-140 3.0E+02 5.6E+06 7.7E+06 1.0E+05 31 Sb-124 3.0E+02 5.1E+06 4.8E+06 6.1E+06 32 Sb-125 8.0E+02 3.2E+06 3.0E+06 4.0E+06 32 Sb-125 8.0E+02 3.0E+06 3.0E+06 4.0E+06 32 Sb-125 8.0E+02 3.0E+06 3.0E+06 4.0E+06 32 Sb-125 8.0E+02 3.0E+06 3.	28	Ru-106	1.0E+02	6.4E-06	6.4E-06 7.6E-06		28	Ru-106	1.0E+02	6.4E-06	6.4E-06	7.6E-06			
31 Sb-124 3.0E+02 5.1E-06 4.8E-06 6.1E-06 32 Sb-125 8.0E+02 3.2E-06 3.0E-06 4.0E-06 33 Pm-147 3.0E+03 2.9E-06 3.9E-05 2.7E-05 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.6E-06 1.5E-05 36 Sm-151 8.0E+03 1.5E-06 3.3E-05 1.3E-05 37 Cs-134 6.0E+01 1.5E-06 1.6E-06 1.5E-06 38 Te-125m 9.0E+02 1.0E-06 1.0E-06 8.8E-06 39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	29	Cm-243	6.0E+00	5.8E-06	1.5E-05 9.4E-06		29	Cm-243	6.0E+00	5.8E-06	1.5E-05	9.4E-06			
32 Sb-125 8.0E+02 3.2E-06 3.0E-06 4.0E-06 4.0E-06 3.2E-06 3.0E-06 4.0E-06 4.0E-06 3.2E-06 3.0E-06 4.0E-06 4.0E-06 3.2E-06 3.0E-06 4.0E-06 3.0E-05 2.7E-05 3.0E-02 3.0E-02 3.0E-06 7.8E-06 1.4E-07 3.0E-02 1.6E-06 1.6E-06 1.5E-05 3.0E-02 1.0E-06 1.6E-06 1.5E-05 3.0E-02 3.0E-02 1.0E-06 1.5E-05 3.0E-02 3.0E-02 1.0E-06 1.5E-05 3.0E-02 3.0E-02 1.0E-06 1.5E-05 3.0E-02 3.0E-02 1.0E-06 1.5E-06 1.5E-06 3.0E-02 3.0E	30	Ba-140	3.0E+02	5.6E-06	7.7E-06 1.0E-05		30	Ba-140	3.0E+02	5.6E-06	7.7E-06	1.0E-05			
33 Pm-147 3.0E+03 2.9E-06 3.9E-05 2.7E-05 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.6E-06 1.5E-05 34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 36 Sm-151 8.0E+03 1.5E-06 3.3E-05 1.3E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-05 37 Cs-134 6.0E+01 1.5E-06 1.5E-06 1.5E-06 3.3E-05 38 Te-125m 9.0E+02 1.0E-06 1.0E-06 8.8E-06 39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	31	Sb-124	3.0E+02	5.1E-06	4.8E-06 6.1E-06		31	Sb-124	3.0E+02	5.1E-06	4.8E-06	6.1E-06			
34 Cd-113m 4.0E+01 1.7E-06 7.8E-06 1.4E-07 35 Te-129m 3.0E+02 1.6E-06 1.5E-05 36 Sm-151 8.0E+03 1.5E-06 1.5E-06 1.3E-05 36 Sm-151 8.0E+03 1.5E-06 3.3E-05 1.3E-06 3.2E-05 37 Cs-134 6.0E+01 1.5E-06 1.5E-06 1.5E-06 38 Te-125m 9.0E+02 1.0E-06 8.8E-06 38 Te-125m 9.0E+02 1.0E-06 8.8E-06 38 38 Te-125m 9.0E+02 3.1E-06 9.7E-07	32	Sb-125	8.0E+02	3.2E-06	3.0E-06 4.0E-06		32	Sb-125	8.0E+02	3.2E-06	3.0E-06	4.0E-06			
35 Te-129m 3.0E+02 1.6E-06 1.5E-05 3.0E+02 1.5E-06 3.3E-05 1.3E-05 3.0E+02 1.5E-06 1.5E-06 1.5E-06 3.0E+02 1.5E-06 1.5E-06 1.5E-06 3.0E+02 1.5E-06 1.5E-06 1.5E-06 3.0E+02 1.5E-06 1.5E-06 1.5E-06 3.0E+02 1.5E-06 1.5E-06 3.0E+02 1.5E-06 1.5E-06 3.0E+02 1.5E-06 3.0E+02 1.5E-06 1.5E-06 3.0E+02 3.0E+02 3.0E+02 3.0E+02 3.0E+02 3.0E+02 3.0E+02 3.0	33	Pm-147	3.0E+03	2.9E-06	3.9E-05 2.7E-05		33	Pm-147	3.0E+03	2.9E-06	3.9E-05	2.7E-05			
36 Sm-151 8.0E+03 1.5E-06 3.3E-05 1.3E-05 37 Cs-134 6.0E+01 1.5E-06 1.4E-06 1.5E-06	34	Cd-113m	4.0E+01	1.7E-06	7.8E-06 1.4E-07		34	Cd-113m	4.0E+01	1.7E-06	7.8E-06	1.4E-07			
37 Cs-134 6.0E+01 1.5E-06 1.4E-06 1.5E-06 1.5E	35	Te-129m	3.0E+02	1.6E-06	1.6E-06 1.5E-05		35	Te-129m	3.0E+02	1.6E-06	1.6E-06	1.5E-05			
38 Te-125m 9.0E+02 1.0E-06 1.0E-06 8.8E-06 39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	36	Sm-151	8.0E+03	1.5E-06	3.3E-05 1.3E-05		36	Sm-151	8.0E+03	1.5E-06	3.3E-05	1.3E-05			
39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05 39 Am-241 5.0E+00 9.4E-07 3.1E-06 9.7E-07 40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	37	Cs-134	6.0E+01	1.5E-06	1.4E-06 1.5E-06		37	Cs-134	6.0E+01	1.5E-06	1.4E-06	1.5E-06			
40 Te-123m 6.0E+02 9.0E-07 9.2E-07 5.4E-06 41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	38	Te-125m	9.0E+02	1.0E-06	1.0E-06 8.8E-06		38	Te-125m	9.0E+02	1.0E-06	1.0E-06	8.8E-06			
41 Cs-137 9.0E+01 8.0E-07 7.7E-07 8.0E-07 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	39	Am-241	5.0E+00	9.4E-07	3.1E-06 9.7E-07		39	Am-241	5.0E+00	9.4E-07	3.1E-06	9.7E-07			
42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05 42 Rb-86 6.0E+01 7.8E-07 9.9E-05 3.7E-05	40	Te-123m	6.0E+02	9.0E-07	9.2E-07 5.4E-06		40	Te-123m	6.0E+02	9.0E-07	9.2E-07	5.4E-06			
	41	Cs-137	9.0E+01	8.0E-07	7.7E-07 8.0E-07		41	Cs-137	9.0E+01	8.0E-07	7.7E-07	8.0E-07			
43 Cm-242 3.0E+02 7.7E-07 7.7E-07 7.2E-06 43 Cm-242 3.0E+02 7.7E-07 7.2E-06	42	Rb-86	6.0E+01	7.8E-07	9.9E-05 3.7E-05		42	Rb-86	6.0E+01	7.8E-07	9.9E-05	3.7E-05			
	43	Cm-242	3.0E+02	7.7E-07	7.7E-07 7.2E-06		43	Cm-242	3.0E+02	7.7E-07	7.7E-07	7.2E-06			

The Japanese version shall prevail.

196

			Cur	rent		
44	Te-127m	5.0E+00	7.2E-07	8.0E-07	1.3E-06	
45	Am-242m	3.0E+02	6.7E-07	5.3E-07	1.3E-06	
46	Pu-238	4.0E+00	4.6E-07	3.1E-07	7.6E-07	
47	Pu-240	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
48	Pu-239	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
49	Ni-63	6.0E+03	2.3E-07	5.5E-06	1.7E-06	
50	Cm-244	7.0E+00	8.6E-08	1.1E-05	4.2E-06	
51	Тс-99	1.0E+03	6.7E-08	1.5E-05	4.5E-05	
52	Sr-89	3.0E+02	6.1E-08	2.1E-07	6.0E-08	
53	Cs-135	6.0E+02	5.3E-08	2.9E-08	4.3E-08	
54	Pu-241	2.0E+02	2.2E-08	1.5E-08	3.7E-08	
55	Sr-90	3.0E+01	1.1E-08	4.1E-08	1.1E-08	
56	H-3	6.0E+04	4.7E-09	4.7E-09	1.8E-09	
57	I-129	9.0E+00	9.1E-11	5.2E-08	2.3E-08	
58	Y-90	3.0E+02	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
59	Rh-103m	2.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
60	Rh-106	3.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
61	Te-129	1.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
62	Ba-137m	8.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
63	Pr-144	2.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	4.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide

C2. Setting of management values

In the analysis results of tanks and ALPS outlet water, seven nuclides excluding C-14 were not detected among the nuclides subject to management. The management values of the undetected nuclides are obtained by rounding up 120% of the minimum detection limit (larger result of the two tank groups) in the secondary treatment performance test considering errors. That of C-14, which was detected, is obtained by rounding up the concentration twice as high as the maximum value.

Figure C-1 and Table C-6 show the setting flow of management values and the set management values, respectively.

44	Te-127m	5.0E+00	7.2E-07	8.0E-07	1.3E-06	
45	Am-242m	3.0E+02	6.7E-07	5.3E-07	1.3E-06	
46	Pu-238	4.0E+00	4.6E-07	3.1E-07	7.6E-07	
47	Pu-240	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
48	Pu-239	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
49	Ni-63	6.0E+03	2.3E-07	5.5E-06	1.7E-06	
50	Cm-244	7.0E+00	8.6E-08	1.1E-05	4.2E-06	
51	Тс-99	1.0E+03	6.7E-08	1.5E-05	4.5E-05	
52	Sr-89	3.0E+02	6.1E-08	2.1E-07	6.0E-08	
53	Cs-135	6.0E+02	5.3E-08	2.9E-08	4.3E-08	
54	Pu-241	2.0E+02	2.2E-08	1.5E-08	3.7E-08	
55	Sr-90	3.0E+01	1.1E-08	4.1E-08	1.1E-08	
56	H-3	6.0E+04	4.7E-09	4.7E-09	1.8E-09	
57	I-129	9.0E+00	9.1E-11	5.2E-08	2.3E-08	
58	Y-90	3.0E+02	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
59	Rh-103m	2.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
60	Rh-106	3.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
61	Te-129	1.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
62	Ba-137m	8.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
63	Pr-144	2.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	4.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide

Revised

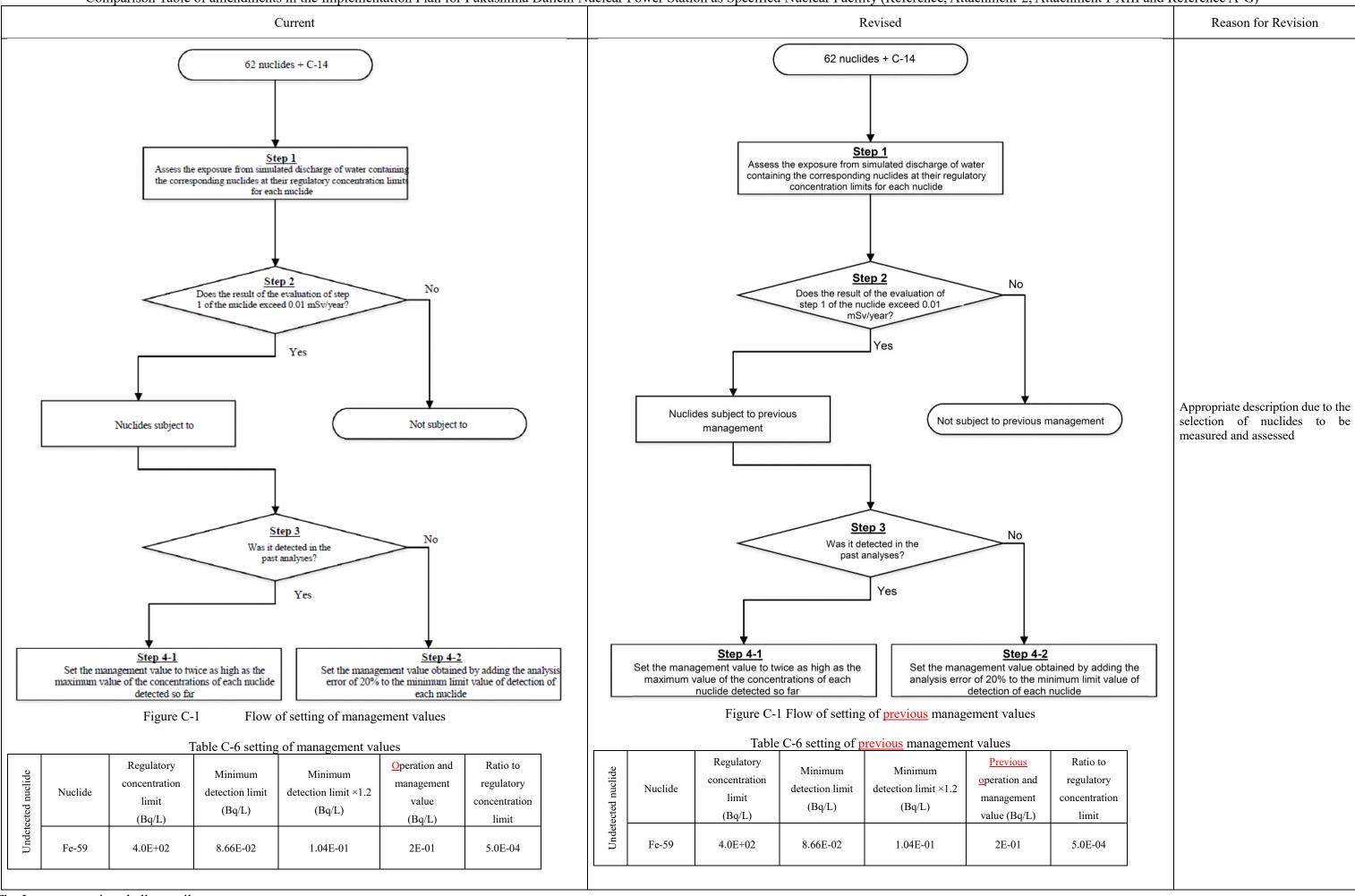
C2. Setting of <u>previous</u> management values

In the analysis results of tanks and ALPS outlet water, which were analyzed so far, seven nuclides excluding C-14 were not detected among the nuclides subject to previous management. The management values of the undetected nuclides are obtained by rounding up 120% of the minimum detection limit (larger result of the two tank groups) in the secondary treatment performance test considering errors. That of C-14, which was detected, is obtained by rounding up the concentration twice as high as the maximum value.

Figure C-1 and Table C-6 show the setting flow of previous management values and the set previous management values, respectively.

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision



Ag-110m

3.0E+02

	Con	ipanson raoic		Current	union i iun ioi	T ukusiiiilu De
	Ag-110m	3.0E+02	4.26E-02	5.11E-02	6E-02	2.0E-04
	Cd-113m	4.0E+01	8.55E-02	1.03E-01	2E-01	5.0E-03
	Cd-115m	3.0E+02	2.70E+00	3.24E+00	4E+00	1.3E-02
	Sn-119m	2.0E+03	4.24E+01	5.09E+01	6E+01	3.0E-02
	Sn-123	4.0E+02	6.59E+00	7.91E+00	8E+00	2.0E-02
	Sn-126	2.0E+02	2.92E-01	3.50E-01	4E-01	2.0E-03
Detected nuclide	Nuclide	Regulatory concentration limit (Bq/L)	Maximum detected value (Bq/L)	Maximum detected value×2 (Bq/L)	Operation and management value (Bq/L)	Ratio to regulatory concentration limit
Dete	C-14	2.0E+03	2.15E+02	4.30E+02	5E+02	2.5E-01
	Total of regulatory concentration ratios			3.2E-01		

C3. Simulation assessment of human exposure from ALPS treated water

To verify that the management values set in C2. reduce the risk caused by the uncertainty of the source term, we assessed the exposure from continuous discharge of simulated ALPS treated water containing only nuclides with relatively great impacts of exposure such as the nuclides subject to management as a very conservative assessment, though such ALPS treated water cannot exist in reality.

a. Setting of the source terms

Based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-7.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million L (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the management value, which is the upper limit, is set to the concentrations of 8 nuclides with relatively great impacts on exposure. The sum of the ratios to regulatory concentrations limits of the 8 nuclides is 0.32.
- For the other 55 nuclides, Zn-65, whose impact on exposure is relatively great following the 8 nuclides subject to management, shall be assessed, and the concentration of Zn-65 is set to 140Bq/L, which is equivalent to the regulatory concentration ratio of 0.68. Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium become 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 9 nuclides by multiplying the concentrations of the 8 nuclides subject to management and Zn-65 by the annual discharge volume of water of 220 million L.

(Omission)

4.0E+01 8.55E-02 1.03E-01 5.0E-03 Cd-113m 2E-01 Cd-115m 3.0E+02 2.70E+00 3.24E+00 4E+00 1.3E-02 2.0E+03 4.24E+01 6E+01 3.0E-02 Sn-119m 5.09E+01 Sn-123 4.0E+02 6.59E+00 7.91E+00 8E+00 2.0E-02 2.0E+02 2.92E-01 4E-01 2.0E-03 Sn-126 3.50E-01 Regulatory Operation and Ratio to Maximum Maximum detected concentration management regulatory Nuclide detected value value×2 concentration limit (Bq/L)(Bq/L) limit (Bq/L) (Bq/L)C-14 2.0E+03 2.15E+02 4.30E+02 5E+02 2.5E-01 3.2E-01 Total of regulatory concentration ratios

Revised

5.11E-02

6E-02

2.0E-04

4.26E-02

C3. Simulation assessment of human exposure from ALPS treated water

To verify that the <u>previous</u> management values set in C2. reduce the risk caused by the uncertainty of the source term, we assessed the exposure from continuous discharge of simulated ALPS treated water containing only nuclides with relatively great impacts of exposure such as the nuclides subject to <u>previous</u> management as a very conservative assessment, though such ALPS treated water cannot exist in reality.

a. Setting of the source terms

Based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-7.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million L (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the <u>previous</u> management value, which is the upper limit, is set to the concentrations of 8 nuclides with relatively great impacts on exposure. The sum of the ratios to regulatory concentrations limits of the 8 nuclides is 0.32.
- For the other 55 nuclides, Zn-65, whose impact on exposure is relatively great following the 8 nuclides subject to <u>previous</u> management, shall be assessed, and the concentration of Zn-65 is set to 140Bq/L, which is equivalent to the regulatory concentration ratio of 0.68. Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium becomes 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 9 nuclides by multiplying the concentrations of 8 nuclides subject to previous management and Zn-65 by the annual discharge volume of water of 220 million L.

(Omission)

Appropriate description due to the selection of nuclides to be measured and assessed

Reason for Revision

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi N	Juclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and F	teference A-G)
Current	Revised	Reason for Revision
	C4. Assessment of environmental protection with ALPS treated water As with the human exposure assessment, we assessed exposure of animals and plants in the case of continuous discharge of simulated ALPS treated water.	
a. Setting of the source terms As with C3, a Setting of the source term, based on the following steps, we set the source term of each puelide.	a. Setting of the source terms As with C3, a Setting of the source term, based on the following steps, we set the source term of each nuclide.	

As with C3. a. Setting of the source term, based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-11.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million L (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the management value, which is the upper limit, is set to the concentrations of 2 nuclides with relatively great impacts on exposure. The sum of the ratios to regulatory concentrations limits of the 2 nuclides (Fe-59 and Sn-126) is 0.0025 (2.5E-03).
- For the other 61 nuclides, Pm-148m, whose impact on exposure is relatively great following the 2 nuclides subject to management, shall be assessed, and the concentration of Pm-148m is set to 499Bq/L, which is equivalent to the regulatory concentration ratio of 0.9975 (9.975E-01)). Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium become 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 3 nuclides by multiplying the concentrations of the 2 nuclides subject to management and Pm-148m by the annual discharge volume of water of 220 million L.

(Omission)

Reference D Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water

(Omission)

Table D-2 TEPCO's consideration result of the non-radiological environmental impact assessment of nuclides

	contained in the ALPS treate	d water	
Impact factors	Presence and operation of the facilities	Implementation of construction	
	Presence of facilities related to discharge of	Construction of facilities related to discharge of	
Environmental	ALPS treated water into the sea	ALPS treated water into the sea]
elements			•
Atmosphere	The motor operation method or pneumatic	The ships used for construction are 1 dredger,	
environment	method shall be adopted for the power to drive	2 crane barges, and 1 concrete plant vessel	(
(Air quality and	active components such as pumps or valves	(not operated simultaneously). Heavy	(
noise/vibration)	and no facility to emit air pollutants shall be	equipment is up to about 20 units/day. The	1
	installed.	shield machine (diameter of about 3m) is one	
	In addition, the total flow rate of 3 seawater	unit. Material transportation is up to about 30	
	dilution pumps in normal operation for	units/day.	
	discharge of ALPS treated water and 1 ALPS	Only the installation of the intake and	
	treated water transfer pump (maximum daily	discharge facilities is construction out of the	
	amount: about 510 thousand m ³) is smaller	site and most of the installation of the intake	
	than that in normal operation of the circulation	and discharge facilities is construction of the	
	water pump of a general nuclear power plant	undersea tunnel. The construction is limited	
	(about 9 times as large daily amount in Unit 1,	to the inside of the FDNPS and the area	
	which is the smallest, if FDNPS before the	where no fishing is conducted on a daily	
	accident is used as an example: about 4.25	basis and the surrounding area of the FDNPS	
	million m ³). The area surrounding the FDNPS	within about 2 km from the place of	
	is used as an intermediate storage facility	construction are used for the intermediate	
	completely surrounding the land side of the	storage facilities, so there is no target whose	
	FDNPS, and the closest place in the outside	impact on the life environment should be	
	Difficult-to-Return Zone is at least 1 km away	assessed within the range where noise,	
	from the site boundary of FDNPS and about 2		

As with C3. a. Setting of the source term, based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-11.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million I (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the previous management value, which is the upper limit, is set to the concentrations of 2 nuclides with relatively great impacts on exposure. The sum of the ratios to regulatory concentrations limits of the 2 nuclides (Fe-59 and Sn-126) is 0.0025 (2.5E-03).

Appropriate description due to the

selection of nuclides to

measured and assessed

- For the other 61 nuclides, Pm-148m, whose impact on exposure is relatively great following 2 nuclides subject to previous management, shall be assessed, and the concentration of Pm-148m is set to 499Bq/L, which is equivalent to the regulatory concentration ratio of 0.9975 (9.975E-01)). Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium becomes 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 3 nuclides by multiplying the concentrations of the 2 nuclides subject to management and Pm-148m by the annual discharge volume of water of 220 million L.

(Omission)

Assessment result of environmental impacts including other elements than radiation related to Reference D discharge of ALPS treated water

(Omission)

Table D-2 TEPCO's consideration result of the non-radiological environmental impact assessment of nuclides

contained in the ALPS treate	d water	contained in the ALPS treated water			
ence and operation of the facilities Implementation of construction		Impact factors	Presence and operation of the facilities	Implementation of construction	
ce of facilities related to discharge of	Construction of facilities related to discharge of		Presence of facilities related to discharge of	Construction of facilities related to discharge of	
ALPS treated water into the sea	ALPS treated water into the sea	Environmental	ALPS treated water into the sea	ALPS treated water into the sea	
		elements			
otor operation method or pneumatic	The ships used for construction are 1 dredger,	Atmosphere	The motor operation method or pneumatic	The ships used for construction are 1 dredger,	
shall be adopted for the power to drive	2 crane barges, and 1 concrete plant vessel	environment	method shall be adopted for the power to drive	2 crane barges, and 1 concrete plant vessel	
components such as pumps or valves	(not operated simultaneously). Heavy	(Air quality and	active components such as pumps or valves	(not operated simultaneously). Heavy	
facility to emit air pollutants shall be	equipment is up to about 20 units/day. The	noise/vibration)	and no facility to emit air pollutants shall be	equipment is up to about 20 units/day. The	
d.	shield machine (diameter of about 3m) is one		installed.	shield machine (diameter of about 3m) is one	
tion, the total flow rate of 3 seawater	unit. Material transportation is up to about 30		In addition, the total flow rate of 3 seawater		
n pumps in normal operation for	units/day.		dilution pumps in normal operation for		
ge of ALPS treated water and 1 ALPS	Only the installation of the intake and		discharge of ALPS treated water and 1 ALPS	Only the installation of the intake and	
water transfer pump (maximum daily	discharge facilities is construction out of the		treated water transfer pump (maximum daily	discharge facilities is construction out of the	
t: about 510 thousand m ³) is smaller	site and most of the installation of the intake		amount: about 510 thousand m ³) is smaller	site and most of the installation of the intake	
at in normal operation of the circulation	and discharge facilities is construction of the		than that in normal operation of the circulation	and discharge facilities is construction of the	
nump of a general nuclear power plant	undersea tunnel. The construction is limited		water pump of a general nuclear power plant	undersea tunnel. The construction is limited	
9 times as large daily amount in Unit 1,	to the inside of the FDNPS and the area		(about 9 times as large daily amount in Unit 1,	to the inside of the FDNPS and the area	
is the smallest, if FDNPS before the	where no fishing is conducted on a daily		which is the smallest, if FDNPS before the	where no fishing is conducted on a daily	
nt is used as an example: about 4.25	basis and the surrounding area of the FDNPS		accident is used as an example: about 4.25	basis and the surrounding area of the FDNPS	
m ³). The area surrounding the FDNPS	within about 2 km from the place of		million m ³). The area surrounding the FDNPS	within about 2 km from the place of	
d as an intermediate storage facility	construction are used for the intermediate		is used as an intermediate storage facility	construction are used for the intermediate	
etely surrounding the land side of the	storage facilities, so there is no target whose		completely surrounding the land side of the	storage facilities, so there is no target whose	
S, and the closest place in the outside	impact on the life environment should be		FDNPS, and the closest place in the outside	impact on the life environment should be	
lt-to-Return Zone is at least 1 km away	assessed within the range where noise,		Difficult-to-Return Zone is at least 1 km away	assessed within the range where noise,	
e site boundary of FDNPS and about 2			from the site boundary of FDNPS and about 2		

Current	Revised	Reason for Revision
km away from the place assumed to be the construction site (seaside area of Unit 5). Therefore, there is no target whose impact on the life environment should be assessed within the possible range of noise, vibration, etc.	km away from the place assumed to be the construction site (seaside area of Unit 5). Therefore, there is no target whose impact on the life environment should be assessed within the possible range of noise, vibration, etc.	
Water environment (Water (Water quality/Water temperature/Flo w velocity)* Other than radioactive materials There is no target to be assessed becaus occurrence of water turbidity caused by the construction is deemed to be limited becaus the construction of the intake facilities is performed in the port, most of the discharge the pollution load, which causes an increase in radioactive materials There is no target to be assessed becaus occurrence of water turbidity caused by the construction is deemed to be limited becaus the construction of the intake facilities is performed in the port, most of the discharge facilities is constructed by the shield method as undersea tunnels, and a rocky shore is selected as the site for tunnel outlets. It was verified in past measurement ² that the water quality of ALPS treated water sufficiently meets the wastewater standard. Moreover, in actual discharge of ALPS treated water, the water to be discharged shall be verified to meet the wastewater standard.	e environment (Water quality/Water temperature/Flo w velocity)* with the contained radioactive materials occurrence of water turbidity caused by the construction is deemed to be limited because the construction of the intake facilities is performed in the port, most of the discharge facilities is constructed by the shield method	
In addition, seawater to be taken and discharged is only used for dilution of ALPS treated water and is not heated. The temperature of ALPS treated water stored on land may change due to the ambient temperature. However, it is not in an equilibrium state with the seawater temperature and discharged after diluted 100 or more times with seawater, so there is almost no difference between the temperatures of wastewater and seawater. The discharge flow velocity from the discharge outlet is as slow as about 1 m/s even in the case of the maximum flow rate with the three seawater dilution pumps in operation. Water is discharged straight up from the seabed with a water depth of about 12 m. Therefore, changes in the flow velocity are limited to near the discharge outlet.	In addition, seawater to be taken and discharged is only used for dilution of ALPS treated water and is not heated. The temperature of ALPS treated water stored on land may change due to the ambient temperature. However, it is not in an equilibrium state with the seawater temperature and discharged after diluted 100 or more times with seawater, so there is almost no difference between the temperatures of wastewater and seawater. The discharge flow velocity from the discharge outlet is as slow as about 1 m/s even in the case of the maximum flow rate with the three seawater dilution pumps in operation. Water is discharged straight up from the seabed with a water depth of about 12 m. Therefore, changes in the flow velocity are limited to near the discharge outlet.	
Other environments (terrain/geology, subgrade, and soil) The discharge flow velocity from the discharge outlet is as slow as about 1m/s even in the case of the maximum flow rate with the stabed, and soil) Water is discharged straight up from the seabed. The protrusion from the seabed height is limited to a height of about 2 m within about 3 m in the four directions. The square area of about 40 m around the discharge outlet (about 1,600 m²) is backfilled. Therefore, changes in the flow velocity are limited to near the discharge outlet, and there is no risk of scouring. Pumping of groundwater, which causes ground subsidence, shall not be performed and it is planned not to use any substance which causes soil contamination. Terrain modifications are limited to very small areas, namely the discharge vertical shaft (upper-stream storage of about 670 m², a total of about 750 m²) and the outlet of the undersea tunnel (about 1,600 m²) by avoiding new terrain modifications by reuse of about 40 m², a total of about 750 m²) and the outlet of the undersea tunnel (about 1,600 m²) by avoiding new terrain modifications are limited to very small areas, namely the discharge vertical shaft (upper-stream storage of about 80 m², a total of about 750 m²) and the outlet of the undersea tunnel (about 1,600 m²) by avoiding new terrain modifications by reuse of the existing facilities, installation of the undersea tunnel by the shield method which gives very low change to terrain drilling bedrock.	is limited to a height of about 2 m within about 3 m in the four directions. The square area of about 40 m around the discharge outlet (about 1,600 m²) is backfilled. Therefore, changes in the flow velocity are limited to near the discharge outlet, and there is no risk of scouring. Pumping of groundwater, which causes ground subsidence, shall not be performed and it is planned not to use any substance which causes soil contamination.	
Animals, plants, and ecosystem Most of the facilities are installed in places where site preparation has been completed reuse of the existing facilities, installation of	Animals, plants, and ecosystem Most of the facilities are installed in places New terrain modifications are avoided by where site preparation has been completed reuse of the existing facilities, installation of	

77

Current			Revised			Reason for Revision
	discharge is an undersea tunnel and requires the minimum necessary area of about 40 m x about 40 m (about 1,600 m²) near the outlet. The impact of discharge of ALPS treated water on tidal currents, etc., is small and there is almost no impact of the operation of the facility on organisms, because of ALPS treated water being diluted 100 or more times with the seawater of the adjacent sea and the low discharge flow velocity of about 1 m/s.	the undersea tunnel by the shield method, etc. No important species, habitat, etc., have been found in the sea area where construction is to be performed.		within the site of the FDNPS. The facility for discharge is an undersea tunnel and requires the minimum necessary area of about 40 m x about 40 m (about 1,600 m²) near the outlet. The impact of discharge of ALPS treated water on tidal currents, etc., is small and there is almost no impact of the operation of the facility on organisms, because of ALPS treated water being diluted 100 or more times with the seawater of the adjacent sea and the low discharge flow velocity of about 1 m/s.	the undersea tunnel by the shield method, etc. No important species, habitat, etc., have been found in the sea area where construction is to be performed.	
Rich natural environment (landscape, etc.)	There is no item to be assessed because the existing facilities are reused and the scale of the facilities to be newly installed is small.	Since the scales of the facilities to be installed are small, the traffic of vehicles for transportation of materials, etc., is assumed to be up to 20 vehicles/day, which is limited.	Rich natural environment (landscape, etc.)	There is no item to be assessed because the existing facilities are reused and the scale of the facilities to be newly installed is small.	Since the scales of the facilities to be installed are small, the traffic of vehicles for transportation of materials, etc., is assumed to be up to 20 vehicles/day, which is limited.	
Environmental loads (waste, emission of greenhouse gas, etc.)		Construction waste soil is generated (about 40 thousand m³) associated with excavation of the undersea tunnel, but the generated amount is small and it is disposed of at the existing soil disposal site in the premises without transfer to outside.	Environmental loads (waste, emission of greenhouse gas, etc.)	Discharge of ALPS treated water does not generate any new waste. In addition, the motor operation method or pneumatic method shall be adopted for the power to drive active components such as pumps or valves used for the facilities for discharging ALPS treated water into the sea, so no greenhouse gas including that generated by combustion of fossil fuel is emitted. Therefore, there is no item to be assessed.	Construction waste soil is generated (about 40 thousand m³) associated with excavation of the undersea tunnel, but the generated amount is small and it is disposed of at the existing soil disposal site in the premises without transfer to outside.	
Radioactive materials already exist in environment	The planned discharge outlet is installed in a rocky shore outside the port, the surrounding square area of 40 m is backfilled with concrete, etc., and water is discharge straight up at a low flow velocity of about 1 m per second, so discharge of treated water does not swirl marine sediment or disperse radioactive materials. The seawater for diluting the ALPS treated water is planned to be drawn from the outside of the port (north side of the Unit 5/6 discharge outlet) by blocking the intake path opening channel with partition weir (rubble mound and sheet) from the port of the Unit 1-4 side considering that the concentration of radioactive materials is slightly higher than that of the seawater in the surrounding sea area and that it may swirl marine sediment, etc., in the port. As shown in attachment V "Impacts of intake and discharge of diluted water on outside," the result of the assessment of exposure considering the impact of the radioactive materials, which may be contained in drawn seawater in the case of intake of seawater outside this port is 9.6E-05 mSv/year, which is much lower than 0.05mv/year.	has almost no impact such as dispersion of radioactive materials, etc., thanks to installation of contamination prevention fences for construction, careful work at slower construction speed than usual, etc., in order to reduce sedimentation sand swirled in the port. It was confirmed that the concentration of radioactive materials in the seawater did not vary significantly during similar construction performed in the port (pouring materials such as riprap into the sea by using working crafts and backhoes) in the past three years ³ . Actually, the concentration of radioactive materials in the seawater in the port is below the domestic regulatory standard even inside	Radioactive materials already exist in environment	rocky shore outside the port, the surrounding square area of 40 m is backfilled with concrete, etc., and water is discharge straight up at a low flow velocity of about 1 m per second, so discharge of treated water does not swirl marine sediment or disperse radioactive materials. The seawater for diluting the ALPS treated water is planned to be drawn from the outside of the port (north side of the Unit 5/6 discharge outlet) by blocking the intake path	It is considered that construction in the port has almost no impact such as dispersion of radioactive materials, etc., thanks to installation of contamination prevention fences for construction, careful work at slower construction speed than usual, etc., in order to reduce sedimentation sand swirled in the port. It was confirmed that the concentration of radioactive materials in the seawater did not vary significantly during similar construction performed in the port (pouring materials such as riprap into the sea by using working crafts and backhoes) in the past three years ³ . Actually, the concentration of radioactive materials in the seawater in the port is below the domestic regulatory standard even inside the intake path opening channel of Units 1 to 4, in which the concentrations are relatively high (Cs-137 1E+00Bq/L order, Sr-90 1E+00Bq/L order, 10E+2Bq/L as of 2021) ⁴ . In addition, it is considered that the tunnel outlet construction outside the port has almost no impact, such as swirling of the seabed sediment, because a rocky shore is selected for the construction area, the excavation area is as small as about 40 m × 40 m, the concentration of radioactive materials contained the marine sediment is	

Current	Revised	Reason for Revision	
will be taken if a significant change in the turbidity of seawater is observed during the construction period. Therefore, we assessed that there is almost no impact of construction such as dispersion of radioactive materials, etc.	will be taken if a significant change in the turbidity of seawater is observed during the construction period. Therefore, we assessed that there is almost no impact of construction such as dispersion of radioactive materials, etc.		
mission)	(Omission)		
eference E State of consultation with domestic and foreign stakeholders	Reference E State of consultation with domestic and foreign stakeholders		
mission)	(Omission)		
2. Responses to public comments regarding the Radiological Impact Assessment Report fter the <u>public action</u> of this report on November 17, 2021, we received 400 or more opinions from both inside d outside of Japan in response to our Public Comment Procedure. We have revised the contents of the report in bril 2022, by taking into account the public comments we received through this procedure ³ .	E2. Responses to public comments regarding the Radiological Environmental Impact Assessment Report After the <u>publication</u> of this report on November 17, 2021, we received 400 or more opinions from both inside and outside of Japan in response to our Public Comment Procedure. For the purpose of further enhancing the content of the report, TEPCO solicited <u>public comments both in Japanese and English for a month.</u> We have revised the contents of the report in April 2022, by taking into account the <u>public comments</u> we received through this procedure ³ . Table E-1 shows examples of the items reflected in the revision, based on the results of soliciting <u>comments</u> .	Appropriate description Enhancement of description	
	<u>Table E-1: Examples of the items reflected in the Radiological Environmental Impact Assessment Report,</u> based on the results of public comments on the Report		
	Assessment addition/revision Review of potential assessment methods Consideration of the effects of organically bound tritium Effects of radioactive materials already released into the environment Consideration of effects outside the model due to specific concentrations at model boundaries Case study of sea water concentrations used in the assessment Addition of a chapter and references on the process of selecting a disposal method Added description of nuclide accumulation in the environment Addition of the model used in the simulation and the assessed conditions. Reflecting the progress of the review by the Nuclear Regulation Authority and the review after the publication of the report. Transcription of information from previously published documents (e.g., consideration of discharge period) Assessment results for environmental effects other than radiation Review of difficult-to-understand expressions Improvement of translation quality of English translation Correction of errors		
emission)	(Omission)		
. Transmission to and consultation with the international community Cooperation with the IAEA	E3. Transmission to and consultation with the international community (1) Cooperation with the IAEA		
mission)	(Omission)		

Economy, Trade and Industry. In addition, they also saw and reviewed the ALPS, the K4 tank groups to be reused | Economy, Trade and Industry. In addition, they also saw and reviewed the ALPS, the K4 tank groups to be reused

The Japanese version shall prevail.

for measurement and confirmation of the concentration of radioactive materials contained in the treated water before

dilution and discharge, and the harbor area which is being considered for the installation of facilities for dilution

and discharge of the treated water. The contents of discussions with the IAEA were also reflected in the review of

for measurement and confirmation of the concentration of radioactive materials contained in the treated water before

dilution and discharge, and the harbor area which is being considered for the installation of facilities for dilution

and discharge of the treated water. The contents of discussions with the IAEA were also reflected in the review of

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and Reference A-G)

Current	Revised	Reason for Revision
s report.	Table E-2 Main examples of areas reflected in the report are shown in Table E-2. Table E-2 Main examples of areas reflected in the report based on the findings of the IAEA review. No. IAEA Comments Considering that 12 years have passed since the accident, the source 1 term should be realistic, even if 1 sufficiently conservative. It is should be realistic, even if 1 sufficiently conservative. Even if the ALPS-treated water to be discharged contains hittle or no organically bound tritium (OBT). The assessment should be added, and that this assessment will be reviewed as necessary. Even if the ALPS-treated water to be discharged contains hittle or no organically bound tritium (OBT). The assessment should be added, and that this assessment will be reviewed as necessary. Assessed a conservative assumption of 10% of tritium to be injusted as OBT along with the injusted in the monitoring program to verify the validity of the Assessment. The rationale for setting the Assessment no verify the validity of the Assessment. The rationale for setting the Assessment area as 10 km x 10 km around the power plant to the nearest fishing port and the local total that this assessment and the found of the power plant to the nearest fishing port as least 5 km away and fishing operations are conducted mainly around the fishing port. The impact on the assessment due to the difference in the sea area to be assessed (epistemic uncertainty). The establishment of a representative person's lifestyle and the focation of where they receive exposure should be considered for the future as well. The establishment of a representative person's lifestyle and the focation of where they receive exposure should be considered for the future as well. The establishment of a representative person's lifestyle and the focation of where they receive exposure should be considered for the future as well. The establishment of a representative person's lifestyle and the focation of where they receive exposure should be considered for the future as	Enhancement of description
	It should be indicated that the expected exposure pathway is taken into account, even if the contribution 5 is small. Assessments were also conducted for pathways that were thought to have a small contribution, and relatively small effects on exposure were found. "Ingestion of water due to swimming, etc." and "inhalation of seawater spray" were added to the assessed results. Attachment VI Transfer pathways and exposure pathways other than the assessment target	
	Potential exposure scenarios should consider uncontrolled releases due to External events. Assessed should include all exposure pathways and the source term should consider all radioactive nuclides. Potential exposure scenarios should external evaluation was limited to external exposure and was assessed using a conservative source term, which is not possible in reality and includes a large amount of only nuclide, which has a large exposure. Evidence should be provided that Clearly describe the rationale. Main text 6-2 Potential exposure assessment exposure assessment Main text 6-2 Potential exposure assessment Exposure assessment Main text 6-2 Potential exposure assessment Exposure assessment Main text 4(3) Assessment of	

Comparison Table of amendments in the Implementation Plan for Fukushima Daiichi N	Juclear Power Station as Specified Nuclear Facility (Reference, Attachment-2, Attachment I-XIII and	Reference A-G)
Current	Revised	Reason for Revision
	Considering that the discharge period will continue for about 30 in seawater concentration due to adsorption years, the accumulation of to seabed soil, etc., is not considered, while adsorption to seabed soil and concentration in organisms are evaluated by account and assessed to maximize exposure. In the assessment of diffusion, the decrease in seawater concentration due to adsorption migration and accumulation of nuclides other than tritium values of nuclides other than tritium va	Enhancement of description
	The impact on neighboring countries should be assessed in order to respond to the interests of the international community. At the boundary of the calculation area of the diffusion simulation (approximately 490 km north-south and 270 km east-west) with meteorological and oceanographic data from 2014 to 2020 years, the report states that the maximum value of annual average is 0.00026 Bq/L and the maximum value of day average is 0.014 Bq/L, which is sufficiently low compared to the tritium concentration in sea water (about 0.1 Bq/L) in the sea area around the main island on the day of the report.	
	In the consideration of uncertainty, sensitivity analysis (e.g., sorting out the effects of changing parameters) is recommended. Uncertainty is broadly classified into "aleatory uncertainty" and "epistemic uncertainty," and sensitivity analysis is performed for those that are possible, and the discussion is described in terms of these two types of uncertainty.	
	The dose constraint should be used as an input to the Radiological Impact Assessment Report to indicate that the tritium discharge limit is appropriate and to confirm the discharge limit for other nuclides, if necessary. 111 The dose constraint should be used as an input to the Radiological Impact Assessment Regulation Authority of Japan (NRA) announced the "Concept and Assessment Guidelines for Verifications in the Radiological Impact Assessment," which is to confirm that "it must be verified that the estimated result of the representative person is small when compared to the fluctuation range of the annual radiation dose in humans in the region are exposed to through their living habits, etc., that is less than 50 µSv/year. The value of 50 µSv/year is the target dose for commercial light water reactors in normal operation, which corresponds to the dose constraint set in the IAEA Safety Standards." Assessed by treating 50 µSv/year = 0.05 mSv/year as the dose constraint.	
(Omission)	(Omission)	Change in the position of the description of the rationale behind
(Not currently listed)	Reference F Rationale behind the selection of nuclides subject to removal by ALPS (Newly described)	the selection of nuclides subject to removal by ALPS due to the selection of nuclides to be measured and assessed
(Not currently listed)	Reference G Annual discharge limit and optimization estimation results for individual nuclide based on dose constraint	Enhancement of description
	(Newly described)	

Part 1 (Security Measures regarding Units 1 to 4)

(Refer to comparison table for any amendments)

Part 2 (Security Measures regarding Units 5 and 6)

(Refer to comparison table for any amendments)

(Refer to comparison table for any amendments)	

Management of Radioactive Liquid Waste, etc.

2.1.2

Selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea

1. Overview

With regard to radionuclides other than tritium in ALPS treated water, the result of the analysis of the radioactivity concentrations of the seven major nuclides plus carbon 14 and technetium 99 in ALPS treated water, and the measured value of gross β shows no discrepancies that would raise suspicion regarding radionuclides except for radionuclides of the current 64 nuclides. In addition, some of the nuclides subject to removal by ALPS will be considered sufficiently decayed and become less abundant by the time of the discharge of ALPS treated water into the sea. Therefore, the sum of the ratios to regulatory concentration limits is considered to satisfy less than 1. In order to ensure that the sum of the ratios to regulatory concentration limits is less than 1, target nuclides to be measured and assessed (hereinafter "nuclides to be measured and assessed") are selected after thorough verification whether they are significantly present in contaminated water based on domestic knowledge of decommissioning and disposal facilities.

2. Policy on the selection of nuclides to be measured and evaluated
For verification of nuclides which have possibility to be significantly contained in contaminated
water at FDNPS, nuclide analyses are conducted based on the domestic knowledge on
decommissioning and disposal facilities, and inventory assessments are conducted

Nuclide analysis

Verify whether or not the nuclides to be assessed in the research on decommissioning and disposal facilities are also significantly present in contaminated water by actual analysis of water. Also verify the results of past nuclide analyses.

Inventory assessment

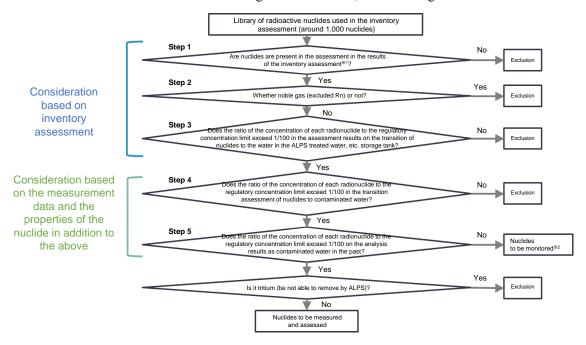
Assess an inventory of fission products in the same way as in the study of nuclides subject to removal by ALPS. Assess the inventory quantity generated by activation of such as structures in reactor pressure vessel based on the studies on decommissioning and disposal facilities. In the above assessments, taken into account the reduction of inventory quantity due to decay as the 12 years have passed since the earthquake until discharge.

Based on the above assessment results, verify the existence of nuclides that may be significantly contained in contaminated water, taking into account such as the ease of transfer to water.

Based on the results of nuclide analysis and inventory assessment, the nuclides to be measured and assessed are selected, taking into account the impacts on dose assessment.

- 3. Selection of nuclides to be measured and assessed at the time of the discharge of ALPS treated water into the sea
- 3.1 Rational behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea

Based on the results of nuclide analysis and inventory assessment in section 2, the nuclides to be measured and assessed are selected according to the flowchart, shown in Figure-1.



- %1: The decay period of the inventory evaluation is appropriately set according to the time when the selection result is to be used. (First time set to 2023 (12 years after the accident))
- *2: Nuclides were continuously confirmed whether are significantly presence in contaminated water

Figure-1 Flowchart for selection of nuclides to be measured and assessed

for discharge of ALPS treated water into the sea

3.2 Selection result

Before discharging ALPS treated water into the sea, it will be confirmed that the nuclides selected for measurement and assessment based on the flowchart in Figure-1 satisfy the discharge criteria (sum of the ratios to regulatory concentration limit of nuclides other than tritium is less than 1.)

3.3 Regular confirmation of nuclides to be measured and assessed

These nuclides to be measured and assessed are selected based on the flowchart in Figure-1. However, there is a possibility that the situation may change depending on the progress of the decommissioning work in the future. Therefore, the following methods are used to confirm that there are no significant nuclides other than the selected nuclides to be measured and assessed (hereinafter "other nuclides"). If it is confirmed that other nuclides are significantly present during this confirmation process, re-assessment of the nuclides to be measured and assessed will be performed. The decay of radionuclides will be also reflected in the selection flowchart.

3.3.1 Confirmation of each discharge

When confirming that ALPS treated water meets the discharge limit, also confirm that no other nuclides are present significantly by measuring with gross α , gross β , and Ge semi-conductor detectors.

3.3.2 Trend confirmation in contaminated water

Confirm that concentrations of radionuclides, regularly checked in contaminated water of downstream from the centralized radioactive waste building, are below the previously confirmed concentration and there is no change in the status of the transfer of radionuclides to contaminated water.

3.3.3 Investigation analysis

The existence of other nuclides is investigated when the event with concern is confirmed in the sections 3.3.1 and 3.3.2. Even if such concerns are dispelled, check the presence of the nuclides subject to be monitored in contaminated water prior to ALPS treatment at a frequency of once a year in order to investigate the presence of other nuclides.

(Refer to comparison table for any amendments)

Dose Assessment by Radioactive Liquid Waste, etc.

2.2.3

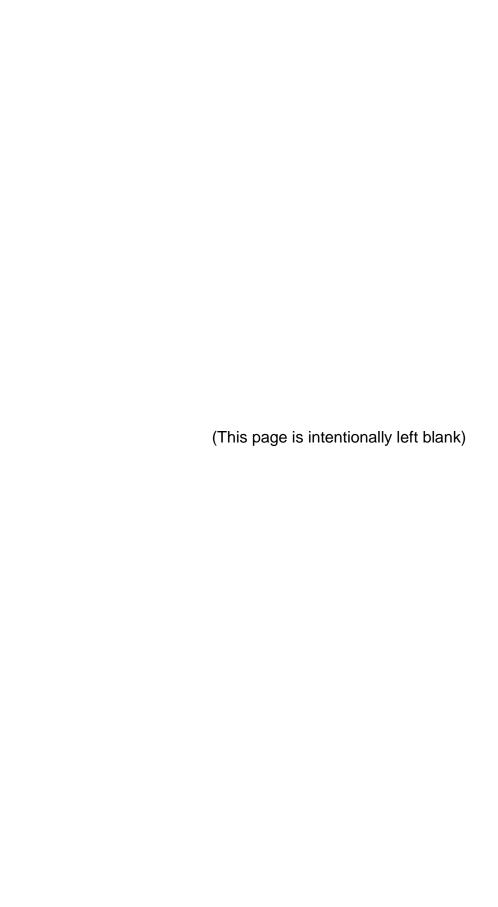
Reference Action in response to "Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station"
(Refer to comparison table for any amendments)

	Attachment-1
Action in Response to the Basic Policy of the Government	
(Refer to comparison table for any amendments)	

Provisional Translation

Radiological Environmental Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Construction stage)

November 2022
Tokyo Electric Power Company Holdings, Inc.



Executive summary

This report compiles the results of the assessment of the radiological impacts on humans and the environment resulting from the discharge of the water treated by the Advanced Liquid Processing System (Multi-Nuclide Removal Facility, hereinafter called "ALPS") (hereinafter, the water called "ALPS treated water") from the Fukushima Daiichi Nuclear Power Station (hereinafter "FDNPS") into the sea in accordance with the standards and guidelines established by internationally recognized organizations such as International Atomic Energy Agency (hereinafter called "IAEA") and International Commission on Radiological Protection (hereinafter called "ICRP").

This report first describes how contaminated water has been generated, managed, treated, and stored as a result of the accident of FDNPS following the Great East Japan Earthquake in 2011, and what on-going efforts are to ensure public and environmental safety (Chapter 1).

Next, the report describes how several proposals for handling of ALPS treated water have been discussed among experts for more than six years since the potential risk associated the storage of contaminated water became apparent in 2013 (Chapter 2), the purpose of this assessment (Chapter 3), the concept of this assessment (Chapter 4), and the quality of ALPS treated water, etc., the method of discharge, and the overview of the discharge facility (Chapter 5), respectively.

Subsequent chapters 6 and 7 describe the assessment of the radiological environmental impacts on humans and marine plants and animals. Each chapter details the concepts of source term, modeling of diffusion and transfer in seawater, exposure pathways, and establishment of representative persons and reference animals and plants, which are the main components of radiological environmental impact assessment. The results of the sea diffusion simulation indicate that the concentration of radioactive materials exceeds the background level only within a few kilometers of sea area around the FDNPS because the discharged ALPS treated water is quickly advected and diffused by tidal currents, etc. (Details can be found in "the Summary of Evaluation" and chapter 6-1-3.(1) "Diffusion simulation result").

The results of the assessment of the radiological environmental impacts obtained by inhouse and external experts based on the above-mentioned reasonable and conservative assumption indicate that (1) in the case of discharge of ALPS treated water from the seabed approximately 1km offshore from the FDNPS, the foreseeable radiological impact on the people who are most likely to be affected in the vicinity of the discharge point is sufficiently small, that is approximately 1/500,000 to 1/50,000 of Japanese safety standard set according to the international guidelines; (2) the impact on plants and animals inhabiting in 10km x 10km sea area around the FDNPS is only about 1/25,000,000 to 1/1,000,000 of the lower limit of the level proposed by ICRP as the threshold range beyond which there is concern that some impact may occur on the corresponding plants and animals (derived consideration reference level); and (3) the impact on areas far from the discharge point (transboundary impact) was evaluated undetectably low. This indicates that advanced water treatment by ALPS and the discharge plan to effectively

use the period of time required for decommissioning will restrain the impacts on humans and marine plants and animals, and the impacts will be well within Japan's regulatory standard in accordance with the internationally established safety guidelines.

Chapter 8 describes the considerations related to uncertainties in the assessments described above. It concludes that considering uncertainties does not impair the conservatism of the assessment.

Chapter 9 describes the monitoring plan to be implemented in conjunction with the discharge of ALPS treated water into the sea. This includes an enhanced and expanded monitoring plan that includes increased sampling points, target of measurement and frequency. This monitoring plan is regarded as appropriate based on the results of the radiological environmental impact assessment conducted up to Chapter 7.

In preparing this report, TEPCO has invited external experts from domestic institutes and universities to review and obtain comments in three field of human radiation protection, environmental protection, and ocean diffusion calculation.

In November 2021, The assessments in this report were conducted on the based on the information available at the design stage of the plan regarding to the discharge into the sea. In April 2022, this report was reviewed and revised based on the progress of our study, opinions received through the public comment survey, reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority. Subsequently, based on the progress of construction work, the previous reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority, the nuclides to be measured and assessed for the discharge of ALPS treated water into the sea were selected, source terms were reviewed, based on which the assessment was reconsidered as an assessment of the construction stage. TEPCO plans to further review the assessment and revise this report as necessary to reflect the progress of studies on implementation, opinions from various sectors, and the knowledge obtained through cross-checks by third-party assessments, etc. and to reflect in the plan and other necessary items respectively.

Before discharging ALPS treated water, TEPCO will analyze the radionuclides contained in the ALPS treated water which is pre-diluted and publish the results. In addition, during the initial period of the water discharge into the sea, TEPCO will also directly confirm the conditions of mixing and dilution prior to the discharge into the sea, and publish the results. Moreover, for discharge into the sea, the plan is to start the discharge with a small amount of discharge, while monitoring the impact on the surrounding environment, etc. In the unlikely event of a malfunction of the dilution facility due to trouble, power failure, or other reasons, or if any significant difference to the variation range of baseline monitoring is detected by monitoring enhanced and expanded after the start of discharge, TEPCO will stop discharging until it is confirmed that the conditions have been established for safe discharge and will make every effort to ensure the safety of human and marine plants and animals.

Table of Contents

Executive summary	ES-i
Overview of the assessment	Overview-i
1. Background	1
2. Consideration of handling of ALPS treated water	4
3. Objectives of the assessment	7
4. Concept of assessment	8
(1) Dose constraints	8
(2) About tritium	9
(3) Assessment of migration and accumulation of nuclides other than tritium.	10
5. Properties of ALPS treated water, etc. and discharge method	13
5-1. Properties of ALPS treated water, etc	13
5-2. Discharge method	16
5-3. Facilities for discharge	18
5-3-1. Overview of the facilities for discharge	18
5-3-2. Measurement/confirmation facility	20
5-3-3. Transfer facility	22
5-3-4. Dilution facility	24
5-3-5. Discharge facility (related facility)	25
6. Assessment of protection of humans (general public)	29
6-1. Exposure assessment under normal conditions	29
6-1-1. Assessment procedure	29
6-1-2. Assessment method	30
(1) Source term (annual discharge amount of each nuclide)	30
(2) Modeling of diffusion and transfer after discharge	38
(3) Setting of exposure pathways	42
a. External exposure	43
b. Internal exposure	48
(4) Setting of the representative person subject to the exposure assessment.	59
(5) Dose assessment method	63
6-1-3. Assessment result	64
(1) Diffusion simulation result	64
(2) Concentration of each nuclide used for the assessment in the seawater	75
(3) Exposure assessment result	79
6-2. Potential exposure assessment	84
6-2-1. Assessment method	84
(1) Identification and selection of potential exposure scenarios	84
(2) Source term (daily discharge amount of each nuclide)	86

(3)	Modeling of diffusion and transfer, and exposure pathway	94
(4)	Setting of the representative person	97
(5)	Dose assessment method	97
6-2-2	Assessment result	98
(1)	Concentration in the seawater used for the assessment	98
(2)	Exposure assessment result	.103
7.	Assessment regarding environmental protection	.105
7-1.	Concept of assessment	
7-1-1	. Assessment procedure	.105
7-2.	Assessment method	.106
7-2-1	. Source term	.106
7-2-2	Modeling of diffusion and transfer after discharge	.106
(1)	Selection of the migration model	.106
(2)	Assessment of advection and diffusion in the sea area	.106
7-2-3	S. Setting of exposure pathways	.106
7-2-4	Selection of reference plants and animals (organisms to be assessed)	.109
7-2-5		
7-3.	Assessment result	.115
7-3-1	. Concentration in the seawater used for the assessment	.115
7-3-2	Exposure assessment result	.120
8.	Discussion about the uncertainty of the assessment	
8-1.	Uncertainty included in the selection of the source term	
8-1-1		
8-1-2	Uncertainty of analysis (aleatory uncertainty)	.122
8-1-3		
8-2.	Uncertainty of modeling of diffusion and transfer in the environment	.128
8-2-1	. Uncertainty of meteorological and oceanographic data, etc. (aleatory	
	uncertainty)	.128
8-2-2	2. Uncertainty of the simulation model itself (epistemic uncertainty)	.128
8-2-3	B. Uncertainty in the selection of migration pathways (epistemic uncertainty)	.128
8-2-4	. Uncertainty in the concentration factor of seafood and the distribution coefficient	of
	seabed sediment (epistemic uncertainty)	.129
8-3.	Uncertainty in the setting of exposure pathways	.129
8-3-1	. Uncertainty in the selection of exposure pathways (epistemic uncertainty)	.129
8-4.	Uncertainty in the selection of the representative person	.130
8-4-1	. Uncertainty in the actual life of the representative person (aleatory uncertainty)	.130
8-4-2	Uncertainty in the selection of the representative pathway (epistemic uncertainty))130
8-4-3	3. Uncertainty depending on the range of the sea area to be assessed (epistemic	
	uncertainty)	.131
8-5.	Summary about uncertainty	.131

9.	Monitoring to be performed in response to discharge of ALPS treated water into the		
	sea	133	
9-1.	Analytical capability in the Fukushima Daiichi Nuclear Power Station	133	
9-1-1	. Analytical capability in terms of facilities	133	
9-1-2	. Analytical capability in terms of competence	135	
9-1-3	Our management and supervision	138	
9-2.	Monitoring within the premises of the Fukushima Daiichi Nuclear Power Station \dots	140	
9-2-1	. Source monitoring	141	
9-2-2	. Monitoring at the discharge vertical shaft (upper-stream storage)	147	
9-2-3	. Monitoring in seawater piping	149	
9-3.	Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station	า 151	
9-3-1	. Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by		
	TEPCO	152	
9-3-2	. Monitoring by the government and Fukushima prefecture	159	
(1)	Previous sea area monitoring performed by the government and Fukushima	159	
a.	Seawater	159	
b.	Seabed sediment	160	
C.	Marine organisms	160	
(2)	Sea area monitoring enhanced and expanded by the government in response to		
	discharge of ALPS treated water	160	
a.	Seawater	160	
b.	Marine biota	162	
(3)	Seawater monitoring enhanced and expanded by Fukushima prefecture in respons	se	
	to discharge of ALPS treated water	164	
(4)	Cooperation with the IAEA for sea area monitoring by the government and IAEA		
	marine monitoring	166	
9-4.	Actions to be taken in case of abnormalities	167	
9-5.	Summary of monitoring	168	
10.	Summary	169	
Refer	ences	170	
Term	s	172	
Prens	aration member	174	

Attachment

Attachment I Rationale behind the selection of nuclides subject to be measured and assesed for discharge of ALPS treated water into the sea Attachment II Properties of ALPS treated water, etc. Attachment III Impact of the organically bound tritium in the exposure assessment of tritium Attachment IV Analysis on the period of discharge of ALPS treated water Attachment V Impacts of intake and discharge of diluted water on outside Attachment VI Transfer pathways and exposure pathways Attachment VII Validity of the diffusion simulation Attachment VIII Difference in the diffusion area by discharge location Attachment IX Contribution to the undetected nuclides in the source term based on the measured value

Attachment X Breakdown of the exposure assessment result by nuclide

Attachment XI Conservativeness of the external exposure dose conversion factor (Comparison

with the dose conversion factor of FGR-15)

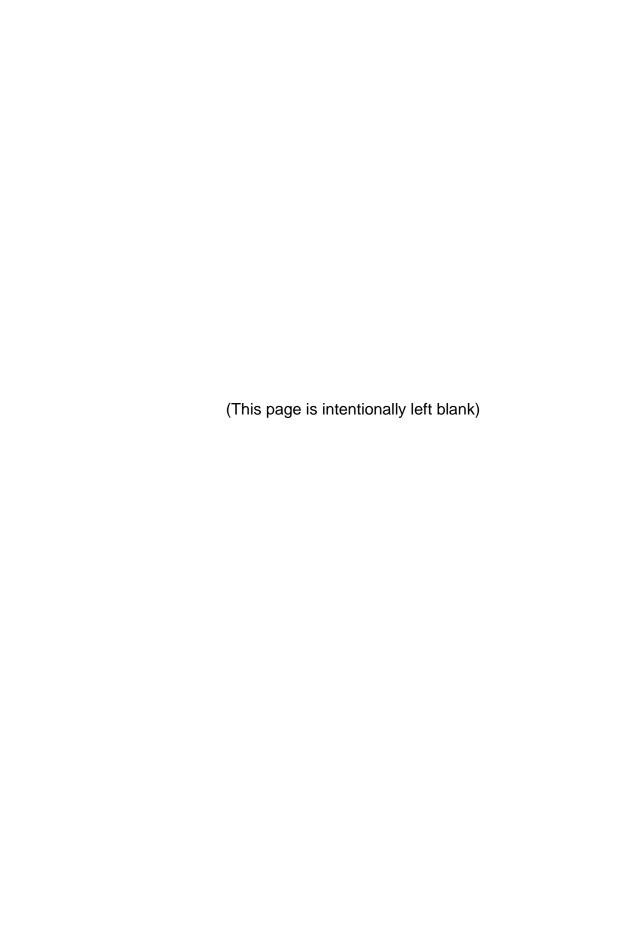
Attachment XII Impact of the assessment range of concentrations in seawater used for the

assessment of exposures

Attachment XIII Application of uncertainty in the analysis of ALPS treated water

References

Reference A	Site boundary dose assessment of Fukushima Daiichi and the regulatory concentration limit in the Japanese laws
Reference B	Timeline of consideration of each disposal method of ALPS treated water
Reference C	Setting of previous management values and exposure assessment of hypothetical ALPS treated water
Reference D	Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water
Reference E	State of consultation with domestic and foreign stakeholders
Reference F	Rationale behind the selection of nuclides subject to removal by ALPS
Reference G	Annual discharge limit and optimization estimation results for individual nuclide based on dose constraint



Overview of the assessment

We conducted the dose assessment for humans in respect of the planned discharge, as described in the IAEA safety standard document GSG-9 "Regulatory Control of Radioactive Discharges to the Environment" [1] (hereinafter called "GSG-9") as well as conducted the dose assessment of potential exposure¹ and environmental protection, which is out of scope of the assessment under GSG-9, based on the current consideration of the discharge method of ALPS treated water into the sea. The specific procedure of the assessment follows the IAEA safety standard document GSG-10 "Prospective Radiological Environmental Impact Assessment for Facilities and Activities" [2] (hereinafter called "GSG-10"). The result of this assessment finds that advanced water treatment by ALPS and the discharge plan that effectively utilizes the decade-long decommissioning period will restrain the impact of discharge of ALPS treated water into the sea on humans and marine plants and animals, and will keep within the domestic safety standard determined in accordance with the internationally established safety guidelines.

In compiling this report, in-house experts with knowledge on the radiological environmental impact assessments were selected and assigned, and external experts were invited as members to submit their opinions in three fields of human radiation protection, environmental protection, and marine diffusion calculation.

In this report, the contents conducted by the government on handling of ALPS treated water and enhancement and expansion of future monitoring are also taken into account.

Assessment of radioactive nuclides and diffusion

The nuclides to be assessed are a total of 31 nuclides including tritium (H-3) and carbon 14 (C-14) (for the rationale behind the procedure to estimate radioactive materials contained in contaminated water and select 30 nuclides other than tritium as nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea, see Attachment I "Rationale behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea"). The nuclide composition of ALPS treated water differs for each tank groups² depending on the composition and concentrations of radioactive materials in contaminated water before treatment, and lifetime of each adsorbent at the time of treatment in ALPS, etc. Therefore, the nuclide compositions of ALPS treated water used for the assessment were the nuclide compositions of the three tank groups in which measurement and assessment of 62 nuclides subject to removal by ALPS, tritium, and

¹ Potential exposure: Exposure caused by possible events in operation or events or possible events sequences including accidents of radiation sources or failures and operation mistakes of equipment. It was considered for the future.

² Multiple tank groups used in connection. Usually, 1 tank group consists of about 8 to 10 tanks.

carbon 14 had actually been completed, plus analysis results such as Se-79 (for details, see 6-1-2.(1)).

According to the Japanese regulatory standard based on the internationally recognized guidelines specified by ICRP [3], it is stipulated that that the sum of the ratios of concentrations to the regulatory concentration limits³, which are the regulatory standards, (hereinafter called "the sum of the ratios to regulatory concentrations limits"⁴) should be less than 1 after dilution with a large amount of seawater at the discharging point. However, we have decided to minimize the amount of radioactive materials discharged into the environment as possible by appropriately treating nuclides other than tritium using water treatment facilities including ALPS, and reducing the sum of the ratios to regulatory concentrations limits less than 1 before dilution. In other words, we will not only confirm that the results of the individual assessments of radioactive nuclides such as cesium 137 (Cs-137) and iodine 129 (I-129) are below the regulatory standards, but also manage to ensure never to exceed the regulatory standards even when the overall effect of the overlapping effects of all those multiple radionuclides is taken into account.

Tritium is an isotope of hydrogen. In most cases, it exists as the molecule, which is one of the two hydrogen atoms in normal water molecule (H₂O) replaced by one tritium atom (HTO in chemical formula). The tritium concentration in the water stored in the tanks exceeds 60,000 Becquerel⁵ (Bq)/L, which is the regulatory standard value (regulatory concentration limit), even after treatment by ALPS, etc., and tritium is almost impossible to remove, so the water shall be diluted until it meets the regulatory standard. In addition to strict compliance with regulatory standards to protect the public, the government required us to ensure that the tritium concentration of ALPS treated water at the point of discharge does not exceed 1,500Bq/L⁶, which is much sufficiently lower compared to the level of regulatory concentration limit, in order to dispel any concerns of consumers and others and to control reputational effects to the maximum extent possible. In "TEPCO Holdings' Action in Response to Government's Policy on the Handling of the ALPS Treated Water from the Fukushima Daiichi Nuclear Power Station" (hereinafter called "TEPCO's Action in response

limit every day all their life (for 70 years in the case of an adult), the annual exposure dose will be 1 mSv/year.

³ The regulatory concentration limit is the standard of discharge of radioactive waste into the sea set for each radioactive nuclide in "Pronouncement which set the dose limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials." If a person drinks 2L of water equivalent to the regulatory concentration

⁴ Sum of the ratios to the regulatory concentration limits [34], which are legal concentration limits specified for each nuclide in the case that multiple radioactive materials, are contained. If multiple radioactive materials are contained, the sum of the ratio to the concentrations to the regulatory concentration limit specified for each nuclide by laws must be less than 1.

⁵ Unit indicating the amount of radiation. Becquerel is the number of nuclei whose radioactive nuclide changes into another one by radioactive disintegration in one second.

⁶ It is set to the same value as the operation target value of the discharge concentration of the groundwater bypass and subdrain, through which water has been discharged. This value has been described in "Implementation plan III 3.2.1 Management of radioactive waste, etc." and permitted by the Nuclear Regulation Authority.

The tritium concentration of 1,500Bq/L is 1/40 of the regulatory concentration limit of 60,000Bq/L and about 1/7 of 10,000Bq/L, which is the WHO Guidelines for Drinking Water Quality.

to Government's Policy,") we stipulated that we shall keep the tritium concentration in the discharged water less than 1,500Bq/L and set the upper limit of the annual discharge amount 22 TBq⁷ (2.2E+13Bq)⁸. To keep the tritium concentration in the discharged water less than 1,500Bq/L, the ALPS treated water shall be diluted with seawater at least 100 times or more (at most 1,400 times or more considering the maximum measured tritium concentration of approximately 2.16 million Bq/L in the water stored in the tank measured so far) before discharge.

The concentration of nuclides other than tritium in the ALPS treated water is already below the regulatory standard even before the dilution. The concentration will be further reduced by dilution with seawater. Therefore, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium in discharged water after seawater dilution is less than 0.01, and the impact of radiation will be further reduced (for details, see 5-2).

The diffusion calculation for the discharged water into the sea area was executed by the model of the sea area near the FDNPS using a high resolution, based on the model [4] whose reproducibility had been verified by the reproduction calculation of the cesium concentration in the seawater after the accident of the FDNPS (for details, see 6-1-2.(2)). For the assessment, only the radiation amount per unit time of tritium released (flow rate and concentration are not considered) is used in the diffusion calculations. Therefore, the effect of dilution is not considered in this assessment.

In this assessment, the concentration of radioactive materials in seawater does not take into account the decrease in dissolved concentration through absorbance of radionuclides to seabed and other materials. On the other hand, the concentration of radionuclides in fish, shellfish and seabed sediment assumed to be in equilibrium with the concentration in seawater after the adsorption, etc. (no further adsorption occurs). Also it is assessed using concentration coefficient and concentration ratio including the impact to the food chain. In reality, it takes a long period of time for radionuclides in seawater, fish and shellfish and seabed sediment to reach an equilibrium, however by using conservative assumptions mentioned above, this model verifies that there is no further increase in exposure to humans, fish and shellfish even if the discharge continues for a long time. This assessment actually verified the impact for a year of discharge of ALPS treated water, and it can also verify accumulation of radioactive materials in the environment for long term discharge (For details, see 4.(3)).

⁷ Target discharge control value of the FDNPS before the accident.

⁸ E+XX means the XXth power of 10. 2.2E+13 indicates 2.2×10¹³.

Human exposure pathways

In the setting of exposure pathways, they are roughly divided into external exposures and internal exposures. In line with previous practice, etc.9, external exposures were assessed assuming the following five pathways: (1) external exposure from the sea surface, (2) external exposure from ship hulls, (3) external exposure under water during swimming, etc., (4) external exposure from beach sands, and (5) external exposure from fishing nets. Internal exposure was assessed assuming the following three pathways: (6) internal exposure from ingestion of seawater, (7) internal exposure from inhalation of seawater spray, and (8) internal exposure from ingestion of seafood (for details, see 6-1-2.(3)).

The exposure pathway to human is set with an assumption of a representative person in vicinity of the discharge point who are considered most affective. For the living habits and characteristics of the representative person for some exposure pathways should be used the highest group (e.g. 95 percentile value) from some lifestyle data distribution, etc. However, in considering current situation around FDNPS, we have instead assumed the representative persons are engaged in fishing for 120 days a year (2,880 hours), of which they work near fishing nets for 80 days (1,920 hours), stay on the seashore for 500 hours, and swim for 96 hours, according to "Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities" [5]. Following the preconditions, the ingestion amount of seafood was investigated for two cases based on the ingestion amount data from "National Health and Nutrition Survey in Japan in 2019" [6] for each of (1) person who ingest an average amount of seafood and (2) person who ingest more seafood than average (one fifth of the amount of an adult for an infant, and half of the amount of an adult for child under school age) (for details, see 6-1-2.(4)).

The result of the assessments was compared with the dose limit¹⁰ of 1mSv/year for the general public, and the dose constraint¹¹ of 0.05 mSv/year established by the Nuclear Regulation Authority, and the sum of internal and external exposure was below both the public dose limit and the dose constraint in all cases¹². The dose limit of 1 mSv/year is the internationally recognized standard of public exposure (for details, see 6-1-3).

⁹ Handbook for Determining Environmental Impacts of Decommissioning Work, etc. For details, see Chapter 6.

¹⁰ Dose limit: Effective dose or equivalent dose to a person which must not be exceeded in the planned exposure situation (GSR Part 3).

¹¹ Dose constraint: Predictive value of individual dose related to radiation sources used as a parameter for the optimization of protection and safety at the radiation source in planned exposure situation. It is useful as the boundary for setting of the range of options in optimization. For public exposure, this is a value related to the radiation source established or approved by the government or regulatory body considering the dose from planned handling of all radiation sources under control (GSR Part 3).

¹² The dose limit is the limit for the total of the exposure amount of an individual from all related acts subject to the regulations. The dose constraint is used as the limit value of the dose from a specific radiation source related to a planned act.

In addition, the potential exposure assessment based on the IAEA safety standard¹³, which was also conducted, assumed that (1) in case of leakage from the piping, a piping rupture occurs near the ocean and all the ALPS Treated Water about 10,000 m3 in one group of tanks at the facility for measurement and confirmation of water is discharged from north breakwater into the ocean for 20days without being diluted, as well as (2) the case of massive leakage from tanks, all three groups of tanks for measurement and confirmation are damaged simultaneously due to great earthquake, etc. and of 30,000 m³ of ALPS treated water is discharged into the sea in a single day. In this case, the migration pathways and exposure pathways of this case shall be the same as for normal exposure excluding for the discharge location near the north breakwater. The exposure time of leakage from piping is conservatively set to about one month (27 days), and about one week (8 days) in the case of huge earthquake. As a result, even in such cases, the effective dose of potential exposure was significantly smaller compared to the standard of the accident assessment shown in the IAEA safety standard¹³ (for details, see 6-2).

Impact on marine plants and animals

As the assessment of environmental protection, we also assessed the protection of plants and animals during normal operation of the facility for discharging ALPS treated water according to the procedure shown in Annex I of the IAEA safety standard¹³. As the composition of nuclides in ALPS treated water used in the assessment, three cases based on the measured values were adopted in the same way as the human exposure assessment. As the plants and animals to be assessed, the standard flatfish (left-eyed and right-eyed flounders), the standard crabs (Ovalipes punctatus and Portunus trituberculatus) and the standard brown seaweeds (sargassum and Eisenia bicyclis) were selected from the list of standard animals and plants¹⁴ indicated by the guideline of ICRP. The dose was assessed by the method shown by ICRP and the dose rate in the habitat of the standard animals and plants was compared with the derived consideration reference level (DCRL)¹⁵. As a result, all dose rates in the habitats of the standard animals and plants are much less than the lower limit value of the derived consideration reference level (for details, see Chapter 7). Just for a precaution, the evaluation results of environmental impact from the factors other than radioactive materials from the ALPS treated water reveal that there is no severe pollution or no serious and hazardous changes to the environment (for details, see

¹⁴ Standard animals and plants: Specific types of animals and plants assumed in order to associate radiation exposure from the environment with the dose and impact.

¹⁵ Derived consideration reference level (DCRL): Range of the dose rates within a range of one digit specified for each species advocated by ICRP. Dose rate level at which the impact has to be considered if is exceeded.

Reference D "Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water").

Changes in response to new information and the result of monitoring

The assessment described in this report was conducted based on the information available in November 2021 at this point in time during the design stage of the plan for discharge into the sea. In April 2022, it waswas revised based on the assessment reflecting the comments received from the public, comments pointed out by the Nuclear Regulation Authority, the findings of review by the IAEA, etc. Subsequently, based on the progress of construction work, the previous reviews by the IAEA experts, and discussions with the Nuclear Regulation Authority, the nuclides to be measured and assessed for the discharge of ALPS treated water into the sea were selected, source terms were reviewed, based on which assessment was reconsidered as an assessment of the construction stage. We are planning to revise this report further in order to reflect findings obtained through consideration of operation associated with the plan, opinions from various sectors, reviews by experts of the IAEA, cross-checks by third-party assessments, etc., and to modify the planned discharge program and its implementation as necessary.

Before discharging ALPS treated water, we will analyze the radionuclides contained in the ALPS treated water before dilution, and publish the results. In addition, during the initial period of the water discharge into the sea, we will also directly confirm the conditions of mixing and dilution before discharge into the sea and publish the results. Moreover, for discharge into the sea, TEPCO will carefully start the discharge with a small amount while monitoring the impact on the surrounding environment, etc. In case that the dilution facility fails due to malfunction, power failure, or other reasons, or if any significant difference to the variation range of baseline monitoring is detected by monitoring after the start of discharge, TEPCO will stop discharge until it is confirmed that the conditions for safe discharge of the ALPS treated water have been securely re-established, and make every effort to ensure the safety of human and marine plants and animals.

This report concludes that the result of the assessment according to internationally recognized documents shows that exposure from radioactive materials contained in ALPS treated water discharged from the FDNPS is sufficiently lower than the dose limit, the dose constraint and the derived consideration reference level.

Background

At the FDNPS, which experienced an unprecedented accident in the event of the Great East Japan Earthquake in 2011, it has been continued to inject of cooling water into the reactor in order to cool the damaged reactor and nuclear fuel since the accident. The injected water contacts so-called fuel debris, which is fuel overheated, damaged, and molten in the event of the accident, and then solidified together with surrounding structures, passes through the reactor pressure vessel and reactor containment vessel damaged by the accident, and finally got stagnant on the lowest floor of the reactor building as building stagnant water (hereinafter called "stagnant water"). According to the previous investigation, it has turned out that stagnant water contains damaged fuel and structures of reactor core due to the damage in the event of the accident, or a high volume of water-derived radioactive materials, which are reactor coolants. From the viewpoint of prevention of diffusion of radioactive materials into the environment, it is especially necessary to prevent leakage of stagnant water outside the building.

On the other hand, seawater entered the basement floor of the building due to the tsunami, which was the direct cause of the accident, and then became stagnant water. In addition, rainwater has been entering the building through the ceiling damaged due to debris scattered by the hydrogen explosion of the reactor buildings that occurred in Units 1, 3, and 4 in the event of the accident. Moreover, the underground water level around the building is kept a little higher than the stagnant water level to prevent leakage of stagnant water mentioned above, which cause a little amount of groundwater to enter the building. It is considered that all of such water is mixed with the cooling water mentioned above and becomes new contaminated water.

Currently, by multilayered countermeasures¹⁶, we manage to prevent leakage of contaminated water out of the building and also reduce the daily generated amount from about 540 m³ (as of May 2014) to about 130 m³ (as of 2021), and we are aiming to further reduce the daily generated amount to less than 100 m³ by 2025. The contaminated water which will be generated in future must be treated in the same way and discharged appropriately.

¹⁶ Examples of multilayered countermeasures:

a To reduce the generated amount of contaminated water, contaminated water pumped and purified by the cesium adsorption device and desalinated by the reverse osmosis membrane device is reused as cooling water used to cool the nuclear fuel damaged by the accident.

b In addition, the amount of groundwater entering the building is controlled. Specifically, the groundwater level near the building is kept low by pumping groundwater from uplands and the area adjacent to the building, installing land-side impermeable walls (frozen soil walls) around the building, etc.

To prevent leakage of contaminated water generated in the building to outside the system, the contaminated water level in the building is kept a little lower than the groundwater level outside the building by pumping contaminated water in the building.

d Pumped contaminated water is stored in tanks installed on uplands after treatment by water treatment facilities which consist of the cesium adsorption device, ALPS, etc., in order to prevent contamination and reduce the dose.

Contaminated water is purified by the cesium adsorption equipments¹⁷ and ALPS, which can remove 62 nuclides, and stored in tanks on the site. ALPS treatment makes the sum of the ratios to regulatory concentrations limits of nuclides other than tritium less than 1 (water in which the sum of the ratios to regulatory concentrations limits of nuclides other than tritium is less than 1 is called "ALPS treated water." Water in which the sum of the ratios to regulatory concentrations limits is not less than 1 even after treatment is called "treated water to be purified." "ALPS treated water" and "treated water to be purified" are collectively called "ALPS treated water, etc.") (See Reference A "Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws"). As of October 2022, there are 1 066 tanks that store strontium treated water (water before ALPS treatment)¹⁸ and ALPS treated water, etc., and the stored amount is about 1.32 million m³, while the capacity is about 1.37 million m³. Although it is necessary to carefully examine the effect of the measures to control the generation of contaminated water and prediction of the amount of contaminated water generated, the planned capacity is expected to reach after the summer of 2023.

As shown in "Mid- to Long-Term Roadmap towards Decommissioning of the Fukushima Daiichi Nuclear Power Station" [7] revised by the government at the ministerial meeting on decommissioning and contaminated water measures (current "the ministerial meeting on decommissioning, contaminated water and treated water measures") in December, 2019, decommissioning at the FDNPS is a continuous risk reduction activity to protect people and the environment from risks associated with radioactive materials manifested by the accident. In the long-term process toward decommissioning of the FDNPS for several decades, it is necessary to deal with the issues with greater radiation risks such as extraction of fuel debris and securing temporary storage locations of spent fuel, and it is essential to steadily reduce total risks from medium- to long-term viewpoints in order to appropriately deal with these issues.

The requirement to reduce the overall risks with the view of medium- to long-term views is the same in handling the contaminated water problem. So far, we have been steadily reducing the risks to the dose of less than 1 mSv/year, which is the dose limit for general public recommended by the ICRP in Publication 60 issued in 1990, for additional exposure dose associated with decommissioning on the site boundary by controlling the amount of contaminated water generated containing large amount of radioactive materials through so-called multi-layered countermeasures, and by removing radioactive materials contained in contaminated water through water treatment facilities including ALPS. In order to safely and steadily proceed with the decades-long decommissioning, storing ALPS treated water, etc. for long time is not practical (for details, see Reference B "Timeline of consideration of each

¹⁷ Equipments to purify contaminated water by adsorbing cesium and strontium.

Water with most of the cesium and strontium removed before purification by ALPS.

disposal method of ALPS treated water"), it is necessary to continue to steadily reduce overall risk at the FDNPS by removing as much radioactive material as possible using water treatment facilities including ALPS, implementing discharge in a safe manner that does not substantially affect humans and plants and animals, and appropriately storing spent fuels in temporary storage in dry cask to be installed in the future.

2. Consideration of handling of ALPS treated water

The details are as described in Reference B "Timeline of consideration of each disposal method of ALPS treated water," the method of handling of contaminated water and ALPS treated water, etc., has been discussed for several years initially with the Ministerial Conference of Contaminated Water, Treated Water and Decommissioning issues, the government, the IAEA, municipal administrations, local residents and experts. In 2013, the government established the Tritiated Water Taskforce under the Committee on Countermeasures for Contaminated Water Treatment, with participation of nine members of experts from the fields such as nuclear, environmental science, radiology, radiation biology, fish chemistry in addition to members from Nuclear Regulation Authority and related ministries. The Taskforce conducted technical studies on the five disposal methods (geosphere injection, discharge into the sea, vapor release, hydrogen release, and underground burial), which were proposed based on the scientific knowledge on tritium and the preceding cases [8]¹⁹. In addition, since 2016, the Sub-committee on Handling of ALPS Treated Water has been established with 13 members of experts from the fields of such as nuclear, geological engineering, sociology, environmental science, agriculture, radiation biology, radiation science, fish chemistry as well as members from related ministries, to conduct a comprehensive deliberations, including social viewpoints such as reputation damage based on the results of the Tritiated Water Taskforce [9]. The Sub-committee on Handling ALPS Treated Water compiled the report in February 2020, in which it examined five disposal methods from various perspective, including monitoring feasibility. The Subcommittee then stated that the methods of geosphere injection, hydrogen release and underground burial have many issues as realistic option in terms of regulatory, technology and time schedule, while the methods of the discharge into the sea and the vapor release are considered as more realistic options. The conclusion was that in comparison to the vapor release, the method of the water discharge into the sea has already established regarding the amount of release. Furthermore, the ease of handling of discharge facilities and the way of monitoring should be conducted. In accordance with these reasons, the Sub-committee also pointed out the limited room for expansion of tanks for long-term storage and the increased risk of leakage due to natural disasters and deterioration, and concluded that discharge of ALPS treated water into the sea ensure the steady implementation. In addition, the Government of Japan has Hosted the decommissioning review missions by the IAEA five times from 2013 to 2021 and has incorporated their opinions into considerations. The decommissioning review missions by the IAEA have pointed out the importance of the disposal plan for ALPS treated water. In the IAEA's report in 2015, IAEA assessed that storage in tanks was "at best a temporary measure while a more sustainable

¹⁹ Discussion on continuation of tank storage was included.

solution was needed²⁰." Subsequently, in the IAEA's report in 2019, it was stated that "a decision on the disposition path for the stored ALPS treated water containing tritium and other radionuclides, after further treatment as needed, must be taken urgently²¹." In addition, in the report of the IAEA following-up review for the progress decommissioning of FDNPS in 2020, also assessed the technical aspects of the report of the Sub-committee, as being "based on a sufficiently comprehensive analysis and sound scientific and technical basis²²."

Moreover, after the report was compiled in the Sub-committee on the Handling of ALPS Treated Water, the government held the Meeting to hear the Opinions of Related Parties on the Handling of ALPS Treated Water and widely solicited for opinions including those in writing. As a result, among the submitted opinions, some expressed concerns about the impact of discharge of ALPS treated water into the sea on the surrounding environment, etc. Based on these considerations and opinions, the government announced the Basic Policy to handling ALPS treated water into the sea upon securing the safety as "Basic Policy on handling of ALPS treated water at the Tokyo Electric Power Company Holdings' Fukushima Daiichi Nuclear Power Station" (April 13, 2021, the Ministerial Conference of Contaminated Water, Treated Water and Decommissioning, hereinafter called "Basic Policy") [10]. Considering the Basic Policy, on April 16th of the same year, we announced "TEPCO's Action in response to Government's Policy" [11] which include the following approach:

- Regarding the discharge of the ALPS treated water into the sea, we will ensure the
 safety of the public, surrounding environment as well as agricultural, forestry and fishery
 products through compliance with safety standards based on relevant laws and
 legislations. We will take further measures based on international standards and
 practices to confirm the safety of the water to be discharged.
 - To ensure the safety of the public and surrounding environment, we will surely comply with regulatory standards and relevant laws for concentration of tritium and other radioactive materials in the water to be discharged, which are set based on international recognized methods (e.g. International Commission on Radiological Protection (ICRP) publication).
 - With regard to the radiological impact of the discharge on the humans and the environment under the condition indicated in the Basic Policy and international recognized method, we will assess its safety and publish the results prior to starting

5

Mission Report, IAEA International Peer Review Mission on Mid-And-Long-Term Roadmap Towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station Units 1-4, issued 13 May, 2015, p. 13, https://www.iaea.org/sites/default/files/missionreport130515.pdf

Mission Report, IAEA International Peer Review Mission on Mid-And-Long-Term Roadmap Towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station Units 1-4, issued 31 January, 2019, p. 8, https://www.iaea.org/sites/default/files/19/01/missionreport-310119.pdf

Review Report IAEA Follow-up Review of Progress Made on Management of ALPS Treated Water and the Report of the Subcommittee on Handling of ALPS treated water at TEPCO's Fukushima Daiichi Nuclear Power Station, issued 2 April, 2020, p. 6, https://www.meti.go.jp/press/2020/04/20200402002/20200402002-2.pdf

the necessary procedure for approval by Nuclear Regulation Authority. Additionally, we will receive reviews by experts such as those of International Atomic Energy Agency (IAEA) and others. (The original report was issued in November 2021. We will publish the results including this revision and continue to receive reviews by experts of IAEA, etc.)

3. Objectives of the assessment

The objective of this Radiological Environmental Impact Assessment is as follows.

- Objective 1: Evaluate the impact of radiation on humans and the environment in the case of our disposal of ALPS treated water by the internationally recognized method (IAEA safety standard and ICRP recommendation).
- Objective 2: Announce the result of the assessment inside and outside Japan and consider the method to minimize the risks associated with disposal by making revisions, etc., as needed considering opinions from related parties.

4. Concept of assessment

This report was drafted assuming a dose assessment of the representative person by planned discharge shown in GSG-9, but the specific assessment method was based on GSG-10 and we also assessed potential exposure and environmental protection, which is not required in GSG-9.

The following shows the concepts of the assumptions in the assessment and the evaluation method.

(1) Dose constraints

The Japanese nuclear regulation system does not specifically set any dose constraints²³ and instead sets a target dose value of 0.05 mSv/year for the general public outside the surrounding monitoring area of light water reactor for power generation in normal operation.

On February 16, 2022, the Nuclear Regulation Authority issued the "Concept and Assessment Guidelines for Verifications in the Radiological Impact Assessment," which says that "it must be verified that the estimated result of the representative person is small when compared to the fluctuation range of the annual radiation dose in humans in the region are exposed to through their living habits, etc., that is less than 50 µSv/year. The value of 50 µSv/year is the target dose for commercial light water reactors in normal operation, which corresponds to the dose constraint set in the IAEA Safety Standards." [12]. In this assessment, "Determine appropriate constraints" in GSG-9 Fig.3, "Steps in setting discharge limits, indicating those responsible." corresponds to it and the target dose value of $50\mu Sv/year = 0.05mSv/year$ as the dose constraint value. However, the annual total amount of tritium contained in ALPS treated water actually discharged into the sea was specified in the Basic Policy of the Government of Japan before the assessment by this report, etc., in order to keep it below the discharge control value of 22 TBq/year (2.2E+13Bq/year) of the FDNPS before the accident from the viewpoints of various factors, such as the risk optimization of the whole of decommissioning, the effect of natural decay of radioactive materials expected during land storage of ALPS treated water, the leakage risk and occupational exposure during long-term storage, the plan to complete disposal of ALPS treated water before the completion of decommissioning, and the policy to dispel even little of the concerns of stakeholders. As shown in "TEPCO's Action in response to Government's Policy" (April 2021) above, we set the annual discharge amount of tritium to 22 TBq/year (2.2E+13Bq/year) as an evaluation condition of this report and assessed the radiological environmental impact.

The relationship between the dose constraint and the annual discharge amount of tritium of 22 TBq/year (2.2E+13Bq/year) is discussed in 6-1-3.

²³ See footnote No.12.

(2) About tritium

A part of tritiated water (HTO) is converted to organically bound tritium (OBT) by plants and animals, etc., in the environment.

The following shows the effective dose factor in the case of ingestion of tritium [13].

Tritiated water 1.8E-11 Sv/Bq
OBT 4.2E-11 Sv/Bq

The effective dose factor of tritiated water reflects conversion of a part of tritium to OBT in the body after a human ingests tritium. As shown in Table II-9-1 and II-9-2 in chapter II-6 "Water quality other than radioactive materials" of Attachment II "Properties of ALPS treated water, etc.," the ALPS treated water to be discharged contains almost no organic matter and almost the whole of it is considered to be tritiated water when discharged, so the case of directly drinking seawater or inhaling seawater spray is assessed by the effective dose factor of tritiated water.

On the other hand, as with humans, a part of tritiated water is converted to OBT when ingested by plants and animals. If OBT is ingested directly through seafood, etc., the effective dose factor of OBT is applied, so for the ingestion of seafood, the effective dose factor is used after correction assuming that 10% of tritium ingested is OBT. Specifically, we used adult: 2.0E-11Sv/Bq, child under school age: 3.5E-11Sv/Bq, and infant: 7.0E-11Sv/Bq as the corrected effective dose coefficient of tritium for the exposure assessment of ingestion of seafood.

In monitoring of fish, we performed near the FDNPS, no OBT was detected and no event of concentration of tritium compared with the tritium concentration in the seawater in the surrounding area was observed. In addition, there is a general understanding that no evidence for biological concentration of OBT from HTO has been found in international studies [14]²⁴.

For example, "Tritium and the environment," which was issued by Institute for Radiological Protection and Nuclear Safety in France in 2012 [14] says "To date, no phenomenon of tritium bioaccumulation has been observed in marine organisms on the French Channel coast. This observation leads to the conclusion that discharge from nuclear industry, led by the spent fuel processing plant in La Hague, are overwhelmingly in the form of HTO."

For OBT, see Attachment III "Impact of the organically bound tritium in the exposure assessment of tritium."

(3) Assessment of migration and accumulation of nuclides other than tritium

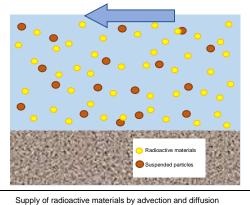
The assessment of this report assumed that nuclides other than tritium was advected and diffused while dissolved in the seawater. A part of discharged nuclides is adsorbed to suspended particles in the seawater, seabed sediment, hulls, beach sand, and fishing nets, or advected or concentrated in marine organisms depending on the chemical forms of radioactive materials, etc., so the disposition in the environment is assumed not to be the same as that of tritium. As for this trend, the higher the distribution factor to seabed sediment, etc., or biological concentration factor the element has, the more significant the concentration decrease in the seawater side and the concentration increase in the soil and organism side may become because of more significant migration from the seawater to the soil and organisms.

However, ALPS treated water to be discharged is purified by coagulating sedimentation, adsorption, filtration, etc., and contains almost no impurities, so even if it is adsorbed to suspended particles, it will be unlikely that a lot of sediment is generated, and only a limited amount of seawater directly contacts the seabed sediment, etc., which means that initially the amount of radioactive materials adsorbed to seabed sediment is much smaller than the total amount of discharged radioactive materials. Therefore, while the decrease in the concentration in the seawater caused by adsorption to the seabed sediment in diffusion is not considered from the viewpoint of model simplification, considerations have been made so that such differences in the disposition in the environment need not be considered, by assuming that adsorption has proceeded until the concentration in the seawater reaches the equilibrium state as for adsorption to seabed sediment, etc., and biological concentration, which proceeds in the long term in reality, and setting both of them conservatively. This is shown in Figure 4-1.

For advection and diffusion in the sea, we also verified that annual variation was small, by simulated calculation of seven years

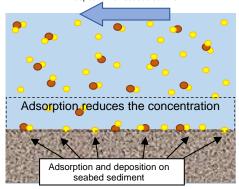
Thanks to these considerations, we can assess accumulation of radioactive materials in the environment due to long-term discharge, though this assessment is performed for just one year. Thus, the peak dose value is considered not higher than the value in this assessment.

In this report, although the source term was revised, there is no need to change the concept of advection and dispersion of radioactive materials.



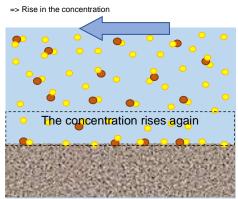
If discharge into the sea starts, advection and diffusion of radioactive materials discharged from the discharge outlet supplies radioactive materials, which increases the concentration in the seawater.

=> Adsorption to suspended particles and adsorption and deposition on seabed sediment

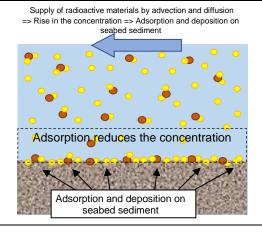


Due to a rise in the concentration, some of the supplied radioactive materials are adsorbed to seabed sediment, suspended particles, etc. As a result, the radioactive material concentration in the seawater drops and the radioactive material concentrations in seabed sediment, suspended particles, etc., rises and reaches the equilibrium states depending on the distribution factors.

Supply of radioactive materials by advection and diffusion => Rise in the concentration



Then, more radioactive materials are discharged and the radioactive material concentration in the seawater



Some of the radioactive materials are adsorbed near seabed sediment, suspended particles, etc., the concentration in the seawater side drops, and the concentrations in seabed sediment and suspended particles rises and reaches equilibrium. Long-term repetition of this process raises the radioactive material concentrations in seabed sediment, suspended particles, etc., as well as the radioactive material concentration in the seawater, which reaches the equilibrium state.

Accumulation process in seabed sediment, etc. in actual phenomena

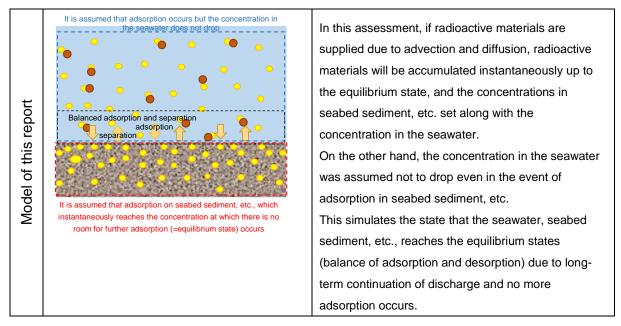


Figure 4-1 Actual accumulation process in seabed sediment, etc., and model in this report (image)

5. Properties of ALPS treated water, etc. and discharge method

5-1. Properties of ALPS treated water, etc.

ALPS treated water, etc., of about 1.28 million m³ currently stored in tanks is water purified by ALPS (excluding strontium treated water), which is designed to be able to remove 62 nuclides excluding tritium and C-14 among the radioactive nuclides contained in contaminated water. Contaminated water newly generated during the period of discharge into the sea has to be treated appropriately by ALPS, etc., in the same manner and discharged into the sea. The rationale behind the selection of 62 nuclides subject to removal by ALPS is shown in Reference F "Rationale behind the selection of nuclides subject to removal by ALPS" and the mechanism to remove radioactive materials from contaminated water is shown in Attachment II "Properties of ALPS treated water, etc."

ALPS can purify 62 radioactive materials other than tritium and C-14 up to less than 1 of sum of the ratios to regulatory concentrations limits, but about 70% of ALPS treated water (based on the breakdown of the tank groups fully filled with water by December 31, 2019) is so-called "treated water to be purified," which contains more radioactive materials other than tritium than the standard applicable to discharge into the environment (sum of the ratios to regulatory concentrations limits of less than 1) due to the treatment before performance improvement in the early stage of the treatment plan, priority on the treatment amount for reduction of additional exposure dose on the site boundary, etc. Such treated water to be purified, which is yet to be purified sufficiently, is surely purified until the sum of the ratios to regulatory concentrations limits of radioactive materials other than tritium becomes less than 1 before discharge (secondary treatment) and then discharged as ALPS treated water. Table 5-1-1 shows the regulatory concentration limit of tritium, C-14, and 62 nuclides subject to removal by ALPS.

As for the secondary treatment by ALPS, we conducted a secondary treatment performance verification test for a total of 2,000 m³ of two tank groups since September 2020 and verified that the sum of the ratios to regulatory concentrations limits of nuclides excluding tritium in each tank group can be reduced to less than 1 [15]. The water quality of ALPS treated water, etc., including the result of the secondary treatment performance verification test, is shown in Attachment II "Properties of ALPS treated water, etc."

On the other hand, among the 62 nuclides to be removed by ALPS, it is possible that some nuclides are now sufficiently decayed to have sufficiently small abundances since for these 62 nucliedes the inventory data set of one year after the accident at FDNPS, was used for theassessment.

In light of the above, TEPCO conducted thorough studies to select the target nuclides for ALPS treated water discharge into the sea and newly selected 30 nuclides were newly selected as nuclides to be measured and assessed (Table5-1-2). This report assesses 31 nuclides, including tritium, as target nuclides for dose assessment

Table 5-1-1 Regulatory concentration limits of

62 nuclides subject to removal by ALPS, tritium, and C-14

	To the second se		ui D	y ALPS, trittum, and C-14	Damilatani
	Torget puelides	Regulatory		Torget puelides	Regulatory
	Target nuclides (physical half-life)	concentration limit		Target nuclides (physical half-life)	concentration limit
	(physical flair life)	(Bq/L)		(priysical flail life)	(Bq/L)
1	H-3 (about 12 years)	6.0E+04	33	Te-129m (about 34 days)	3.0E+02
2	C-14 (about 5700 years)	2.0E+03	34	I-129 (about 16 million years)	9.0E+00
3	Mn-54 (about 310 days)	1.0E+03	35	Cs-134 (about 2.1 years)	6.0E+01
4	Fe-59 (about 44 days)	4.0E+02	36	Cs-135 (about 2.3 million years)	6.0E+02
5	Co-58 (about 71 days)	1.0E+03	37	Cs-136 (about 13 days)	3.0E+02
6	Co-60 (about 5.3 years)	2.0E+02	38	Cs-137 (about 30 years)	9.0E+01
7	Ni-63 (about 100 years)	6.0E+03	39	Ba-137m (about 2.6 minutes)	8.0E+05
8	Zn-65 (about 240 days)	2.0E+02	40	Ba-140 (about 13 days)	3.0E+02
9	Rb-86 (about 19 days)	3.0E+02	41	Ce-141 (about 33 days)	1.0E+03
10	Sr-89 (about 51 days)	3.0E+02	42	Ce-144 (about 280 days)	2.0E+02
11	Sr-90 (about 29 years)	3.0E+01	43	Pr-144 (about 17 minutes)	2.0E+04
12	Y-90 (about 64 hours)	3.0E+02	44	Pr-144m (about 7.2 minutes)	4.0E+04
13	Y-91 (about 59 days)	3.0E+02	45	Pm-146 (about 5.5 years)	9.0E+02
14	Nb-95 (about 35 days)	1.0E+03	46	Pm-147 (about 2.6 years)	3.0E+03
15	Tc-99 (about 210,000 years)	1.0E+03	47	Pm-148 (about 5.4 days)	3.0E+02
16	Ru-103 (about 39 days)	1.0E+03	48	Pm-148m (about 41 days)	5.0E+02
17	Ru-106 (about 370 days)	1.0E+02	49	Sm-151 (about 90 years)	8.0E+03
18	Rh-103m (about 56 minutes)	2.0E+05	50	Eu-152 (about 14 years)	6.0E+02
19	Rh-106 (about 30 seconds)	3.0E+05	51	Eu-154 (about 8.6 years)	4.0E+02
20	Ag-110m (about 250 days)	3.0E+02	52	Eu-155 (about 4.8 years)	3.0E+03
21	Cd-113m (about 14 years)	4.0E+01	53	Gd-153 (about 240 days)	3.0E+03
22	Cd-115m (about 45 days)	3.0E+02	54	Tb-160 (about 72 days)	5.0E+02
23	Sn-119m (about 290 days)	2.0E+03	55	Pu-238 (about 88 years)	4.0E+00
24	Sn-123 (about 130 days)	4.0E+02	56	Pu-239 (about 24,000 years)	4.0E+00
25	Sn-126 (about 230,000 years)	2.0E+02	57	Pu-240 (about 6600 years)	4.0E+00
26	Sb-124 (about 60 days)	3.0E+02	58	Pu-241 (about 14 years)	2.0E+02
27	Sb-125 (about 2.8 years)	8.0E+02	59	Am-241 (about 430 years)	5.0E+00
28	Te-123m (about 120 days)	6.0E+02	60	Am-242m (about 140 years)	5.0E+00
29	Te-125m (about 57 days)	9.0E+02	61	Am-243 (about 7400 years)	5.0E+00
30	Te-127 (about 9.4 hours)	5.0E+03	62	Cm-242 (about 160 days)	6.0E+01
31	Te-127m (about 110 days)	3.0E+02	63	Cm-243 (about 29 years)	6.0E+00
32	Te-129 (about 70 minutes)	1.0E+04	64	Cm-244 (about 18 years)	7.0E+00

^{*} The half-lives are indicated 2-digit accuracy using ICRP Publication 107 "Nuclear Decay Data for Dosimetric Calculations" [16]

Table5-1-2 Tritium and nuclides to be measured and assessed for discharge of ALPS treated water into the sea

Regulatory Target nuclides concentration (Physical half life) limit (Bq/L) H-3 (approx.12Years) 6.0E+04 1 2 C-14 (approx.5700Years) 2.0E+03 3 Mn-54 (approx.310Days) 1.0E+03 4 Co-60 (approx.5.3Years) 2.0E+02 Ni-63 (approx.100Years) 5 6.0E+03 6 Se-79 (approx.300,000Years) 2.0E+02 7 Sr-90 (approx.29Years) 3.0E+01 Y-90 (approx.64 Hours) 8 3.0E+02 9 Tc-99 (approx.210,000Years) 1.0E+03 10 Ru-106 (approx.370Days) 1.0E+02 11 Cd-113m (approx.14Years) 4.0E+01 12 Sb-125 (approx.2.8Years) 8.0E+02 13 Te-125m (approx.57 Days) 9.0E+02 14 I-129 (approx.16M Years) 9.0E+00 15 Cs-134 (approx.2.1Years) 6.0E+01 16 Cs-137 (approx.30Years) 9.0E+01 17 Ce-144 (approx.280Days) 2.0E+02 18 Pm-147 (approx.2.6Years) 3.0E+03 19 Sm-151 (approx.90Years) 8.0E+03 20 Eu-154 (approx.8.6Years) 4.0E+02 21 Eu-155 (approx.4.8Years) 3.0E+03 22 U-234 (approx.250,000Years) 2.0E+01 23 U-238 (approx.4.5B Years) 2.0E+01 24 Np-237(approx.2.1MYears) 9.0E+00 25 Pu-238 (approx.88Years) 4.0E+00 26 Pu-239 (approx.24000Years) 4.0E+00 27 Pu-240 (approx.6600Years) 4.0E+00 28 Pu-241 (approx.14Years) 2.0E+02 29 Am-241 (approx.430Years) 5.0E+00 30 Cm-243 (approx.29Years) 6.0E+00 31 Cm-244 (approx.18Years) 7.0E+00

**Half-life shows in 2 significant digits referring to ICRP Publication 107 "Nuclear Decay Data for Dosimetry Calculations" [16]

5-2. Discharge method

The following shows the policy on the method of discharge into the sea following "TEPCO's Action in response to Government's Policy."

- The design and operation of the facilities necessary for discharge into the sea shall comply with laws and get the necessary permissions from the Nuclear Regulation Authority.
- The amount of radioactive materials excluding tritium in treated water will be reduced by repeating secondary treatment prior to the discharge until the concentration before dilution surely falls below the regulatory standard value related to safety (until the sum of the ratios to regulatory concentrations limits of nuclides other than tritium becomes less than 1). We shall not discharge treated water of which sum of the ratios to regulatory concentrations limits of radioactive materials excluding tritium before dilution is not less than 1.
- Before dilution and discharge, we shall measure and assess the concentration of the radioactive materials in ALPS treated water (30 nuclides to be measured and assessed and tritium) and announce the results of the measurement and assessment every time, as well as perform third-party measurement, assessment, announcement, etc., and announce the results. Nuclides that are not included as the nuclides to be measured and assessed among nuclides subject to removal by ALPS (62 nuclides) will be measured and the results will be announced, as well.
- After that, tritium, which is difficult to exclude, is diluted with a massive amount of seawater (to be determined depending on the tritium concentration in the treated water to be discharged; about 100 to 1,400 times or more) before discharge, in order to meet the standard of the safety regulations of the government (regulatory concentration limit) set to reduce the impact on the environment immediately after discharge (at site boundary), dispel concerns of consumers, etc., as much as possible, and minimize reputation damage. Thanks to this, the sum of the ratios to regulatory concentrations limits of radioactive materials other than tritium becomes less than 0.01. Besides, in actual operation, two sea water transfer pumps are enough to dilute the ALPS treated water to be discharged by setting the concentration limit of tritium before dilution below 1 million Bg/L.
- The tritium concentration of discharged water shall be sufficiently lower than 60,000Bq/L, which is the standard of the safety standards of the government (regulatory concentration limit), and 10,000Bq/L, which is the WHO Guidelines for Drinking Water Quality: specifically, less than 1,500Bq/L as with the operation target of the currently applied discharge concentration of the groundwater bypass, subdrain, etc.
- Discharge into the sea shall be started carefully with a small amount. The soundness of facilities, the transfer procedure of ALPS treated water, measurement process of the concentration of radioactive materials, assessment of dilution of tritium in discharged water, the state of diffusion into the sea, etc., shall be verified.

- If the transfer facility or dilution facility does not function as planned due to malfunction, power failure, etc., we will stop the discharge immediately. If any significant difference to the variation range of baseline monitoring is detected in sea area monitoring, we will stop discharge and investigate the state. When resuming discharge, confirm the safety of discharge.
- The upper limit of the annual discharge amount of tritium, which cannot be removed by ALPS, shall be 22 TBq (2.2E+13Bq) per year, which is the discharge control value of the FDNPS before the accident, for the time being. Moreover, we shall minimize the discharge amount as well as secure the site for facilities necessary for decommissioning by preferentially discharging water with a low tritium concentration and waiting for natural decay based on the half-life for water with a high concentration. Attachment IV "Analysis on the period of discharge of ALPS treated water" shows the simulation result related to discharge of ALPS treated water assuming that discharge will be started in FY 2023 and completed in FY 2051.

Table 5-2-1 shows the specific items to be implemented as shown in "TEPCO's Action in response to Government's Policy."

Table 5-2-1 Specific items to be implemented

	Die 3-2-1 Opecific items to be implemented
Secondary treatment of treated water to be purified	The amount of radioactive materials excluding tritium in treated water to be purified to be discharged into the environment is reduced by secondary treatment by ALPS, etc., to ensure that radioactive materials other than tritium surely falls below the regulatory standard value related to safety (until the sum of the ratios to regulatory concentrations limits of nuclides other than tritium becomes less than 1).
Analysis of ALPS treated water	Before dilution and discharge, we shall announce the measurement and assessment results of the concentration of radioactive materials of tritium, 30 nuclides to be measured and assessed and nuclides subject to removal by ALPS that are out of above every time, as well as perform third-party measurement, assessment, announcement, etc.
Dilution and discharge (including emergency actions)	 Tritium, which is difficult to remove, is diluted with a sufficient amount of seawater (100 or more times) before discharge so that the concentration will be sufficiently lower than the regulatory concentration limit. Thanks to this, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium in discharged water becomes less than 0.01. The tritium concentration shall be the same as the operation target of the discharge concentration of the groundwater bypass, subdrain, etc. (less than 1,500Bq/L). The upper limit of the annual discharge amount of tritium shall be 22 TBq (2.2E+13Bq) per year, which is the discharge control value at FDNPS before the accident, for the time being. The annual discharge amount of tritium is reviewed as needed based on the progress of decommissioning. If the transfer facility or dilution facility does not function as planned due to a failure, outage, etc., stop the discharge immediately. If any any significant difference to the variation range of baseline monitoring is detected in sea area monitoring, stop discharge and investigate the state. When resuming discharge, confirm the safety of discharge.

Sea area monitoring	 Sea area monitoring is started according to the plan enhanced since about one year before the scheduled date to start discharge.
	 Monitoring of seawater, fish, and seaweeds are enhanced.
	- Tritium is intensively measured and assessed in addition to the past
	measurement and assessment focusing on Cs-137.
	- The measurement sample continued to be seawater but the sampled
	amount of fish and seaweeds are increased.
	The radioactivity measurement result at the time of discharge is announced.
	- Third-party analysis, announcement, etc., are considered.

In addition, management values as discharge amount of radioactivity are set for further reduction of the impact of radiation on the environment for nuclides with relative impacts of human exposure as management before discharge of ALPS treated water.

5-3. Facilities for discharge

"TEPCO's Action in response to Government's Policy" shows a conceptual diagram of the facilities for discharging into the sea (Figure 5-3-1). Subsequent to that, the design of the facilities was concretized, and thereafter finalized through the IAEA review and NRA review meetings. The assessment was performed reflecting the status of consideration of the facilities for discharge shown below. For more details on the discharge facilities, see "Application for amendments in the Implementation Plan for Fukushima Daiichi Nuclear Power Station as Specified Nuclear Facility" [17].

5-3-1. Overview of the facilities for discharge

The facilities for discharge into the sea mainly consist of "the measurement/confirmation facility" to verify the radioactive material concentration of ALPS treated water before dilution, "the dilution facility" which consists of seawater transfer piping and discharge vertical shaft (upper-stream storage) including the seawater transfer pump and seawater pipe header to pump and discharge seawater for dilution, "the transfer facility" which consists of the treated water transfer pump and treated water transfer piping and valves to transfer ALPS treated water from the measurement/confirmation facility to the seawater piping, and "the discharge facility (related facility)" which consists of the discharge tunnel and discharge outlet. After confirming the water, of which radioactive materials have been removed by ALPS up to a sufficiently law concentration, is so-called "ALPS treated water" (water whose sum of the ratios to regulatory concentrations limits of nuclides other than tritium is verified to be less than 1), and then diluted with a large amount of seawater 100 or more times. The water to be discharged is received by the measurement/confirmation facility, the radioactive material concentration is homogenized by circulation and stirring, and then it is verified by sampling and analysis that the water is ALPS treated water. The verified water is transferred to the dilution facility by the transfer facility, mixed with a large amount of seawater pumped with the seawater transfer pump through the Unit 5 intake channel by the

dilution facility, and drained to the discharge facility after dilution of the tritium concentration up to less than 1,500Bq/L.

The details of each facility are shown in the following pages. Figure 5-3-1 shows the conceptual diagram of the discharge facility. Figure 5-3-2 shows the big picture of the facility for discharge into the sea and related facilities.

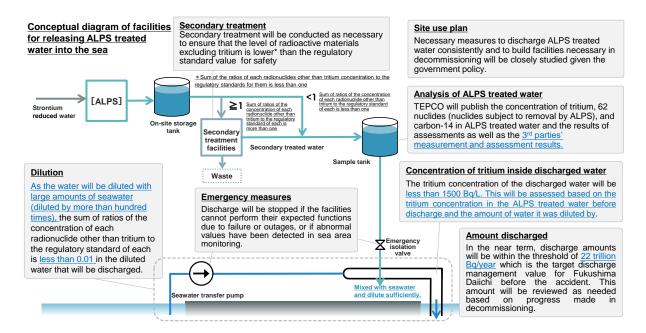


Figure 5-3-1 Conceptual diagram of facilities for discharging ALPS treated water into the sea

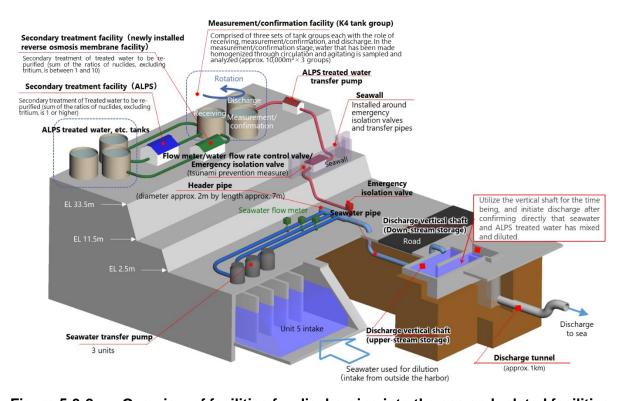


Figure 5-3-2 Overview of facilities for discharging into the sea and related facilities

5-3-2. Measurement/confirmation facility

For the measurement/confirmation facility, we will use 30 out of 35 tanks, each of which has a capacity of 1,000m³, installed in the K4 tank areas in the center of the site 33.5 m above sea level near ALPS. To sample and analyze homogenized water, use 10 tanks, whose nominal total capacity is about 10,000 m³, as 1 group, and install total 30 units of a stirring device in each tank and a circulation device with two circulation pumps of which the capacity is 160m³/h for each pump in each tank group. In principle, setting aside time more than the required time for two rounds of water flow of measurement/confirmation tank for operation time (this is not an option when enough circulation/agitation is confirmed by examination, even after the service started). Since we have to deal with three purposes, namely receiving, measurement/confirmation, and discharge, set up three tanks groups and operate them on a rotation basis.

Figure 5-3-3 shows the schematic diagram of the measurement/confirmation facility. This figure also outlines the operation of the measurement/confirmation facility.

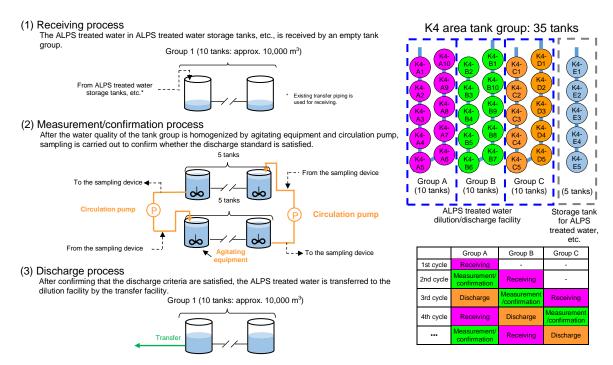


Figure 5-3-3 Schematic diagram of measurement/confirmation facilities

In the discharge process, the tritium concentration of ALPS treated water is registered in monitoring/control device, and ALPS treated water transfer flow rate is set within the maximum 500m³/day (minimum flow rate (annual average) is equal to or greater than the volume of contaminated water generated) so that the tritium concentration contained in the released water is less than 1,500Bg/L which is the upper limit of the operation.

To prevent human error, the tritium concentration confirmed in the process of measurement/confirmation should be mechanically read by a scanner and registered in monitoring/control device.

Monitoring/control device automatically calculates ALPS treated water transfer flow rate from the registered tritium concentration and seawater flow rate.

5-3-3. Transfer facility

The transfer facility is mainly composed of ALPS treated water transfer pump and transfer piping, etc.

In the transfer facility, the ALPS treated water transfer pump has a 30m³/h transfer capacity per unit and consists of two units: an operation unit and a spare unit. The flow rate is operated within the max. 500m³/day using ALPS treated water flow rate control valve and ALPS treated water flow meter installed downstream. And these pumps are installed in the ALPS transfer facility building near the measurement/confirmation facility to transfer ALPS treated water from the tanks of the measurement/confirmation facility 33.5 m above sea level to the dilution facility. Install a radiation detector (scintillation detectors) to detect gamma rays for emergency isolation in the building in order to prevent water from being discharged without sufficient purification.

In the transfer facility, the transfer piping is installed to connect the measurement/confirmation facility 33.5 m above sea level to the seawater piping 2.5 m above sea level. Install an emergency isolation valve in two points in the transfer piping to enable to stop immediately transfer of ALPS treated water in the event of occurrence of an abnormality. One point is set before the injection part of the seawater piping in order to minimize the discharge amount of ALPS treated water in the event of occurrence of an abnormality. The other point is set in the ALPS electrical equipment room set up inside the seawall to be newly constructed 11.5m above sea level in preparation for cases that the former emergency isolation valve does not work due to water immersion, etc., caused by the expected Japan Trench tsunami. In the same room, a flowmeter to measure the flow rate of ALPS treated water to be transferred to the seawater pipe header and the flow rate adjustment valve to adjust the flow rate as specified and the range of maximum 500m³/day are installed. Figure 5-3-4 shows the schematic diagram of the transfer facility

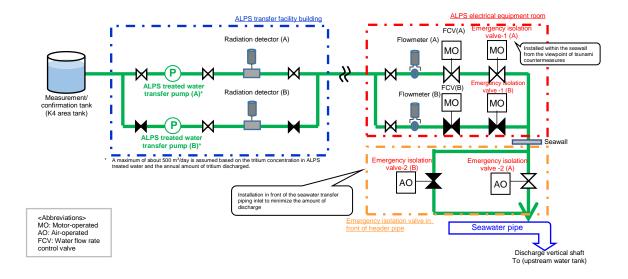


Figure 5-3-4 Schematic diagram of the transfer facility

5-3-4. Dilution facility

The dilution facility consists of a seawater transfer pump, seawater piping (including header), and a discharge shaft (upstream water tank) with the purpose of diluting the ALPS treated water with seawater, transferring it to the discharge shaft (upstream water tank), and discharging it to the discharge facility (related facility). Dilution is done by injecting ALPS treated water into the seawater pipe header and mixing it.

The dilution facility is installed in a location 2.5 m above sea level in the sea side of Units 5/6. A flowmeter is installed in the seawater transfer piping to ensure that the tritium concentration is less than 1,500Bq/L by dilution with a high volume of water (100 or more times). For the seawater transfer pump, the intake channel for the existing Unit 5 circulation water pump is reused. Conservatively, three pumps (one pump out of three is for spare) are installed. The capacity of the seawater transfer pump shall be about 7,086 m³/h/unit, at which the flowrate of the seawater transfer pump can be measured, in order to enable sufficient dilution with seawater. And no flowrate adjustment is performed. Figure 5-3-5 shows the schematic diagram of the dilution facility.

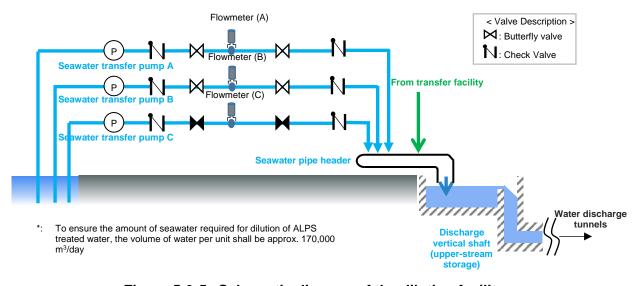


Figure 5-3-5 Schematic diagram of the dilution facility

As mentioned above, because dilution is performed by injecting ALPS treated water into the seawater pipe header and mixing it; the mixing behavior in the seawater piping of ALPS treated water was calculated, the expected dilution effect was assessed, the maximum mass concentration on the cross section of the concentration assessment at the seawater piping outlet of injected water was assessed to be 0.28%, and it was concluded that the water was diluted about 357 times.

5-3-5. Discharge facility (related facility)

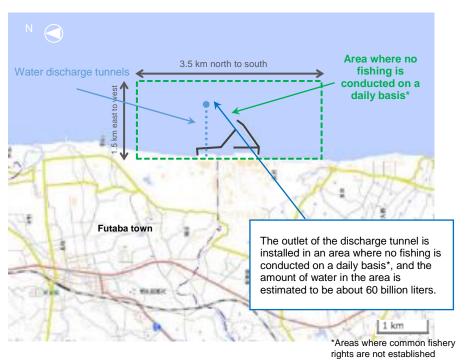
In this discharge of ALPS treated water into the sea, as a result of optimization of the design process, the water diluted and mixed with a large amount of seawater is discharged not through the existing discharge outlet installed on the coast to the north of the northern breakwater, but through the discharge outlet installed on the seabed about 1 km off the coast of the FDNPS (See Figures 5-3-6 to 5-3-7).

The discharge facility consists of the discharge vertical shaft (down-stream storage), discharge tunnel, and discharge outlet, and is designed to transfer water flowing out over the partition wall (weir which separates the upper-stream storage from the down-stream storage) in the discharge vertical shaft to the outlet, which is approximately 1 km away, by making use of the head between water in the discharge vertical shaft (down-stream storage) and the sea surface. The discharge tunnel passes through bedrock to minimize the leakage risk and improve seismic resistance.

This proposal has the following advantages compared with the proposal to use the existing discharge outlet.

- Compared with water intake inside and outside the port using the existing intake and discharge facilities, water inside the port, of which radioactive material concentration is higher than that of water outside the port, is not discharged. To take water outside the port, isolation from the inside of the port is secured with a partition weir in the south side of the Unit 5 intake gate, and a part of the permeation prevention work of the north breakwater of the port is removed. Attachment V "Impacts of intake and discharge of diluted water on outside" shows discussion about the impact of the radioactive material concentration in the port. As a result of the exposure assessment, the assessment results of both water intake inside and outside the port was much smaller than the dose limit and target dose value, but it turned out that the external impact of water intake outside the port is smaller.
- Since discharged water is diffused offshore, seawater is hard to recirculate (hard to be taken again as seawater for dilution).
- The impact on fishing is reduced by setting the position of the discharge outlet within "area where common fishery rights are not set" where fishing is not done on a daily basis.
- As a result of a geological investigation, a stable bedrock is exposed on the seabed, so construction can be performed safely and steadily (See Figure 5-3-8).

Figures 5-3-9 shows the overview of the structure of the discharge vertical shaft (upper-stream storage/down-stream storage) in the water discharge tunnel side. Figure 5-3-10 shows the image of the discharge outlet, which is the discharge tunnel outlet. Figure 5-3-11 shows its sectional view.



Source: the Geographical Survey Institute map (national land electronic website) revised by Tokyo Electric Power Company Holdings Corporation

 $\underline{https://maps.gsi.go.jp/\#13/37.422730/141.044970/\&base=std\&ls=std\&disp=1\&vs=c1j0h0k0l0u0t0z0r0s0m0f1}$

Figure 5-3-6 Discharge location map

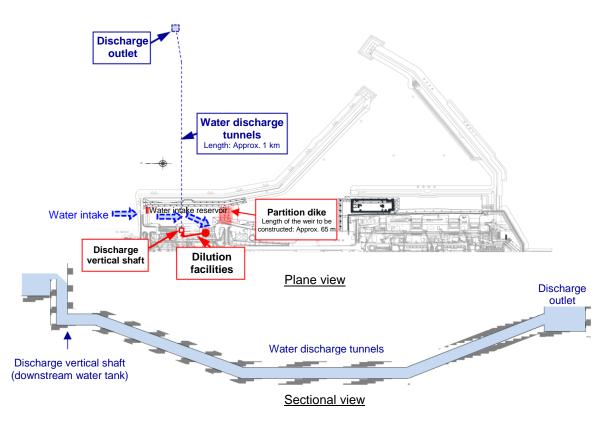


Figure 5-3-7 General view of the intake and discharge facilities

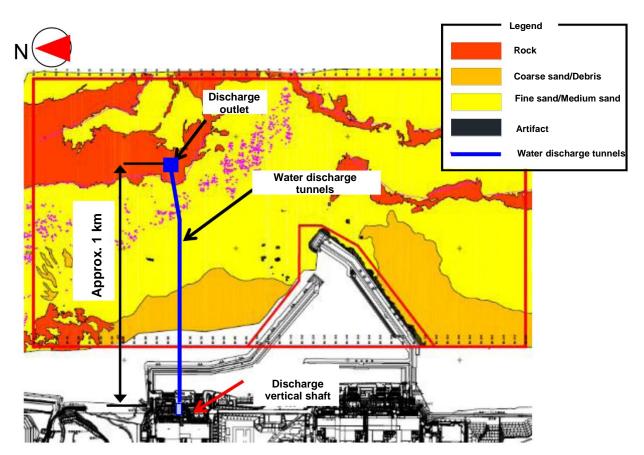


Figure 5-3-8 Plane view of assumed geology

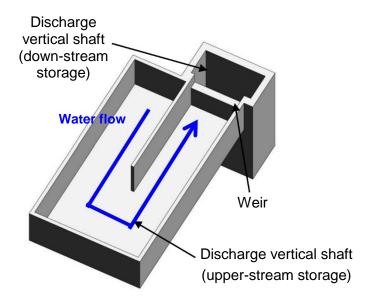


Figure 5-3-9 Schematic diagram of the discharge vertical shaft (upper-stream storage/down-stream storage)

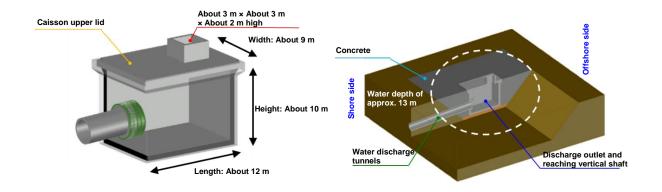


Figure 5-3-10 Image drawing of discharge outlet

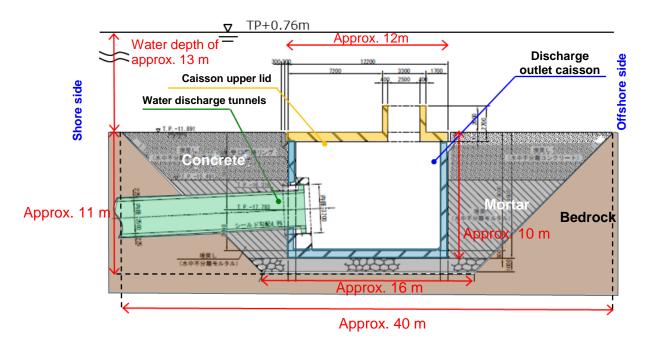


Figure 5-3-11 Section view of the discharge outlet

- 6. Assessment of protection of humans (general public)
- 6-1. Exposure assessment under normal conditions

6-1-1. Assessment procedure

We assess the dose of the representative person in order to verify the risk from the viewpoint of radiation protection for human based on the current consideration situation. The specific procedure of the assessment is as shown in the procedure of Figure 6-1-1 shown in GSG-10.

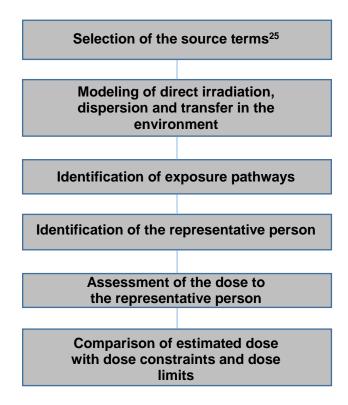


Figure 6-1-1 Exposure assessment procedure (prepared from GSG-10)

²⁵ In this assessment, the source term means the annual discharge amount (total amount) of each nuclide contained in the ALPS treated water discharged into the sea in a certain period (e.g. one year).

6-1-2. Assessment method

(1) Source term (annual discharge amount of each nuclide)

As shown in 5-1, the target nuclides of the radiological environmental impact assessment related to discharge into the sea of ALPS treated water are a total of 64 were nuclides: 62 nuclides subject to removal by ALPS, tritium and C-14. However, TEPCO performs the radioactive environmental impact assessment with 31 nuclides, as target nuclides for dose assessment, which include tritium and 30 selected nuclides as nuclides to be measured and assessed (Table 5-1-2) in response to findigs pointed by the NRA and the IAEA...

In "TEPCO's Action in response to Government's Policy," the upper limit of the annual discharge amount of tritium is set to 22 TBq (2.2E+13Bq), which is the discharge control value of the FDNPS before the accident, for the time being.

The discharge amount of 30 nuclides other than tritium is calculated by the product of the composition of nuclides in ALPS treated water (concentration of each nuclide) and the annual discharge volume of water. Though the composition of nuclides in ALPS treated water varies among tank groups, TEPCO continues to use the compositions of nuclides of three tank groups, namely K4, J1-C, and J1-G, of which the analysis results of all of the 64 nuclides, previously designated as target nuclides for dose assessment, are available. Although Se-79, which is newly selected as nuclides to be measured and assessed and it has not been subject to analysis of 64 nuclides in each of three tank groups-to date, was not detected in the additional measurement carried out for this nuclide's selection process, its concentration at the outlet of ALPS (detection limit value) will be used in common for all three tank groups. For U-238 and Np-237 of alpha nuclides, the results of analysis on gross alpha were used, as before.

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

The water in the K4 tank group has been treated by one treatment process using the performance of ALPS to make the sum of the ratios to regulatory concentrations limits less than 1, as described in b.2016 of II-7. "Reason for generation of treated water to be purified" of Attachment II "Properties of ALPS treated water, etc."

On the other hand, the water in the J1-C and J1-G tank groups has been treated while the operating rate of ALPS was high and stored as treated water to be purified because the sum of the ratios to regulatory concentrations limits did not fall below 1 after the first treatment by ALPS. The tank groups were selected as groups with a higher concentration (J1-C tank group; the sum of the ratios to regulatory concentrations limits before secondary treatment is about 2,400) and with a lower concentration (J1-G tank group; the sum of the ratios to regulatory concentrations limits before secondary treatment is about 390). Secondary treatment was performed for each of them and the sums of the ratios to regulatory concentrations limits of both of them were much less than 1 after secondary treatment.

We compared the concentration of the 7 major nuclides²⁶ and Tc-99 of these three tank groups with the measurement results of the tank groups in which the sum of the ratios to regulatory concentrations limits other than tritium is estimated to be less than 1 from the analysis result of the tank groups currently used for storage of water. Figure 6-1-2 shows the result. Though I-129 varies in the three tank groups as well as the other tank groups, the concentrations of the other nuclides are normal in the analysis results of the other tank groups as well. The reason why the three tank groups have lower Cs-134 result, the detection limits of the three tank groups were 0.1 Bq/L, while the detection limits of many other tank groups were from 0.1 to 0.2 Bq/L. Cs-134, a short half-life nuclide, of most tank groups were nevertheless undetected.

In addition, tritium and C-14, which are not subject to removal by ALPS, were compared with the measurement results of all tank groups. The comparison result is shown in Figure 6-1-3. The concentration of C-14 is also normal in the analysis results of the other tank groups.

Based on these comparisons, the compositions of the nuclides of the three tank groups are considered typical as the composition of concentrations in ALPS treated water.

These source terms include uncertainties, which is described in chapter 8.

The 62 nuclides to removal by ALPS had been selected from fission products derived from fuel in the reactors of Unit 1 to 3 and the corrosion products derived from water retained in operating nuclear reactors. However, a gap found later between sum of the measured radioactive concentration of the 7 major nuclides of ALPS treated water and measured gross beta. Examinations has identified Tc-99 and C-14 as the cause of the gap and C-14 has been added into the required nuclides to be measured.

²⁶ Seven nuclides which are significantly detected in the process of ALPS treatment at the facility inlet and outlet (Cs-134, Cs-147, Co-60, Sb-125, Ru-106, Sr-90, I-129)

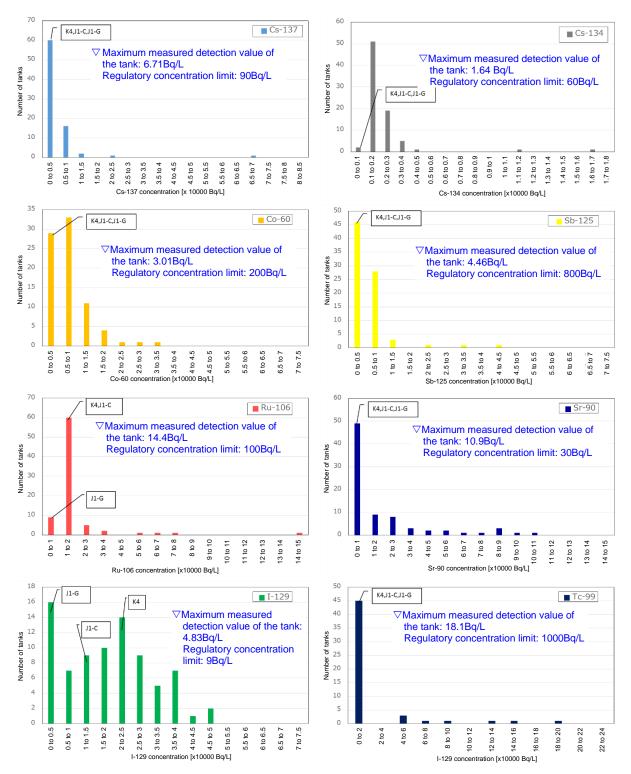


Figure 6-1-2 Concentration distribution of the seven major nuclides and Tc-99 in the analysis result of ALPS treated water (as of the end of March 2021), and comparison among the three tank groups

- * The analysis results in which the sum of the ratios to regulatory concentrations limits of the 7 major nuclides is less than 0.59 (for 80 tanks) (excluding secondary treatment test water)
- * The vertical axis indicates the number of tanks
- * Some maximum values are the detection limit values if they were not detected.
- * Values are measured values at the times and no half-life correction is considered.

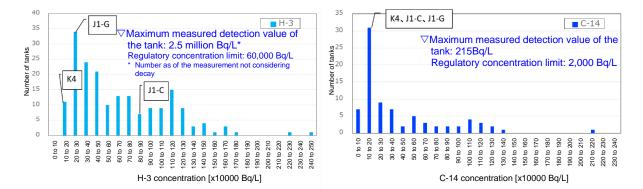


Figure 6-1-3 Concentration distribution of tritium and C-14 in the analysis result of ALPS treated water, etc. (as of the end of March 2021) and comparison among the three tank groups

- * The analysis results of the tank group (189 tanks for tritium and 81 tanks for C-14) are plotted (excluding secondary treatment test water)
- * The vertical axis indicates the number of tanks (counted as the detection limit if not detected)
- * Values are measured values at the times and no half-life correction is considered.

On the other hand, the tritium concentration of stored ALPS treated water, etc., varies as shown in Figure 6-1-3, so the assumed annual discharge volume of treated water depends on the concentration of tritium contained in ALPS treated water to be discharged. The annual discharge volume of water is in inverse proportion to the tritium concentration; the lower the tritium concentration is, the greater the annual discharge amount of 30 nuclides other than tritium becomes. The relationships are as shown in the following equation.

$$S_i = V \times C_i = \frac{S_{H-3}}{C_{H-3}} \times C_i$$

where

 S_i : Annual radioactivity amount of discharged nuclide i (Bq)

V: Annual discharge volume of ALPS treated water (L)

C: Concentration of nuclide i contained in the ALPS treated water discharged (Bq/L)

S_{H-3}: Annual radioactivity amount of tritium discharged (= 22 TBq (2.2E+13Bq))

C_{H-3}: Concentration of tritium contained in the ALPS treated water discharged (Bq/L)

Among them the values of C_i and C_{H-3} are given by the definition of each nuclide's compositions in this assessment, which means that the annual discharge amount of each nuclide is uniquely determined from the concentration of tritium of the nuclide's compositions.

The source term using the analysis result of each tank group is set by the following procedure. In actual discharge, the source term varies among tank groups, but this assessment assumes that it does not vary throughout the year for simplification of the model.

Tables 6-1-1 to 6-1-3 show the concentration, annual discharge volume of water, and annual discharge amount of each nuclide based on these settings.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- (2) The annual discharge volume of water is calculated from (1) and the tritium concentration.
- (3) The annual discharge amount of each nuclide is calculated from the concentration of 31 nuclides and the product of the annual discharge amount calculated in (2). Some of the nuclides below the detection limit value may not actually be present any more, but conservatively they are assumed to exist at the detection limit.

Actually, when ALPS treated water is discharged, the sum of the ratios to regulatory concentrations limits of nuclides other than tritium becomes less than 0.01 because as shown in 5-2, the water is diluted with seawater 100 or more times before discharge into the sea so that the tritium concentration falls below 1,500Bq/L, which is the target value of the groundwater bypass and subdrain.

Table 6-1-1 Source term based on the nuclide composition of measured values (K4 tank group) (annual discharge amount)

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
H-3	1.9E+05	1.2E+08	2.2E+13	For the annual discharge
C-14	1.5E+01		1.7E+09	amount of tritium, the upper limit value of the annual discharge
Mn-54	6.7E-03		7.8E+05	amount is used
Co-60	4.4E-01		5.1E+07	 Dilute with seawater 100 or more times before discharge so
Ni-63	2.2E+00		2.5E+08	that the tritium concentration
Se-79	1.5E+00		1.7E+08	becomes less than 1,500Bq/L
Sr-90	2.2E-01		2.5E+07	
Y-90	2.2E-01		2.5E+07	
Tc-99	7.0E-01		8.1E+07	
Ru-106	1.6E+00		1.9E+08	
Cd-113m	1.8E-02		2.1E+06	
Sb-125	3.3E-01		3.8E+07	
Te-125m	3.3E-01		3.8E+07	

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
I-129	2.1E+00		2.4E+08	
Cs-134	4.5E-02		5.2E+06	
Cs-137	4.2E-01		4.9E+07	
Ce-144	6.3E-02		7.3E+06	
Pm-147	1.9E-01		2.2E+07	
Sm-151	9.0E-04		1.0E+05	
Eu-154	1.2E-02		1.4E+06	
Eu-155	3.3E-02		3.8E+06	
U-234	6.3E-04		7.3E+04	
U-238	6.3E-04		7.3E+04	
Np-237	6.3E-04		7.3E+04	
Pu-238	6.3E-04		7.3E+04	
Pu-239	6.3E-04		7.3E+04	
Pu-240	6.3E-04		7.3E+04	
Pu-241	2.8E-02		3.2E+06	
Am-241	6.3E-04		7.3E+04	
Cm-243	6.3E-04		7.3E+04	
Cm-244	6.3E-04		7.3E+04	

Table 6-1-2 Source term based on the nuclide composition of measured values

(J1-C tank group) (annual discharge amount)

	T			
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
H-3	8.2E+05	2.7E+07	2.2E+13	For the annual discharge
C-14	1.8E+01		4.8E+08	amount of tritium, the upper limit value of the annual discharge
Mn-54	3.8E-02		1.0E+06	amount is used
Co-60	3.3E-01		8.9E+06	 Dilute with seawater 100 or more times before discharge so
Ni-63	8.5E+00		2.3E+08	that the tritium concentration
Se-79	1.5E+00		4.0E+07	becomes less than 1,500Bq/L
Sr-90	3.6E-02		9.7E+05	
Y-90	3.6E-02		9.7E+05	
Tc-99	1.2E+00		3.2E+07	
Ru-106	1.4E+00		3.8E+07	
Cd-113m	8.5E-02		2.3E+06	
Sb-125	2.3E-01		6.2E+06	
Te-125m	2.3E-01		6.2E+06	
I-129	1.2E+00		3.2E+07	

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
Cs-134	7.6E-02		2.0E+06	
Cs-137	1.9E-01		5.1E+06	
Ce-144	5.7E-01		1.5E+07	
Pm-147	8.0E-01		2.1E+07	
Sm-151	1.1E-02		3.0E+05	
Eu-154	1.1E-01		3.0E+06	
Eu-155	3.4E-01		9.1E+06	
U-234	3.3E-02		8.9E+05	
U-238	3.3E-02		8.9E+05	
Np-237	3.3E-02		8.9E+05	
Pu-238	3.3E-02		8.9E+05	
Pu-239	3.3E-02		8.9E+05	
Pu-240	3.3E-02		8.9E+05	
Pu-241	1.2E+00		3.2E+07	
Am-241	3.3E-02		8.9E+05	
Cm-243	3.3E-02		8.9E+05	
Cm-244	3.3E-02		8.9E+05	

Table 6-1-3 Source term based on the nuclide composition of measured values

(J1-G tank group) (annual discharge amount)

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
H-3	2.7E+05	8.1E+07	2.2E+13	For the annual discharge
C-14	1.6E+01		1.3E+09	amount of tritium, the upper limit value of the annual discharge
Mn-54	3.8E-02		3.1E+06	amount is used
Co-60	2.3E-01		1.9E+07	 Dilute with seawater 100 or more times before discharge so
Ni-63	8.8E+00		7.2E+08	that the tritium concentration
Se-79	1.5E+00		1.2E+08	becomes less than 1,500Bq/L
Sr-90	3.2E-02		2.6E+06	
Y-90	3.2E-02		2.6E+06	
Tc-99	1.3E+00		1.1E+08	
Ru-106	4.8E-01		3.9E+07	
Cd-113m	8.6E-02		7.0E+06	
Sb-125	1.4E-01		1.1E+07	
Te-125m	1.4E-01		1.1E+07	
I-129	3.3E-01		2.7E+07	
Cs-134	6.7E-02		5.5E+06	
Cs-137	3.3E-01		2.7E+07	

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
Ce-144	5.5E-01		4.5E+07	
Pm-147	7.2E-01		5.9E+07	
Sm-151	1.0E-02		8.1E+05	
Eu-154	1.0E-01		8.1E+06	
Eu-155	1.8E-01		1.5E+07	
U-234	2.8E-02		2.3E+06	
U-238	2.8E-02		2.3E+06	
Np-237	2.8E-02		2.3E+06	
Pu-238	2.8E-02		2.3E+06	
Pu-239	2.8E-02		2.3E+06	
Pu-240	2.8E-02		2.3E+06	
Pu-241	1.0E+00		8.1E+07	
Am-241	2.8E-02		2.3E+06	
Cm-243	2.8E-02		2.3E+06	
Cm-244	2.8E-02		2.3E+06	

(2) Modeling of diffusion and transfer after discharge

(1) Selection of the migration model

As the migration model of radioactive materials discharged into the sea, the following was selected referring to GSG-10, domestic cases, etc. For the timeline of selection, etc., see Attachment VI "Transfer pathways and exposure pathways other than the assessment targets."

- Advection and diffusion by tidal currents, etc.
 Advection and diffusion in the sea were selected because the water will be discharged into the sea.
- ii. Advection and diffusion by tidal currents, etc. -> Adhesion to hullsAdhesion to hulls is selected because ships sail for fishing, etc., in the sea.
- iii. Advection and diffusion by tidal currents, etc. -> Adhesion to seabed sediment and beach sand
 Selected because radioactive materials will be advected and diffused by tidal currents, etc., and migrate to seabed sediment, beach sand, etc.
- iv. Advection and diffusion by tidal currents, etc. -> Adhesion to fishing nets Migration to fishing nets is selected because radioactive materials will be advected and diffused by tidal currents, etc., and adhered to fishing nets used in the surrounding area.
- v. Advection and diffusion by tidal currents -> Resuspension to air by seawater spray Selected because radioactive materials will be advected and diffused by tidal currents, etc., and seawater spray will occur due to waves, etc., at beaches.
- vi. Advection and diffusion by tidal currents, etc. -> Intake and concentration by marine organisms such as fish

 Selected because radioactive materials will be advected and diffused by tidal currents, etc., and migrate to and concentrate in fish.
- (2) Assessment of advection and diffusion in the sea area

For the calculation of diffusion of radioactive materials in the sea area, the area sea model "ROMS: Regional Ocean Modeling System" applied to off-shore of Fukushima by Central Research Institute of Electric Power Industry (CRIEPI) is used. This model was verified to have high reproducibility by reproduction calculation of the cesium concentration in the seawater from actual past meteorological and oceanographic data and comparison with actual data for diffusion of cesium leaked into the sea due to the Accident at the FDNPS (Tsumune et al., 2020) [4], and also used in "TEPCO Draft Study Responding to the Subcommittee Report on Handling ALPS Treated Water," [18] which was issued on March 24, 2020. The concentration was calculated from the model of the sea area near the FDNPS at high resolution in order to set the discharge point and the

FDNPS port facilities more correctly. It was verified that higher resolution improved the reproducibility of the concentration in the seawater of cesium leaked due to the accident at the FDNPS. Attachment VII "Validity of the diffusion simulation" shows discussion about the validity of diffusion simulation.

In this report, the concentration in the seawater was calculated from this model in the case of discharge of a total of 22 TBq (2.2E+13Bq) of tritium per year at an even pace throughout the year, and those of the other nuclides were calculated by proportionate calculation of the annual discharge amount with tritium.

In this model, tritium equivalent to the discharge rate is added to the mesh including the discharge point so that it instantaneously spreads evenly in the mesh. Due to the characteristics of the model, dilution of ALPS treated water with the seawater and the promotion effect of the discharge flow velocity on mixing dilution are not considered, so it may be different from the contribution distribution in the actual discharge near the discharge outlet, but there is considered to be no significant difference in the case of diffusion away from the discharge outlet.

This can also be verified by comparing the diffusion simulation results with different discharge points, shown in Attachment VIII "Difference in the diffusion area by discharge location." The annual mean concentration in the 10 km × 10 km area when ALPS treated water is discharged from the unit 5/6 discharge outlet on the sea surface is higher only by 20% than the concentration when ALPS treated water is discharged from an outlet on the seabed 1 km off the coast.

The following shows the major calculation conditions.

Flow data of the sea area

- For the advection term of the flow and tracer as a setting of ROMS (term representing migration with the flow velocity), third-order upwind difference and MPDATA, respectively, were used; for the harmonic viscosity and diffusion terms, forth-order central difference. The horizontal viscosity and diffusion coefficients are set to 5.0 m²/s. For the vertical viscosity and diffusion, the K-profile parameterization mixing (KPP) model (Large et al., 1994) is used and the minimum limit value of the vertical viscosity and diffusion coefficients are set 10⁻⁵ m²/s and 10⁻⁶ m²/s, respectively.
- For the drive force of the sea surface, we used the result of reanalysis (wind velocity, short wave, long wave, atmospheric pressure, ambient temperature, humidity, and precipitation) with a short-term weather prediction system (Numerical Weather Forecasting and Analysis System (NuWFAS), Hashimoto et al., 2010) [19], which interpolate the short-term weather prediction of the Japan Meteorological Agency (JMA-GSM) using the mesoscale weather model (Weather Research and Forecasting model (WRF), Skamarock, et al, 2008 [20]). The time resolution of the output of NuWFAS is about 1 hour and the horizontal

- resolution is 5 km, so in the simulation, the result with the time and horizontal direction interpolated was given.
- As the original data of the boundary conditions and data assimilation (nudging)²⁷, we used the results (water temperature, salt content, and sea surface height) of the reanalysis data of tidal currents updated in real-time (Japan Coastal Ocean Prediction Experiment 2 (JCOPE2, Miyazawa et al., 2009)²⁸ [21].
- Since the off-shore of Fukushima, which is a mixed area of Oyashio and Kuroshio (a cold current form north and a warm current from south, respectively) is affected by the mesoscale vortex, data assimilation (nudging) was applied which mitigates the simulation result into the reanalysis result of the water temperature and salt content by JCOPE2 (The mitigation factor is a daily reciprocal) for the purpose of reproducing complex behavior such as the mesoscale vortex.
- The drive force by tide was set by interpolating the result (8-divided tide: M2, S2, N2, K2, K1, O1, P1, Q1) of the global tide model (TPXO; Egbert and Erofeeva, 2002) as the tidal level, the tidal ellipse, and their phases near the open boundary. Since the resolution of the result of TPXO is $0.25^{\circ} \times 0.25^{\circ}$, it is likely that the tidal level amplitude and phase associated with synthesis of reflected wave near the coast cannot be set correctly near the boundary. To correct the tidal components of the boundary, harmonic analysis to resolve each tidal level component for the simulation result at the tidal observation points of JMA (Ofunato, Ayukawa, Onahama, and Choshi) was performed to compare tidal level observation data to adjust the scales and phases of the tidal level and tide of the boundary conditions. Actually, the difference between the simulation and observation results was averaged, and adjustments were made with the averaged difference.

Range of the model (See Figure 6-1-4)

Resolution (overall): North-south about 925 m x East-west about 735 m (about 1 km), 30 vertical layers

Resolution (adjacent area): North-south about 185 m x East-west about 147 m (about 200 m), 30 vertical layers

Model range: The resolution of the sea area surrounded by the blue and red lines is improved in stages from a mesh of about 1 km mesh so that the sea area where the red and blue batches of the northern latitude of 35.30 to 39.71 degrees, the eastern longitude of 140.30 to 143.50 degrees (490 km × 270 km), and north-south about 22.5 km x east-west about 8.4 km around the FDNPS get crossed becomes a 200-m mesh

²⁷ Data assimilation: Method to incorporate actual data in numerical simulation.

²⁸ JCOPE2: Tidal current prediction model developed by JAMSTEC to ascertain the variations of the Kuroshio/Kuroshio Extension, the Oyashio current, the mesoscale vortex, etc., in the northwestern Pacific Ocean.

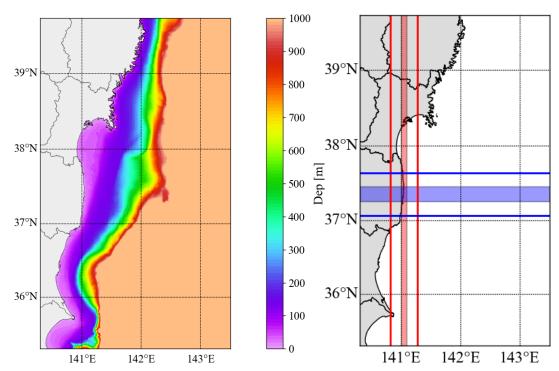


Figure 6-1-4 Range of the model and water depth distribution (In the right figure, the resolution of the sea area where the red and blue hatches get crossed is improved into a 200-m mesh)

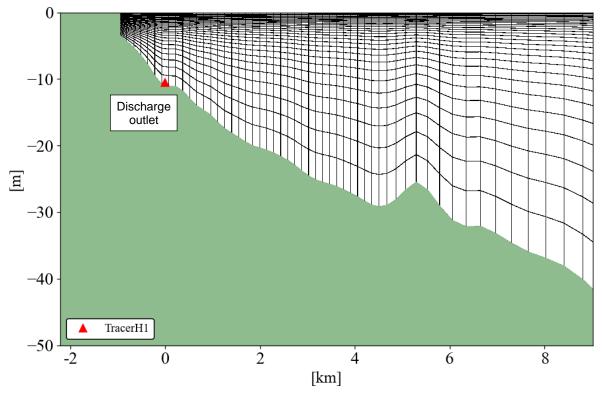


Figure 6-1-5 Section view of the seabed up to 10 km offshore and vertical division on the model

(3) Setting of exposure pathways

A total of eight exposure pathways are selected based on the existing assessments, GSG-10, etc.²⁹: five external exposure pathways and three internal exposure pathways. The following shows the concept of selection. In revising the report, we clarified the beach assessment point described below and added ingestion of seawater and inhalation of seawater spray as express pathways related to beaches.

(1) External exposure from sea surface

Selected as an exposure pathway because external exposure may occur from radiation from radioactive materials in the seawater during offshore navigation by ship or offshore work.

(2) External exposure from hulls

Selected as an exposure pathway because external exposure may occur from radiation from radioactive materials that have migrated from the seawater to hulls (deck) during offshore navigation by ship or offshore work.

(3) Underwater external exposure during swimming, etc.

Selected as an exposure pathway because external exposure may occur from radiation from radioactive materials in the surrounding seawater during swimming, etc.

(4) External exposure from beach sand

Selected as an exposure pathway because external exposure may occur from radiation from radioactive materials that have moved from seawater to beach sand.

(5) External exposure from fishing nets

Selected as an exposure pathway because external exposure may occur from radiation from radioactive materials that have migrated from the seawater to fishing nets because fishing nets are used in the seawater for fishing.

42

²⁹ IAEA-TECDOC-1759, "Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure" (2015)

(6) Internal exposure from ingestion of seawater

Selected as an exposure pathway because internal exposure may occur from radiation from radioactive materials in the seawater due to accidental ingestion of seawater.

- (7) Internal exposure from inhalation of seawater spray Selected as an exposure pathway because internal exposure may occur from radiation from radioactive materials in the seawater due to inhalation of seawater spray caused by waves on beaches.
- (8) Internal exposure from ingestion of seafood Selected as an exposure pathway because internal exposure may occur from ingestion of seafood that radioactive materials in the seawater have moved to and concentrated.

The following shows the assessment model and used parameters of each exposure pathway.

a. External exposure

(1) External exposure from sea surface

Assess the external exposure from radioactive materials in the seawater during swimming and offshore work by the model shown in Figure 6-1-6.

Equation (6-1-1) shows the calculation equation of the effective dose D_1 (mSv/year) from radiation from the sea surface.

$$D_1 = \sum_{i} (K_1)_i \cdot (x_1)_i \cdot t_1 \tag{6-1-1}$$

where

- $(K_1)_i$ is the effective dose conversion factor from gamma radiation from nuclide i from sea surface ((mSv/h)/(Bq/L))
- $(x_1)_i$ is the concentration of nuclide i in seawater (Bq/L)
- t_1 is the annual exposure time (h/year)

For the effective dose conversion factor³⁰ from the gamma rays from the sea surface, the value in the Handbook for Determining Environmental Impacts of Decommissioning Work [22] (hereinafter called "Decommissioning Handbook") was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-5).

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

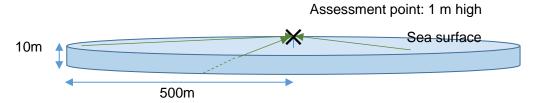


Figure 6-1-6 Assessment model of exposure from the sea surface in the decommissioning handbook

(2) External exposure from hulls

Assess the external exposure from radioactive materials that have migrated from the seawater to hulls during offshore work such as movement by ship by the model shown in Figure 6-1-7.

Equations (6-1-2) and (6-1-3) show the calculation equation of the effective dose D_2 (mSv/year) from hulls.

$$D_2 = \sum_{i} (K_2)_i \cdot (S_2)_i \cdot t_2$$
 (6-1-2)

$$(S_2)_i = (F_2)_i \cdot (x_2)_i \tag{6-1-3}$$

where

 $(K_2)_i$ is the effective dose conversion factor from gamma radiation from nuclide i from hulls ((mSv/h)/(Bq/m²))

 $(S_2)_i$ is the contamination density of nuclide i in hulls (Bq/m²)

 t_2 is the annual exposure time (h/year)

 $(F_2)_i$ is the migration factor of nuclide *i* from seawater to hulls ((Bq/m²)/(Bq/L))

 $(x_2)_i$ is the concentration of nuclide *i* in seawater (Bq/L)

Radiation dose per hour (mSv/h) from radiation from radioactive materials contained in the seawater ingested by those working above the sea surface when any radioactive materials are contained in the seawater at a concentration of 1Bq/L, as shown in the model of Figure 6-1-6.

For the effective dose conversion factor 31 from the gamma rays from radioactive materials adhered to hulls, the value of the Decommissioning Handbook was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-6). The factor of migration to hulls 32 was assumed to be constantly in the equilibrium state with the concentration in the seawater at $100((Bq/m^2)/(Bq/L))$ according to "Application for the Designation of Reprocessing Business of Rokkasho Plant" (Japan Nuclear Fuel Service, 1989). [23]

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

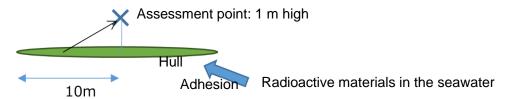


Figure 6-1-7 Assessment model of exposure from hulls in the decommissioning handbook

(3) Underwater external exposure during swimming, etc.

Assess the external exposure from gamma rays from radioactive materials in the surrounding seawater during swimming and underwater work by the submersion model³³.

Equation (6-1-4) shows the calculation equation of the effective dose D_3 (mSv/year) from radiation during swimming and underwater work.

$$D_3 = \sum_{i} (K_3)_i \cdot (x_3)_i \cdot t_3 \tag{6-1-4}$$

where

 $(K_3)_i$ is the effective dose conversion factor from gamma radiation from nuclide i from seawater ((mSv/h)/(Bq/L))

 $(x_3)_i$ is the concentration of nuclide *i* in seawater (Bq/L)

 t_3 is the annual swimming time (h/year)

Radiation dose ingested by people on ships from radiation emitted from radioactive materials that have migrated from the seawater to hulls; evaluated by the model of Figure 6-1-7; and shown as a coefficient for the deposit density of radioactive materials adhered to hulls.

Degree of adhesion of radioactive materials to what contacts the seawater if the concentration of radioactive materials contained in the seawater is 1Bq/L, shown as radiation per unit area.

³³ Model to calculate exposure from radiation from the surrounding radioactive materials.

For the effective dose conversion factor from the gamma rays in the seawater, the value of the Decommissioning Handbook was used. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-7).

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

(4) External exposure from beach sand

Assess the external exposure from radioactive materials migrated from seawater to beach sand while staying on a beach by the model shown in Figure 6-1-8.

Equation (6-1-5) shows the calculation equation of the effective dose D_4 (mSv/year) from the gamma radiation from beach sand.

$$D_4 = \sum_{i} (K_4)_i \cdot (x_4)_i \cdot (F_4)_i \cdot t_4 \tag{6-1-5}$$

where

 $(K_4)_i$ is the effective dose conversion factor from gamma radiation from nuclide i from beach sand ((mSv/h)/(Bq/kg))

 $(x_4)_i$ is the concentration of nuclide i in seawater (Bq/L)

 $(F_4)_i$ is the migration factor of nuclide i from seawater to beaches ((Bq/kg)/(Bq/L))

 t_4 is the annual exposure time (h/year)

For the effective dose conversion factor from the gamma rays from beach sand, the value of the Decommissioning Handbook was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-8). The migration factor of nuclides to beaches is assumed to constantly in the equilibrium state with the concentration in the seawater at 1,000((Bq/kg)/(Bq/L)) for all nuclides based on "Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities."

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

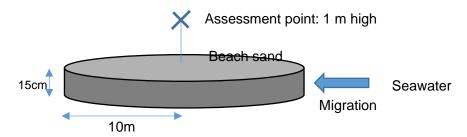


Figure 6-1-8 Assessment model of exposure from beach sand in the decommissioning handbook

(5) External exposure from fishing nets

Assess external exposure from radioactive materials that have migrated from the seawater to fishing nets and adhered to fishing nets when they are placed on a ship or ground during fishing work, by the model shown in Figure 6-1-9.

Equations (6-1-6) and (6-1-7) show the calculation equation of the effective dose D_5 (mSv/year) from radioactive materials adhered to fishing nets.

$$D_5 = \sum_{i} (K_5)_i \cdot (S_5)_i \cdot t_5 \tag{6-1-6}$$

$$(S_5)_i = (F_5)_i \cdot (x_5)_i \tag{6-1-7}$$

where

- $(K_5)_i$ is the effective dose conversion factor from gamma radiation from nuclide i from fishing nets ((mSv/h)/(Bq/kg))
- $(S_5)_i$ is the concentration of nuclide *i* on fishing nets (Bq/kg)
- t_5 is the annual exposure time (h/year)
- $(F_5)_i$ is the migration factor of nuclide i from seawater to fishing nets ((Bq/kg)/(Bq/L))
- $(x_5)_i$ is the concentration of nuclide i in seawater (Bq/L)

For the effective dose conversion factor, the value of the Decommissioning Handbook was used. For the calculation of the dose conversion factor for the effective dose, the simple shielding calculation code QAD-CGGP2 is used using the point attenuation nuclear integration method. For β and γ nuclides and α nuclides not shown in the Decommissioning Handbook, conservatively, the highest values, Co-60 and Am-243, respectively were used (Table 6-1-9). The factor of migration to fishing nets was assumed to be constantly in the equilibrium state with the concentration in the seawater at 4,000((Bq/kg)/(Bq/L)) for all nuclides other than tritium according to "Application for the Designation of Reprocessing Business of Rokkasho Plant."

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

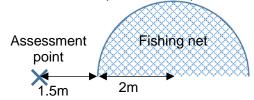


Figure 6-1-9 Assessment model of exposure from fishing nets in the decommissioning handbook

b. Internal exposure

(6) Internal exposure from ingestion of water

Accidental ingestion of seawater while swimming in the sea may happen; therefore, assess internal exposure from ingestion of water while swimming.

Equation (6-1-8) shows the calculation equation of the effective dose D_6 (mSv/year) from radioactive materials from ingestion of water.

$$D_6 = \sum_i t_6 \bullet Hs \bullet (x_6)_i \bullet \left(K_F^{50}\right)_i \tag{6-1-8}$$

where

 t_6 is the annual swimming time (h/year)

Hs is the seawater intake rate during swimming and conservatively set to 0.2L/h for adult and child under school age

 $(x_6)_i$ is the concentration of nuclide i in seawater (Bq/L)

 $(K_F^{50})_i$ is the committed effective dose factor from ingestion of nuclide i ((mSv)/(Bq))

For the committed effective dose factor from ingestion, the factor specified in Table III.2D. "Members of the Public: Committed Effective Dose per Unit Intake e(g) via ingestion (Sv/Bq)" of the IAEA No. GSR Part 3 "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" (hereinafter called "GSR Part 3") was used (Table 6-1-10).

Infant was excluded from the assessment targets because it rarely swims.

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

(7) Internal exposure from inhalation of seawater spray

Internal exposure from inhalation of seawater spray is assessed because seawater spray caused by waves is considered to be inhaled at beaches. The assessment procedure is based on the IAEA-TECDOC-1759 "Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure" [24] (hereinafter called "TECDOC-1759"). Equation (6-1-9) shows the calculation equation of the effective dose D_7 (mSv/year) from

Equation (6-1-9) shows the calculation equation of the effective dose D_7 (mSv/year) from radioactive materials from inhalation of seawater spray.

$$D_7 = 10^3 \bullet \sum_i t_7 \bullet Rs \bullet \frac{C_s}{\rho_w} (x_7)_i \bullet \left(K_h^{50}\right)_i \tag{6-1-9}$$

where

 t_7 is the annual beach stay time (h/year)

Rs is the respiration rate, and 0.925 m³/h, 0.363 m³/h, and 0.119 m³/h are used for adult, child under school age, and infant, respectively, according to "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [25].

C_s is the air concentration of seawater spray (kg/m³) and the recommended value of TECDOC-1759, 1.0E-02kg/m³, is used

 ρ_w is the density of seawater and 1.0E+03 kg/m³ is used.

 $(x_7)_i$ is the concentration of nuclide *i* in seawater (Bq/L)

 $(K_h^{50})_i$ is the committed effective dose factor from inhalation of nuclide i (mSv/Bq)

is the factor converted to the unit (10³L/m³)

For the committed effective dose factor from inhalation, the factor specified in Table III.2E. "Members of the Public: Committed Effective Dose per Unit Intake e(g) via inhalation (Sv/Bq)" of GSR Part 3 was used, but only for tritium, the one specified in Table III.2G. "Inhalation: Committed Effective Dose per Unit Intake e(g) (Sv/Bq) for soluble or reactive gases and vapours" was used. (Table 6-1-11).

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

(8) Internal exposure from ingestion of seafood

Internal exposure from ingestion of radioactive materials that have migrated from the seawater to marine organisms through ingestion of seafood is assessed.

Equations (6-1-10) and (6-1-11) show the calculation equation of the effective dose D_8 (mSv/year) from ingestion of seafood

$$D_8 = \sum_{k} \sum_{i} (K_F^{50})_i \cdot H_{ki}$$
 (6-1-10)

$$H_{ki} = 365 \cdot 10^{-3} \cdot (x_8)_i \cdot (CF)_{ki} \cdot F_k \cdot W_k \cdot f_{ki}$$
(6-1-11)

where

 $(K_F^{50})_i$ is the committed effective dose factor from ingestion of nuclide i (mSv/Bq)

 H_{ki} is the ingestion rate (Bq/year) of nuclide i through ingestion of seafood k

 (x_8) Concentration of nuclide *i* in seawater (Bq/L)

 $(CF)_{ki}$ is the concentration factor of nuclide i to seafood k $((Bq/kg)/(Bq/L))^{34}$

 F_k is the market dilution factor³⁵

 W_k is the ingestion amount of seafood k (g/day)

 f_{ki} is the decay ratio of nuclide *i* from catching to ingestion of seafood *k* 365·10⁻³ is the factor converted to the unit (365 days/year, 10⁻³kg/g)

The committed effective dose coefficient from ingestion is the same as that from ingestion of water during swimming (Table 6-1-10).

For the concentration factor of seafood36, the factor specified in IAEA Technical Reports Series No.422 "Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment" [26] (hereinafter called "TRS-422") was used (Table 6-1-12).

Actually, market dilution which must occur during market distribution of seafood from other production areas and decay of nuclides from catching to ingestion of seafood were ignored to secure conservativeness.

The concentration in the seawater used for the assessment and the annual exposure time are set by the characteristics of representative persons.

Expedient factor indicating the relationship between the radioactive nuclide concentration in marine organisms (per wet weight) in marine organisms (in principle, edible parts) and the radioactive nuclide concentration in the seawater in the environment where such organisms live, which is used for the assessment model for migration to organisms (IAEA, 2004).

Generally, it is extremely rare that all foods are local products, and products caught in other places not affected by discharge of radioactive materials considered are distributed together. This reduces the impact of discharge of radioactive materials to the environment to be performed, so it is instructed to set and assess the percentage of intake (market dilution factor) for each food, but conservatively all products are assumed to be caught in the sea area in question without considering market dilution in this assessment.

Radioactive materials are ingested in organisms which live for a long time in the seawater containing radioactive materials depending on the types of elements, and it reaches equilibrium at a certain concentration. This refers to the ratio of the concentration of the radioactive materials in the seawater in the surrounding environment to the equilibrium concentration of radioactive materials in organisms.

Table 6-1-5 Dose conversion factor for the effective dose of radiation from the sea surface

(Decom	missioning nandbook [24	2] and others are shown in remarks)
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/L))	Remarks
H-3	0.0E+00	Defined 0 due to pure β nuclide
C-14	0.0E+00	Defined 0 due to pure β nuclide
Mn-54	1.7E-07	
Co-60	5.0E-07	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide
Se-79	4.8E-12	
Sr-90	1.6E-09	
Y-90	-	Contained in the parent nuclide Sr-90
Tc-99	1.5E-11	
Ru-106	4.5E-08	
Cd-113m	7.4E-11	
Sb-125	8.7E-08	
Te-125m	6.6E-09	
I-129	4.6E-09	
Cs-134	3.1E-07	
Cs-137	1.2E-07	
Ce-144	1.3E-08	
Pm-147	8.2E-12	
Sm-151	1.7E-12	
Eu-154	2.5E-07	
Eu-155	5.0E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
U-234	5.9E-11	
U-238	5.2E-09	
Np-237	4.4E-08	
Pu-238	4.7E-11	
Pu-239	2.6E-11	
Pu-240	4.6E-11	
Pu-241	2.9E-08	
Am-241	4.6E-09	
Cm-243	4.4E-08	Conservatively, the same value as that of Am- 243 is set because no value is given to this nuclide in the source
Cm-244	4.5E-11	

Table 6-1-6 Dose conversion factor for the effective dose of radiation from hulls (Decommissioning handbook [22] and others are shown in remarks)

(Decomm	issioning handbook [22	2] and others are shown in remarks)
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/m²))	Remarks
H-3	0.0E+00	Defined 0 due to pure β nuclide
C-14	0.0E+00	Defined 0 due to pure β nuclide
Mn-54	1.4E-09	
Co-60	3.5E-09	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide
Se-79	1.5E-12	
Sr-90	5.8E-11	
Y-90	-	Contained in the parent nuclide Sr-90
Tc-99	2.8E-12	
Ru-106	4.0E-10	
Cd-113m	7.2E-12	
Sb-125	8.3E-10	
Te-125m	4.4E-10	
I-129	3.0E-10	
Cs-134	2.4E-09	
Cs-137	9.5E-10	
Ce-144	1.6E-10	
Pm-147	1.9E-12	
Sm-151	8.7E-13	
Eu-154	1.8E-09	
Eu-155	3.5E-09	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
U-234	9.4E-11	
U-238	2.5E-10	
Np-237	1.4E-09	
Pu-238	1.1E-10	
Pu-239	3.9E-11	
Pu-240	1.0E-10	
Pu-241	7.7E-10	
Am-241	2.0E-10	
Cm-243	1.1E-09	Conservatively, the same value as that of Am-243 is set because no value is given to this nuclide in the source
Cm-244	1.0E-10	
· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	·

Table 6-1-7 Dose conversion factor for the effective dose of radiation from seawater during swimming and underwater work

(Decomin	nissioning nandbook [2/	2] and others are snown in remarks)
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/L))	Remarks
H-3	0.0E+00	
C-14	0.0E+00	
Mn-54	4.8E-07	
Co-60	1.4E-06	
Ni-63	0.0E+00	
Se-79	0.0E+00	
Sr-90	7.2E-13	
Y-90	-	Contained in the parent nuclide Sr-90
Tc-99	4.0E-13	
Ru-106	1.2E-07	
Cd-113m	4.2E-11	
Sb-125	2.5E-07	
Te-125m	2.0E-08	
I-129	1.4E-08	
Cs-134	9.0E-07	
Cs-137	3.4E-07	
Ce-144	2.8E-08	
Pm-147	2.5E-12	
Sm-151	8.3E-12	
Eu-154	6.4E-07	
Eu-155	1.4E-06	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
U-234	1.0E-09	
U-238	1.6E-08	
Np-237	1.5E-07	
Pu-238	1.1E-09	
Pu-239	5.2E-10	
Pu-240	9.9E-10	
Pu-241	8.1E-08	
Am-241	1.9E-08	
Cm-243	1.4E-07	Conservatively, the same value as that of Am- 243 is set because no value is given to this nuclide in the source
Cm-244	9.0E-10	

Table 6-1-8 Dose conversion factor for the effective dose of radiation from beach sand

(Decomin		2] and others are snown in remarks)
Nuclide	Dose conversion factor for the effective dose ((mSv/h)/(Bq/kg))	Remarks
H-3	0.0E+00	Defined 0 due to pure β nuclide
C-14	0.0E+00	Defined 0 due to pure β nuclide
Mn-54	1.6E-07	
Co-60	4.7E-07	
Ni-63	0.0E+00	Defined 0 due to pure β nuclide
Se-79	1.8E-12	
Sr-90	1.2E-09	
Y-90	-	Contained in the parent nuclide Sr-90
Tc-99	6.3E-12	
Ru-106	4.3E-08	
Cd-113m	4.1E-11	
Sb-125	8.3E-08	
Te-125m	1.9E-09	
I-129	1.3E-09	
Cs-134	3.1E-07	
Cs-137	1.2E-07	
Ce-144	1.0E-08	
Pm-147	3.5E-12	
Sm-151	6.3E-13	
Eu-154	2.3E-07	
Eu-155	4.7E-07	Conservatively, the same value as that of Co-60 is set because no value is given to this nuclide in the source
U-234	4.1E-11	
U-238	3.9E-09	
Np-237	3.7E-08	
Pu-238	3.6E-11	
Pu-239	2.1E-11	
Pu-240	3.5E-11	
Pu-241	2.0E-08	
Am-241	1.7E-09	
Cm-243	3.1E-08	Conservatively, the same value as that of Am- 243 is set because no value is given to this nuclide in the source
Cm-244	3.6E-11	

Table 6-1-9 Dose conversion factor for the effective dose of radiation from fishing nets

Nuclide Dose conversion factor for the effective dose ((mSv/h)/(Bq/kg)) Remarks H-3 0.0E+00 Defined 0 due to pure β nucli	3
H-3 0.0E+00 Defined 0 due to pure β nucli	
	ide
C-14 0.0E+00 Defined 0 due to pure β nucli	ide
Mn-54 3.2E-08	
Co-60 9.9E-08	
Ni-63 0.0E+00 Defined 0 due to pure β nucli	ide
Se-79 2.0E-13	
Sr-90 2.1E-10	
Y-90 - Contained in the parent nuclion	de Sr-90
Tc-99 7.9E-13	
Ru-106 8.2E-09	
Cd-113m 5.9E-12	
Sb-125 1.5E-08	
Te-125m 2.3E-10	
I-129 1.6E-10	
Cs-134 5.9E-08	
Cs-137 2.2E-08	
Ce-144 2.0E-09	
Pm-147 4.2E-13	
Sm-151 5.8E-14	
Eu-154 4.7E-08	
Eu-155 9.9E-08 Conservatively, the same value is given the source	
U-234 2.9E-12	
U-238 7.1E-10	
Np-237 6.2E-09	
Pu-238 1.7E-12	
Pu-239 1.9E-12	
Pu-240 1.8E-12	
Pu-241 3.1E-09	
Am-241 2.1E-10	
Cm-243 4.8E-09 Conservatively, the same value is given the source	
Cm-244 2.1E-12	

Table 6-1-10 Effective dose factor of ingestion (GSR Part 3 [13])

Table 6-1-10 Effective dose factor of ingestion (GSR Part 3 [13])					
T	Eff	ective dose fac (mSv/Bq)	ctor	BI.	
Target nuclide	Adult	Child under school age	Infant	Remarks	
H-3 (THO)	1.8E-08	3.1E-08	6.4E-08	Used for the assessment of ingestion of water	
H-3 (considering OBT)	2.0E-08	3.5E-08	7.0E-08	Used for the assessment of ingestion of seafood assuming that 10% of tritium to be ingested is OBT	
C-14	5.8E-07	9.9E-07	1.4E-06		
Mn-54	7.1E-07	1.9E-06	5.4E-06		
Co-60	3.4E-06	1.7E-05	5.4E-05		
Ni-63	1.5E-07	4.6E-07	1.6E-06		
Se-79	2.9E-06	1.9E-05	4.1E-05		
Sr-90	2.8E-05	4.7E-05	2.3E-04	Including the impact of the progeny nuclide	
Y-90	2.7E-06	1.0E-05	3.1E-05		
Tc-99	6.4E-07	2.3E-06	1.0E-05		
Ru-106	7.0E-06	2.5E-05	8.4E-05	Including the impact of the progeny nuclide	
Cd-113m	2.3E-05	3.9E-05	1.2E-04		
Sb-125	1.1E-06	3.4E-06	1.1E-05		
Te-125m	8.7E-07	3.3E-06	1.3E-05		
I-129	1.1E-04	1.7E-04	1.8E-04		
Cs-134	1.9E-05	1.3E-05	2.6E-05		
Cs-137	1.3E-05	9.6E-06	2.1E-05	Including the impact of the progeny nuclide	
Ce-144	5.2E-06	1.9E-05	6.6E-05	Including the impact of the progeny nuclide	
Pm-147	2.6E-07	9.6E-07	3.6E-06		
Sm-151	9.8E-08	3.3E-07	1.5E-06		
Eu-154	2.0E-06	6.5E-06	2.5E-05		
Eu-155	3.2E-07	1.1E-06	4.3E-06		
U-234	4.9E-05	8.8E-05	3.7E-04		
U-238	4.5E-05	8.0E-05	3.4E-04		
Np-237	1.1E-04	1.4E-04	2.0E-03		
Pu-238	2.3E-04	3.1E-04	4.0E-03		
Pu-239	2.5E-04	3.3E-04	4.2E-03		
Pu-240	2.5E-04	3.3E-04	4.2E-03		
Pu-241	4.8E-06	5.5E-06	5.6E-05		
Am-241	2.0E-04	2.7E-04	3.7E-03		
Cm-243	1.5E-04	2.2E-04	3.2E-03		
Cm-244	1.2E-04	1.9E-04	2.9E-03		

Table 6-1-11 Effective dose factor of inhalation (GSR Part 3 [13])

Table 0-		ective dose fac (mSv/Bq)		ation (GSR Part 3 [13])
Target nuclide	Adult	Child under school age	Infant	Remarks
H-3	1.8E-08	3.1E-08	6.4E-08	The conversion factor of tritium vapor is used
C-14	5.8E-06	1.1E-05	1.9E-05	
Mn-54	1.5E-06	3.8E-06	7.5E-06	
Co-60	3.1E-05	5.9E-05	9.2E-05	
Ni-63	1.3E-06	2.7E-06	4.8E-06	
Se-79	6.8E-06	1.3E-05	2.3E-05	
Sr-90	1.6E-04	2.7E-04	4.2E-04	Including the impact of the progeny nuclide
Y-90	1.5E-06	4.2E-06	1.3E-05	
Tc-99	1.3E-05	2.4E-05	4.1E-05	
Ru-106	6.6E-05	1.4E-04	2.6E-04	Including the impact of the progeny nuclide
Cd-113m	1.1E-04	1.8E-04	3.0E-04	
Sb-125	1.2E-05	2.4E-05	4.2E-05	
Te-125m	4.2E-06	7.8E-06	1.7E-05	
I-129	3.6E-05	6.1E-05	7.2E-05	
Cs-134	2.0E-05	4.1E-05	7.0E-05	
Cs-137	3.9E-05	7.0E-05	1.1E-04	Including the impact of the progeny nuclide
Ce-144	5.3E-05	1.4E-04	3.6E-04	Including the impact of the progeny nuclide
Pm-147	5.0E-06	1.1E-05	2.1E-05	
Sm-151	4.0E-06	6.7E-06	1.1E-05	
Eu-154	5.3E-05	9.7E-05	1.6E-04	
Eu-155	6.9E-06	1.4E-05	2.6E-05	
U-234	9.4E-03	1.9E-02	3.3E-02	
U-238	8.0E-03	1.6E-02	2.9E-02	
Np-237	5.0E-02	6.0E-02	9.8E-02	
Pu-238	1.1E-01	1.4E-01	2.0E-01	
Pu-239	1.2E-01	1.5E-01	2.1E-01	
Pu-240	1.2E-01	1.5E-01	2.1E-01	
Pu-241	2.3E-03	2.6E-03	2.8E-03	
Am-241	9.6E-02	1.2E-01	1.8E-01	
Cm-243	6.9E-02	9.5E-02	1.6E-01	
Cm-244	5.7E-02	8.3E-02	1.5E-01	

Table 6-1-12 Concentration factor for seafood (TRS-422 [26] and others are shown in remarks)

Target	Concer	tration factor ((Bq/kg)/(Bq/L))	Remarks
Nuclide	Fish	Invertebrate	Seaweeds	Remarks
H-3	1.0E+00	1.0E+00	1.0E+00	
C-14	2.0E+04	2.0E+04	1.0E+04	
Mn-54	1.0E+03	5.0E+04	6.0E+03	
Co-60	7.0E+02	2.0E+04	6.0E+03	
Ni-63	1.0E+03	2.0E+03	2.0E+03	
Se-79	1.0E+04	1.0E+04	1.0E+03	
Sr-90	3.0E+00	1.0E+01	1.0E+01	
Y-90	-	-	-	Equilibrium state with the parent nuclide Sr-90
Tc-99	8.0E+01	5.0E+02	3.0E+04	
Ru-106	2.0E+00	5.0E+02	2.0E+03	
Cd-113m	5.0E+03	8.0E+04	2.0E+04	
Sb-125	6.0E+02	3.0E+02	2.0E+01	
Te-125m	1.0E+03	1.0E+03	1.0E+04	
I-129	9.0E+00	1.0E+01	1.0E+04	
Cs-134	1.0E+02	6.0E+01	5.0E+01	
Cs-137	1.0E+02	6.0E+01	5.0E+01	
Ce-144	5.0E+01	2.0E+03	5.0E+03	
Pm-147	3.0E+02	7.0E+03	3.0E+03	
Sm-151	3.0E+02	7.0E+03	3.0E+03	
Eu-154	3.0E+02	7.0E+03	3.0E+03	
Eu-155	3.0E+02	7.0E+03	3.0E+03	
U-234	1.0E+00	3.0E+01	1.0E+02	
U-238	1.0E+00	3.0E+01	1.0E+02	
Np-237	1.0E+00	4.0E+02	5.0E+01	
Pu-238	1.0E+02	3.0E+03	4.0E+03	
Pu-239	1.0E+02	3.0E+03	4.0E+03	
Pu-240	1.0E+02	3.0E+03	4.0E+03	
Pu-241	1.0E+02	3.0E+03	4.0E+03	
Am-241	1.0E+02	1.0E+03	8.0E+03	
Cm-243	1.0E+02	1.0E+03	5.0E+03	
Cm-244	1.0E+02	1.0E+03	5.0E+03	

^{*} For invertebrates, the value of molluscs (excluding cephalopods) was used.

(4) Setting of the representative person subject to the exposure assessment

(1) Situation around the FDNPS

According to GSG-9, the living habits and characteristics of the representative person for some of the exposure pathways should be based on the highest group from the distribution of the living habit data (e.g. 95 percentile value), etc.

However, as shown in Figure 6-1-10, in the area around the FDNPS, measures to prevent the general public from living in the area are taken by setting Difficult-to-Return Zones set in response to the accident, installing intermediate storage facilities surrounding the land side of the FDNPS, etc. In addition, fishing industry in Fukushima is yet in the middle of reconstruction.

This situation is expected to improve gradually thanks to the lifting of the setting of Difficult-to-Return Zones, mitigation of residence restriction, etc., but it is not desirable as a future prediction to make judgment based on the current data, so no assessment shall be performed based on the actual data of the current situation and instead an assessment shall be performed using the data used for the safety review of the existing reactor facilities, etc. We will consider the adoption of the actual data about living habits and characteristics of the representative person which will be accumulated in the future as the reconstruction of this area will proceed.



Source: Support for victims of the nuclear accident of the Ministry of Economy, Trade and Industry (Regarding evacuation orders)] Prepared by Tokyo Electric Power Company Holdings, Inc. based on the map of the area surrounding Difficult-to-Return Zones (from R2.12.10)

https://www.meti.go.jp/earthquake/nuclear/kinkyu.html

Figure 6-1-10 Condition of Difficult-to-Return Zones, etc. around the FDNPS

(2) Characteristics of the representative person

The characteristics of the representative person subject to exposure assessment was set as follows according to "Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities," etc.

- Engage in fishing 120 days (2,880 hours) a year, of which 80 days (1,920 hours) are spent near fishing nets.
- Stay at the beach 500 hours a year and swim for 96 hours.

The ingestion of seafood was set based on classification into fish (total of the fishery product (excluding shellfish, squid, octopus, shrimp, and crab) and processed fishery products), invertebrates (total of shellfish, squid, octopus, shrimp, and crab), and seaweeds (algae) extracting the data of ingestion of fishery products, processed fishery products, and algae from "National Health and Nutrition Survey (2019)"³⁷ of the Ministry of Health, Labour and Welfare, which is the latest large-scale survey result regarding ingestion of foods of the entire Japanese people. It was decided to assess the ingestion of seafood considering three age groups (adult, child under school age, and infant) in the following two cases.

- i. Individual who ingests the average amount of seafood The average ingestion amount of those who are aged 20 or older is used as the value of adult. 1/2 and 1/5 of the value of adult are used as the values of child under school age (assumed to be aged 5 or older) and infant (assumed to be aged 1), respectively, based on "Guidelines for the Assessment of Dose Target Values Around Light Water Reactor Facilities" [25].
- ii. Persons who ingests the large amount of seafood The value of adult is set to the average ingestion of those who are aged 20 or older plus twice the value of the standard deviation. Those of child under school age and infant are set to 1/2 and 1/5, respectively, of the value of adult. Tables 6-1-13 and 6-1-14 show the set ingestion of seafood.

For external exposure, no age group is set because ICRP Publication 101a "Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public" [27] stipulates "It is generally recognized that for external exposure in the environment, there is little variability in dose per unit of exposure with age."

³⁷ In 2020 and 2021, the survey itself was not performed due to the novel coronavirus.

The assessment points related to exposure and the seawater concentration used for the assessment are as follows.

- External exposure from sea surface and external exposure from hulls

 The nearest ports to the south and north of the FDNPS is 5 km or more away from
 the FDNPS. Fishing is widely performed by ships from fishing ports in the sea area,
 including the area around the FDNPS centering on the fishing ports. Therefore, to
 assess the external exposure from sea surface and external exposure from hulls, it
 seems appropriate to assess the entire sea area centering on the fishing ports. But
 in this assessment, the assessment area is conservatively set within 5 km to the
 north and south and 10 km off the coast of the FDNPS (range of 10 km × 10 km
 around the FDNPS (Figure 6-1-11)). The concentration in the seawater used for the
 assessment is the annual average concentration on the sea surface (top layer)
 within 10 km × 10 km around the FDNPS, including areas where no fishing is
 conducted on a daily basis.
- ii. External exposure from seawater during swimming, etc., external exposure from beach sand, internal exposure from ingestion of water, and internal exposure from inhalation of seawater spray
 - The coastline around the FDNPS is a Difficult-to-Return Zone and intermediate storage facilities are installed there, but there is a beach in the habitable area in the north side. Since the result of dispersion assessment shows that the annual averarge concentration of radioactive materials in seawater near those sand beaches is high, the assessment point for these pathways is set to be the nearby beach to the north of the FDNPS and the concentration in the seawater used for the assessment is set to be the annual average concentration in the seawater (all layers) in front of the beach. Since the water depth is less than 5m near the coast, mixing of the upper and lower layers is remarkable, so that there is little difference between the concentration on the sea surface and the average concentration of all layers.
- iii. External exposure from fishing nets and internal exposure from ingestion of seafood It is considered that radioactive materials will migrate from seawater to fishing nets at the time of fishing. In addition, fish are caught by fishing and delivered to the dinner table as seafood. Therefore, only within the range of 10 km × 10 km around the FDNPS for point of assessment as with i. conservatively, but fish are found from the surface layer to the bottom layer and fishing nets are used at depths

appropriate for the fish to be caught, so the concentration in the seawater is the annual average concentration in the seawater (all layers) in front of the beach.

The specific calculation method of the concentration in the seawater is shown in 6-1-3.(1) to (3).

Table 6-1-13 Ingestion of persons who ingest the average amount of seafood (g/day) (Set based on the National Health and Nutrition Survey in Japan in 2019 (Ministry of Health, Labour and Welfare) [6])

	Fish	Invertebrate	Seaweeds
Adult	58	10	11
Child under school age	29	5.1	5.3
Infant	12	2.0	2.1

Table 6-1-14 Ingestion of persons who consume a large amount of seafood (g/day) (Set based on the National Health and Nutrition Survey in Japan in 2019 (Ministry of Health, Labour and Welfare) [6])

	Fish	Invertebrate	Seaweeds
Adult	190	62	52
Child under school age	97	31	26
Infant	39	12	10

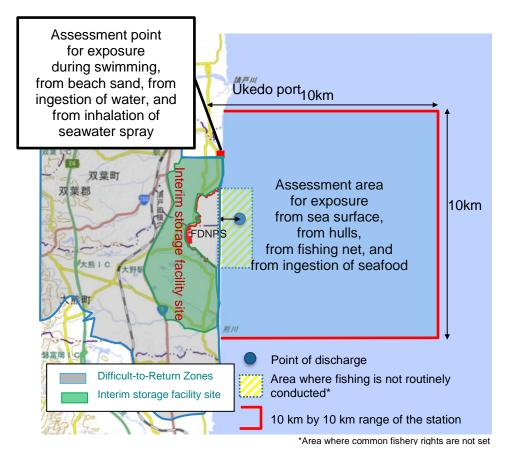


Figure 6-1-11 Point to determine concentrations in seawater used for the assessment of exposures in normal conditions

Source: Geographical Survey Institute (Electronic Map Web) and support for victims of the nuclear accident of the Ministry of Economy, Trade and Industry (Regarding evacuation orders) Prepared by Tokyo Electric Power Company Holdings, Inc. based on the map of the area surrounding Difficult-to-Return Zones (from R2.12.10)

https://maps.gsi.go.jp/#13/37.422730/141.044970/&base=std&ls=std&disp=1&vs=c1j0h0k0l0u0t0z0r0s0m0f1

(5) Dose assessment method

Exposure is calculated by the assessment method set in 6-1-2.(3).

The calculation result is compared with the dose limit of 1 mSv/year for the general public, and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is deemed to be equivalent to the dose constraint by the Nuclear Regulation Authority, as shown in 4.(1).

6-1-3. Assessment result

(1) Diffusion simulation result

The tritium concentration in the seawater after advection and diffusion was calculated using the model shown in 6-1-2.(2) assuming discharge of a total of 22 TBq (2.2E+13Bq) of tritium per year at an even pace throughout the year from the seabed about 1 km off the coast of the FDNPS. The calculation based on the meteorological and oceanographic conditions was performed for two years: 2014 and 2019. Though there is no large difference between the results of the two years, we decided to use the calculation result based on the meteorological and oceanographic conditions of 2019, in which the average concentration around the FDNPS is higher, for the assessment. Figures 6-1-12 to 6-1-18 show the calculation result. Figures 6-1-12 and 6-1-13 show the annual average concentrations of the sea surfaces of a wide area and the area around the FDNPS, respectively. The range of concentrations over 1Bq/L on the sea surface is about 3 km around the FDNPS.

Figures 6-1-14 and 6-1-15 diagrammatically show the annual average concentrations in the seawater with east-west and north-south sectional views, respectively. The stored water amount of the assessed cell near the discharge point of the seabed is large, so the concentration is assessed to be about 30Bq/L and immediately drop in the area around the power station.

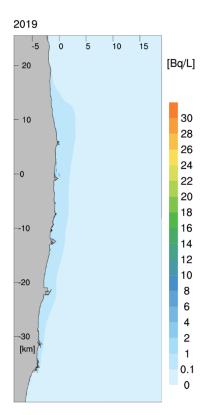
Figure 6-1-16 shows the average concentration distribution diagram of the sea surface in each season. The range of concentrations over 1Bq/L on the sea surface has more seasonal variation than in Figure 6-1-12, but it is limited to the area around the FDNPS.

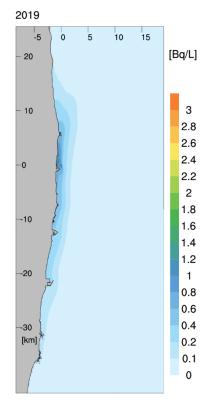
Figures 6-1-17 and 6-1-18 diagrammatically show the daily average concentrations on the sea surface throughout the year, which are expanded the most to the north, south, and east, respectively.

Attachment VIII "Difference in the diffusion range in the discharge position" shows the comparison between the discharge from the coast compared in the consideration of the discharge method and the calculation result.

To verify the impact of the variation of meteorological and oceanographic data between years, simulation calculation was performed using the meteorological and oceanographic data of 2015 to 2018 and 2020. Table 6-1-15 and Figure 6-1-19 show the calculation results of 7 years from 2014 and 2020. The calculation of the seven years is not a continuous calculation of the seven years but a collection of calculations of individual years, but the flow in the sea area changes on a daily basis and no accumulation trend is observed in calculation results of each year. On the other hand, the annual variation of the average concentration and diffusion range within 10 km × 10 km from the FDNPS is so small that there is no problem with using the calculation result of 2019 for a long-term assessment. We also verified the concentration on the boundary of the calculation area from the calculation result of seven years mentioned above. As a result, it turned out that the maximum value of daily average concentrations on the boundary of the calculation area was 1.4E-02Bq/L. The maximum annual mean concentration of the calculation region boundary was up to 2.6 E-04 Bq/L (2015, top layer), measured at the eastern boundary of the region.

This concentration is 3 to 4 orders of magnitude lower than the tritium concentration in the sea water in the sea area around Japan (about 0.1 to 1Bq/L) and 2 to 3 orders of magnitude lower than the assessment result of 10 km \times 10 km around the FDNPS, and no large variation in the concentration between years is observed, so the scale of the calculation area is sufficient and the impact of radiation on the environment outside the calculation area of this assessment is sufficiently small. Table 6-1-16 shows the maximum value of annual mean concentration on the calculation area boundary of each assessment year.





Detailed concentration classification in the left figure

Figure 6-1-12 Distribution of annual mean concentration on the sea surface (Discharge tritium 2.2E+13Bq constantly throughout the year)

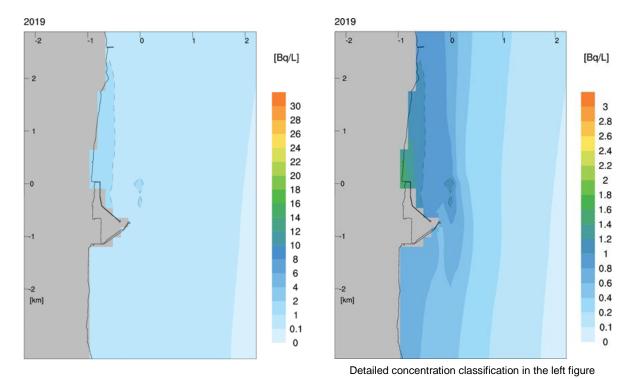


Figure 6-1-13 Distribution of annual mean concentration on the sea surface (expanded diagram of neighborhood)

(Discharge tritium 2.2E+13Bq constantly throughout the year)

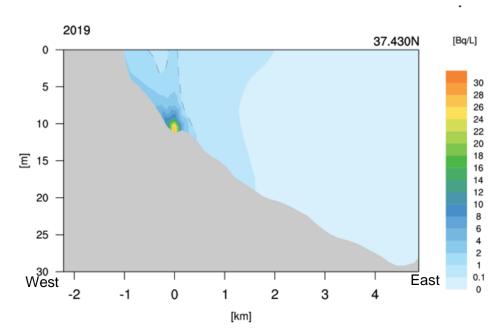


Figure 6-1-14 Distribution of annual mean concentration on the sea surface (east-west section view of the discharge position)

(Discharge tritium 2.2E+13Bq constantly throughout the year)

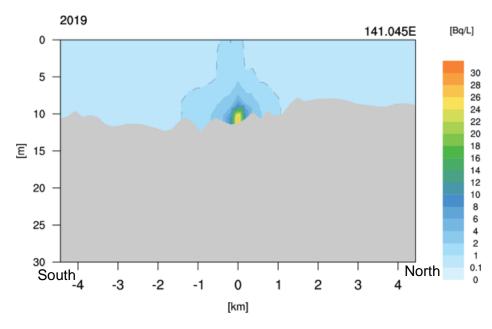
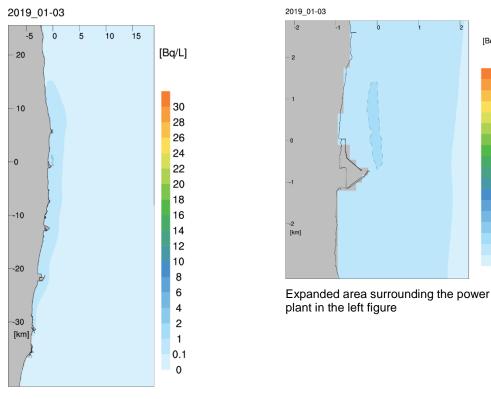


Figure 6-1-15 Distribution of annual mean concentration on the sea surface (north-south section view of the discharge position)

(Discharge tritium 2.2E+13Bq constantly throughout the year)



[Bq/L]

0.1

Figure 6-1-16(1) Average concentration distribution diagram of the sea surface in each season

(Average of January to March)

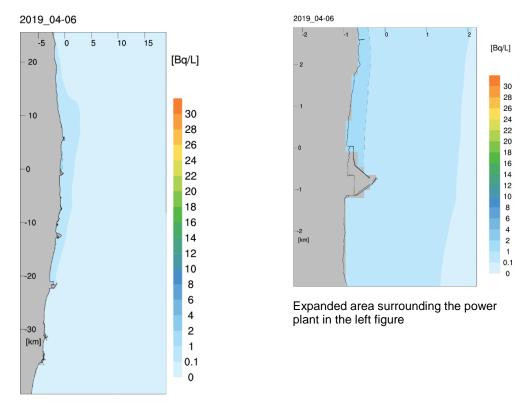


Figure 6-1-16(2) Average concentration distribution diagram of the sea surface in each season

(Average of April to June)

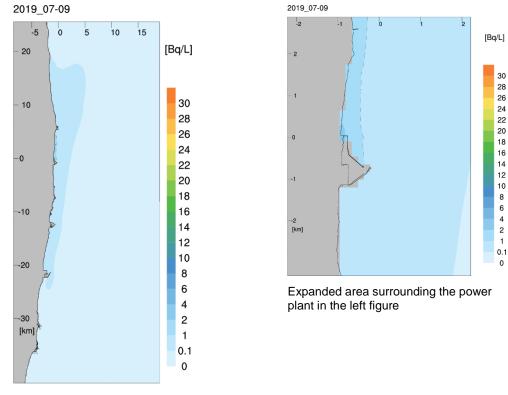


Figure 6-1-16(3) Average concentration distribution diagram of the sea surface in each season

(Average of July to September)

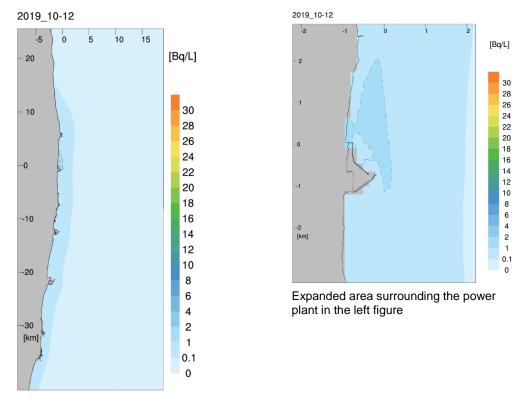


Figure 6-1-16(4) Average concentration distribution diagram of the sea surface in each season

(Average of October to December)

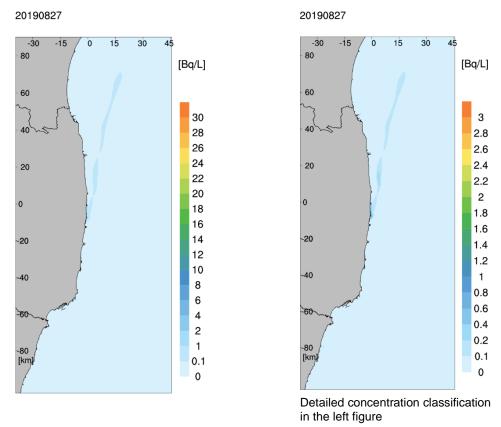


Figure 6-1-17(1) Distribution of daily mean concentration on the sea surface (When the range of 0.1 Bq/L extends to the northernmost point)

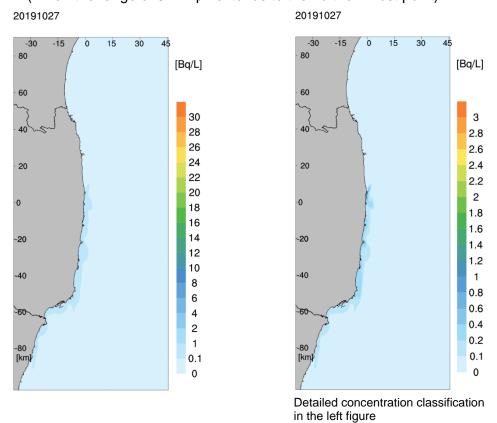


Figure 6-1-17(2) Distribution of daily mean concentration on the sea surface (When the range of 0.1 Bq/L extends to the southernmost point)

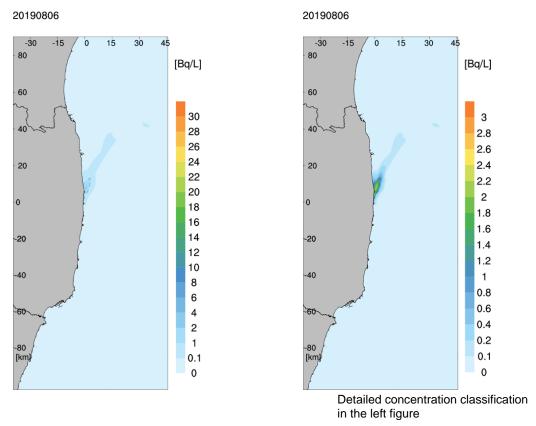


Figure 6-1-17(3) Distribution of daily mean concentration on the sea surface (When the range of 0.1 Bq/L extends to the easternmost point)

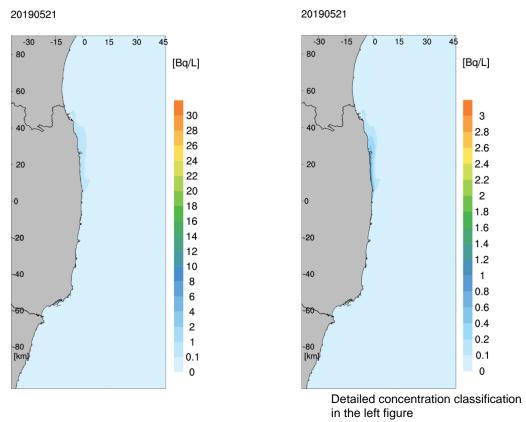


Figure 6-1-18(1) Distribution of daily mean concentration on the sea surface (When the range of 1 Bq/L extends to the easternmost point)

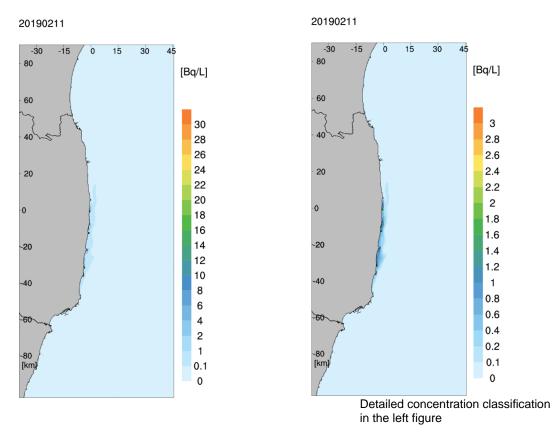


Figure 6-1-18(2) Distribution of daily mean concentration on the sea surface (When the range of 1 Bq/L extends to the southernmost point)

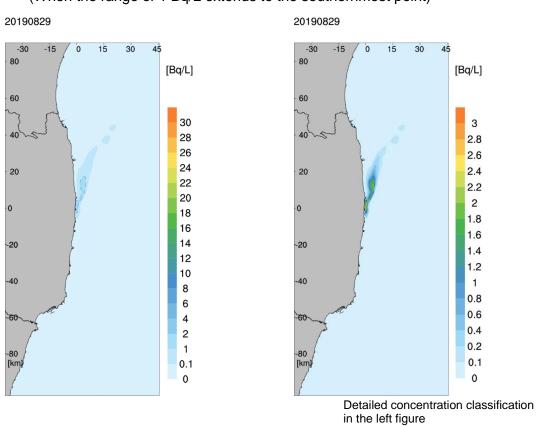


Figure 6-1-18(3) Distribution of daily mean concentration on the sea surface

(When the range of 1 Bq/L extends to the easternmost point)

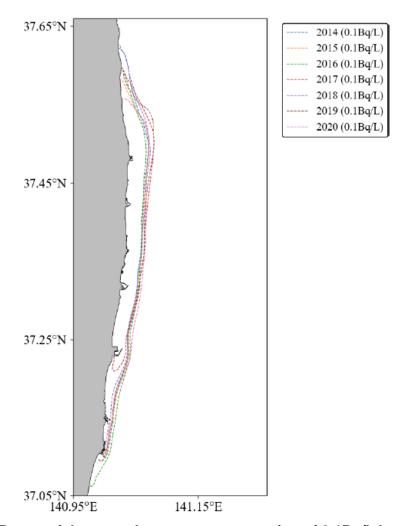


Figure 6-1-19 Range of the annual average concentration of 0.1Bq/L between 2014 and 2020

Table 6-1-15 Calculation result of the annual average concentration within the range of 10 km × 10 km between 2014 and 2020

V	Annual average concentration within 10 km × 10 km around the FDNPS (Bq/L)				
Year	All layers	Top layer	Bottom layer		
2014	4.8E-02	1.0E-01	5.0E-02		
2015	4.9E-02	9.6E-02	5.3E-02		
2016	4.9E-02	9.6E-02	5.3E-02		
2017	5.8E-02	1.2E-01	6.3E-02		
2018	5.0E-02	1.1E-01	5.4E-02		
2019	5.6E-02	1.2E-01	6.0E-02		
2020	5.4E-02	1.1E-01	6.0E-02		
Mean	5.2E-02	1.1E-01	5.6E-02		
Standard deviation	3.8E-03	9.3E-03	4.4E-03		

Table 6-1-16 Maximum concentration on the boundary of the calculation area (all of the north, east, and south sides)

	_	Coordinate				
Year	Concentration (Bq/L)	East - West (0: West boundary, 460: East boundary)	North - South (0: South boundary, 658: North boundary)	Depth (0: Bottom layer, 29: Top layer)		
2014	1.1E-04	460 (East boundary)	80	23		
2015	2.6E-04	460 (East boundary)	145	29		
2016	1.4E-04	460 (East boundary)	318	25		
2017	2.4E-04	460 (East boundary)	224	23		
2018	1.9E-04	460 (East boundary)	150	29		
2019	1.6E-04	460 (East boundary)	181	28		
2020	1.9E-04	460 (East boundary)	232	28		

(2) Concentration of each nuclide used for the assessment in the seawater

The concentration of the other nuclides was calculated from the ratio of tritium to the annual discharge amount of the other nuclides in the source term based on the assessment result of advection and diffusion to tritium.

Table 6-1-17 shows the concentration of tritium in the seawater within 10 km \times 10 km around the FDNPS and at the beach assessment point to the north of the FDNPS (annual discharge amount) in the case of the annual discharge amount of 22 TBq (2.2E+13Bq) of tritium. The change rate of the concentration of 2019 from the concentration of 2014 is about 20%.

Though the impact of annual variation is small, we decided to use the concentration of 2019, which is higher, for the exposure assessment.

Tables 6-1-18 to 20 show this result and the radioactive material concentration in the seawater for the assessment calculated from the annual discharge amount of each nuclide shown in Tables 6-1-1 to 6-1-3.

Table 6-1-17 Tritium concentration in the seawater in the case of the annual tritium discharge amount of 2.2E+13Bq

		Calcu			
	Depth	Meteorological and oceanographic data of 2014	and	Difference (%)	Concentration for assessment (Bq/L)
Annual average concentration within 10 km × 10 km around the FDNPS	All layers	4.8E-02	5.6E-02	17	5.6E-02
	Top layer	1.0E-01	1.2E-01	20	1.2E-01
Annual average concentration of the beach assessment point	All layers	7.2E-01	8.8E-01	22	8.8E-01

Table 6-1-18 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

(000		Concentration in the seawater used for the assessment (Bg/L)				
Target	Annual discharge amount		Within 10 km × 10 km	Beach assessment		
nuclide	(Bq)	Within 10 km x 10 km Average of all layers	Average of the top layer	point Average of all layers		
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01		
C-14	1.7E+09	4.4E-06	9.5E-06	6.9E-05		
Mn-54	7.8E+05	2.0E-09	4.2E-09	3.1E-08		
Co-60	5.1E+07	1.3E-07	2.8E-07	2.0E-06		
Ni-63	2.5E+08	6.5E-07	1.4E-06	1.0E-05		
Se-79	1.7E+08	4.4E-07	9.5E-07	6.9E-06		
Sr-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06		
Y-90	2.5E+07	6.5E-08	1.4E-07	1.0E-06		
Tc-99	8.1E+07	2.1E-07	4.4E-07	3.2E-06		
Ru-106	1.9E+08	4.7E-07	1.0E-06	7.4E-06		
Cd-113m	2.1E+06	5.3E-09	1.1E-08	8.3E-08		
Sb-125	3.8E+07	9.7E-08	2.1E-07	1.5E-06		
Te-125m	3.8E+07	9.7E-08	2.1E-07	1.5E-06		
I-129	2.4E+08	6.2E-07	1.3E-06	9.7E-06		
Cs-134	5.2E+06	1.3E-08	2.8E-08	2.1E-07		
Cs-137	4.9E+07	1.2E-07	2.7E-07	1.9E-06		
Ce-144	7.3E+06	1.9E-08	4.0E-08	2.9E-07		
Pm-147	2.2E+07	5.6E-08	1.2E-07	8.8E-07		
Sm-151	1.0E+05	2.7E-10	5.7E-10	4.2E-09		
Eu-154	1.4E+06	3.5E-09	7.6E-09	5.6E-08		
Eu-155	3.8E+06	9.7E-09	2.1E-08	1.5E-07		
U-234	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
U-238	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Np-237	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Pu-238	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Pu-239	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Pu-240	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Pu-241	3.2E+06	8.3E-09	1.8E-08	1.3E-07		
Am-241	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Cm-243	7.3E+04	1.9E-10	4.0E-10	2.9E-09		
Cm-244	7.3E+04	1.9E-10	4.0E-10	2.9E-09		

	Annual discharge	Concentration in the seawater used for the assessment (Bq/L)			
Target nuclide	amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layer	Beach assessment point Average of all layers	
_	t exposure essment	From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray	

Table 6-1-19 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-C tank group)

`	Т	<u> </u>		<u> </u>
	A manual dia aharma	Concentration in t	the seawater used for	the assessment (Bq/L)
Target nuclide	Annual discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01
C-14	4.8E+08	1.2E-06	2.6E-06	1.9E-05
Mn-54	1.0E+06	2.6E-09	5.6E-09	4.1E-08
Co-60	8.9E+06	2.3E-08	4.8E-08	3.5E-07
Ni-63	2.3E+08	5.8E-07	1.2E-06	9.1E-06
Se-79	4.0E+07	1.0E-07	2.2E-07	1.6E-06
Sr-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08
Y-90	9.7E+05	2.5E-09	5.3E-09	3.9E-08
Tc-99	3.2E+07	8.2E-08	1.8E-07	1.3E-06
Ru-106	3.8E+07	9.6E-08	2.0E-07	1.5E-06
Cd-113m	2.3E+06	5.8E-09	1.2E-08	9.1E-08
Sb-125	6.2E+06	1.6E-08	3.4E-08	2.5E-07
Te-125m	6.2E+06	1.6E-08	3.4E-08	2.5E-07
I-129	3.2E+07	8.2E-08	1.8E-07	1.3E-06
Cs-134	2.0E+06	5.2E-09	1.1E-08	8.2E-08
Cs-137	5.1E+06	1.3E-08	2.8E-08	2.0E-07
Ce-144	1.5E+07	3.9E-08	8.3E-08	6.1E-07
Pm-147	2.1E+07	5.5E-08	1.2E-07	8.6E-07
Sm-151	3.0E+05	7.5E-10	1.6E-09	1.2E-08
Eu-154	3.0E+06	7.5E-09	1.6E-08	1.2E-07
Eu-155	9.1E+06	2.3E-08	5.0E-08	3.6E-07
U-234	8.9E+05	2.3E-09	4.8E-09	3.5E-08
U-238	8.9E+05	2.3E-09	4.8E-09	3.5E-08

	A I Paul	Concentration in t	he seawater used for t	the assessment (Bq/L)
Target nuclide	Annual discharge amount (Bq)	Within 10 km × 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers
Np-237	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Pu-238	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Pu-239	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Pu-240	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Pu-241	3.2E+07	8.2E-08	1.8E-07	1.3E-06
Am-241	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Cm-243	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Cm-244	8.9E+05	2.3E-09	4.8E-09	3.5E-08
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray

Table 6-1-20 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-G tank group)

		Concentration in	Concentration in the seawater used for the assessment (Bq/L)				
Target nuclide	Annual discharge amount (Bq)	Within 10 km x 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers			
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01			
C-14	1.3E+09	3.3E-06	7.1E-06	5.2E-05			
Mn-54	3.1E+06	7.9E-09	1.7E-08	1.2E-07			
Co-60	1.9E+07	4.8E-08	1.0E-07	7.5E-07			
Ni-63	7.2E+08	1.8E-06	3.9E-06	2.9E-05			
Se-79	1.2E+08	3.1E-07	6.7E-07	4.9E-06			
Sr-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07			
Y-90	2.6E+06	6.6E-09	1.4E-08	1.0E-07			
Tc-99	1.1E+08	2.7E-07	5.8E-07	4.2E-06			
Ru-106	3.9E+07	1.0E-07	2.1E-07	1.6E-06			
Cd-113m	7.0E+06	1.8E-08	3.8E-08	2.8E-07			
Sb-125	1.1E+07	2.9E-08	6.2E-08	4.6E-07			
Te-125m	1.1E+07	2.9E-08	6.2E-08	4.6E-07			
I-129	2.7E+07	6.8E-08	1.5E-07	1.1E-06			

		Concentration in the seawater used for the assessment (Bo				
Target nuclide	Annual discharge amount (Bq)	Within 10 km x 10 km Average of all layers	Within 10 km × 10 km Average of the top layers	Beach assessment point Average of all layers		
Cs-134	5.5E+06	1.4E-08	3.0E-08	2.2E-07		
Cs-137	2.7E+07	6.8E-08	1.5E-07	1.1E-06		
Ce-144	4.5E+07	1.1E-07	2.4E-07	1.8E-06		
Pm-147	5.9E+07	1.5E-07	3.2E-07	2.3E-06		
Sm-151	8.1E+05	2.1E-09	4.4E-09	3.3E-08		
Eu-154	8.1E+06	2.1E-08	4.4E-08	3.3E-07		
Eu-155	1.5E+07	3.7E-08	8.0E-08	5.9E-07		
U-234	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
U-238	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Np-237	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Pu-238	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Pu-239	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Pu-240	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Pu-241	8.1E+07	2.1E-07	4.4E-07	3.3E-06		
Am-241	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Cm-243	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Cm-244	2.3E+06	5.8E-09	1.2E-08	9.1E-08		
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray		

(3) Exposure assessment result

Tables 6-1-21 to 22 show the result of the exposure assessments of the following three cases using the concentrations in the seawater shown in Tables 6-1-18 to 6-1-20.

Source term based on the measured composition of nuclides

- K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

The result of human exposure assessment is 0.000002 (2E-06) to 0.0002 (2E-05) mSv/year. In all cases, the results were much smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value.

The assessment in the source term based on the measured value was assessed assuming that nuclides below the detection limits (undetected nuclides) were contained at the detection limits, so the assessment result is considered to be conservative. Attachment IX "Contribution to the undetected nuclides in the source term based on the measured value" shows the contribution of undetected nuclides in the assessment result.

Even in the exposure assessment of infant, of which the assessed value of internal exposure is high because the effective dose factor is large, the assessment result of internal exposure is 0.000001 (1.0E-06) mSv/year to 0.000012 (1.2E-05) mSv/year. This result is much lower than the dose limit of 1mSv/year as well as the target dose value of 0.05mSv/year, which is equivalent to the dose constraint.

Attachment X "Breakdown of the exposure assessment result by nuclide" shows the nuclidespecific breakdown of these assessment results.

In terms of the basic concept of radiation protection³⁸, which is to make every effort to reduce exposure as low as reasonably achievable while also considering social and economical balance, optimization of radiation protection does not necessarily equal to the minimization of exposure. Radiation protection is optimized to the extent that it does not exceed the dose constraint, so "the annual discharge amount of treated water", "Dose constraints", and "Exposure assessment result by the source term" are used for the calculation of the allowable upper limit of annual discharge amount. The result of the calculation is summarized in Reference G "Upper limit of annual discharge and optimization assessment result of each nuclide based on the dose constraint".

For example, if the calculation is performed the annual discharge amount of tritium from the assessment result of the K4 tank group of which value of the exposure assessment result is the largest among the source terms based on the measured values, the result is as follows considering the dose constraint is 0.05mSv/year and the exposure assessment result based on the source term of the K4 tank group (if the ingestion of seafood is large amount) is 2E-05mSv/year:

 $2.2E+13(Bq/year)\times0.05 (mSv/year)\div0.00002(mSv/year)=5.5E+16(Bq/year)=55 PBq/year (55,000 TBq/year)$

³⁸ The principle of "ALARA" (As Low As Reasonably Achievable), which means radiation can be utilized with optimizing exposure as low as reasonably achievable when benefits from a practice with the radiation outweigh risks by the exposure

As the same calculation, if the calculation is performed using the assessment result of the J1-C tank group of which value of the exposure assessment result is the smallest, the result is as follows:

2.2E+13(Bq/year)×0.05 (mSv/year)÷0.000002(mSv/year)= 5.5E+17(Bq/year)= 550 PBq/year (550,000 TBq/year)

The actual discharge amount will be determined setting the minimum value of 55 PBq (source term: K4 tank group, seafood ingestion: large amount) as the limit value, which is the lowest value depends on source term and seafood ingestion at a result of optimization of radiation protection.

On the other hand, the Basic Policy of the government in April 2021 stipulates "The total annual amount of tritium to be discharged will be at a level below the operational target value10 for tritium discharge of the Fukushima Daiichi NPS before the accident (22 TBq/year)." This is a policy-making decision with consideration of the viewpoint of risk optimization of the whole decommissioning process as well as ALPS treated water, the effect of natural decay of radioactive materials expected to occur during land storage of ALPS treated water, leakage risk and occupational exposure during long-term storage, and social acceptance such as understanding from stakeholders. Based on this circumstance, we set the annual discharge amount of tritium 22 TBq/year (2.2E+13Bq/year) in accordance with above mentioned "TEPCO's Action in response to Government's Policy," and assessed radiological environmental impact.

In accordance with the Basic Policy of the government, the annual discharge amount of tritium is to be reviewed periodically below the dose constraint, by closely examining the circumstances of contaminated water generation and tritium concentration of newly generated ALPS treated water, and paying sufficient attention to the optimization including viewpoint of stakeholders.

 Table 6-1-21 Results of human exposures assessment

Source term based on measured values								
	Source		Source to	enn based	on measur			
Assessed	term	i. K4 tar	nk group	ii. J1-C ta	ii. J1-C tank group		iii. J1-G tank group	
case	case Ingestion of seafood		Large	Average	Large	Average	Large	
	Sea surface	7.68	≣-10	2.3E	E-10	4.8E	E-10	
	Hull	7.28	Ξ-1 0	2.2E-10		4.6E-10		
External exposure (mSv/year)	During swimming	5.2E-10		1.6E-10		3.2E-10		
Bea	Beach sand	9.1E-07		2.7E-07		5.6E-07		
	Fishing net		1.8E-07		E-08	1.1E-07		
	Ingestion of water	3.38	3.3E-07		3.1E-07		3.1E-07	
Internal exposure (mSv/year)	posure of spray 9.1E-08		E-08	1.9E-07		3.8E-07		
	Ingestion of seafood	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	
Total (mSv/year)		6E-06	2E-05	2E-06	5E-06	3E-06	1E-05	

Table 6-1-22 Results of internal exposures assessment by age

	U-1-ZZ INC					····	9-
	Source		Source te	rm based	on measur	ed values	
Assessed	term	i. K4 taı	nk group	ii. J1-C ta	ank group	iii. J1-G tank group	
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large
Internal exposure	Adult	3.3E	E-07	3.1E	E-07	3.1E	E-07
from ingestion of	Child under school age	5.7E-07		5.3E-07		5.4E	E-07
water (mSv/year)	Infant	-		-		-	
Internal	Adult	9.1E-08		1.9E-07		3.8E-07	
from inhalation of	Child under school age	6.0E-08		1.1E	E-07	2.1E-07	
spray (mSv/year)	Infant	3.9E-08		6.3E	E-08	1.1E	E-07
Internal	Adult	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06
exposure from ingestion of seafood	Child under school age	4.6E-06	2.9E-06	1.1E-06	4.5E-06	2.4E-06	9.9E-06
(mSv/year)	Infant	2.9E-06	1.2E-05	1.0E-06	4.5E-06	2.5E-06	1.1E-05

6-2. Potential exposure assessment

Potential exposure was assessed according to the assessment procedure of potential exposure shown in GSG-10 (Figure 6-2-1).

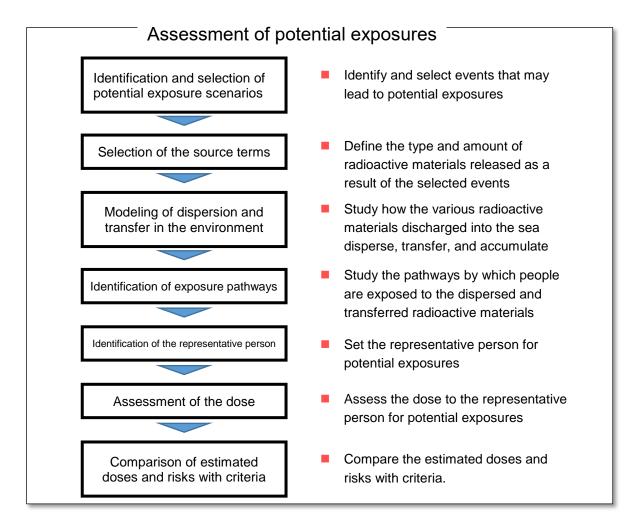


Figure 6-2-1. Assessment procedure of potential exposures

6-2-1. Assessment method

(1) Identification and selection of potential exposure scenarios

The facilities for discharging ALPS treated water into the sea are measurement/confirmation facility, transfer facility, dilution facility, and discharge facility. The target facilities contain two types of radioactive water: diluted and undiluted ALPS treated water. Therefore, unintentional discharge of ALPS treated water into the ocean is defined as the top event, and the following three types of specific abnormal events are defined:

- (1) Discharge radioactive materials with defective measurement/ confirmation
- (2) Discharge with insufficient seawater dilution
- (3) Leakage from facilities

In the design, to prevent these:

For (1)

- Set up interlock for discharge
- Duplication of tank valves
- Comparison with the analysis by a third-party institution
- Homogenization of samples by stirring and circulation equipment

For (2)

- Surveillance of the dilution rate based on the flow rate
- Set up interlock to stop discharge when the seawater flow rate is abnormal
- Installation of double emergency isolation valves

For (3)

- Stop in the event of earthquake
- Implementation of periodic patrol inspection
- Connection between the polyethylene pipes shall be a fusion structure.
- Installation of a leakage detector and weir in the flange
- Installation of a water level gauge in the receiving tank

Thanks to these and other measures, the unintentional discharge amount of ALPS treated water in the event of a single failure is limited to about 1.2 m³ at the most.

As for (1) and (2), discharge is prevented or mitigated by design and operation, but as for (3) leakage from facilities, there remains a possibility of occurrence caused by external events beyond design assumptions, etc., so we selected scenarios.

As mentioned at the beginning, the facilities for discharging ALPS treated water into the sea are measurement/confirmation facility, transfer facility, dilution facility, and discharge facility. Among these facilities, dilution facility and discharge facility are facilities containing ALPS treated water after dilution and the risk of exposure from leakage is negligible.

On the other hand, the measurement/confirmation facility mainly consists of tanks for measurement and confirmation, pumps, piping, and valves, and the transfer facility mainly consists of pumps, piping, and valves. As scenarios of leakage from these facilities, we selected case 1: leakage from piping, and case 2: leakage from tanks as the severest event, as follows.

Case 1 Leakage from piping

In the case of leakage from piping, the flow rate of ALPS treated water is considered to be the same as in normal conditions, but the water flows into the sea without dilution. As the severest scenario of leakage from piping, selected is the event of leakage of the whole amount of the maximum flow rare in the normal operation (500 m³/day) from near the north breakwater due to piping rupture near the sea. In addition, in reality, leakage is considered to stop on the following day because the flow rate is monitored constantly and a patrol inspection is performed every day, but here it is assumed that leakage was overlooked and continued for 20 days until one tank series for measurement/confirmation of 10,000 m³ became empty.

In the case of a break in the transfer pipes of ALPS treated water, the water may leak out to the vicinity of the Units 5/6 intakes or the Units 5/6 discharge outlets, depending on the location of the break, however, the Units 5/6 intakes are connected to the Units 5/6 discharge outlets due to the intake of seawater for dilution of ALPS treated water, so it is conservatively assumed that the entire amount of water would directly flow out the vicinity of the Units 5/6 discharge outlets.

Case 2 Leakage from tanks

As the severest scenario, selected is the event of leakage of ALPS treated water of 30,000 m³ per day into the sea due to damage of all of the 3 tank groups for measurement/confirmation caused by an enormous earthquake, etc. In reality, it is conceivable that some of ALPS treated water may remain in the tanks and weirs or penetrate into the ground within the site, but it was decided that the whole volume would flow into the sea in this case.

The location of the outflow into the sea is assumed to be the same as in Case 1, with the entire amount of water discharged directly to the vicinity of the Units 5/6 discharge outlets.

(2) Source term (daily discharge amount of each nuclide)

Case 1 (Piping rupture)

Leaked ALPS treated water is the one which is usually discharged after dilution, and the source term was calculated from the product of the composition of nuclides based on the measured value and the maximum daily discharge volume of water (500 m³/day). Tables 6-2-1 to 6-2-3 show the source term used for the assessment.

Table 6-2-1 Source term based on the nuclide composition of measured values (K4 tank group) (Case 1)

		•		· · · · · · · · · · · · · · · · · · ·
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	1.9E+05	5.0E+05	9.5E+10	The daily discharge amount
C-14	1.5E+01		7.5E+06	was calculated from the product of the maximum value
Mn-54	6.7E-03		3.4E+03	of the daily discharge volume
Co-60	4.4E-01		2.2E+05	of water in normal operation, 500 m ³ , and the concentrations
Ni-63	2.2E+00		1.1E+06	of each nuclide
Se-79	1.5E+00		7.5E+05	
Sr-90	2.2E-01		1.1E+05	
Y-90	2.2E-01		1.1E+05	
Tc-99	7.0E-01		3.5E+05	
Ru-106	1.6E+00		8.0E+05	
Cd-113m	1.8E-02		9.0E+03	
Sb-125	3.3E-01		1.7E+05	
Te-125m	3.3E-01		1.7E+05	
I-129	2.1E+00		1.1E+06	
Cs-134	4.5E-02		2.3E+04	
Cs-137	4.2E-01		2.1E+05	
Ce-144	6.3E-02		3.2E+04	
Pm-147	1.9E-01		9.5E+04	
Sm-151	9.0E-04		4.5E+02	
Eu-154	1.2E-02		6.0E+03	
Eu-155	3.3E-02		1.7E+04	
U-234	6.3E-04		3.2E+02	
U-238	6.3E-04		3.2E+02	
Np-237	6.3E-04		3.2E+02	
Pu-238	6.3E-04		3.2E+02	
Pu-239	6.3E-04		3.2E+02	
Pu-240	6.3E-04		3.2E+02	
Pu-241	2.8E-02		1.4E+04	
Am-241	6.3E-04		3.2E+02	
Cm-243	6.3E-04		3.2E+02	
Cm-244	6.3E-04		3.2E+02	

Table 6-2-2 Source term based on the nuclide composition of measured values (J1-C tank group) (Case 1)

Target nuclide Nuclide concentration (Bq/L) Daily discharge volume of water (L/day) Daily discharge amount (Bq/day) Remarks H-3 8.2E+05 5.0E+05 4.1E+11 • The daily discharge amount was calculated from the product of the maximum value of the daily discharge volume of water in normal operation, 500 m³, and the concentrations of each nuclide Co-60 3.3E-00 4.3E+06 1.9E+04 • The daily discharge amount was calculated from the product of the maximum value of the daily discharge volume of water in normal operation, 500 m³, and the concentrations of each nuclide Se-79 1.5E+00 4.3E+06 7.5E+05 1.8E+04 1.7E+05 1.8E+04 1.8E+04 1.8E+04 1.8E+04 1.2E+05 1.		,	•		· · · · · · · · · · · · · · · · · · ·
H-3		concentration	discharge volume of water	amount	Remarks
C-14 1.8E+01 9.0E+06 1.9E+04 of the daily discharge volume of water in normal operation, S00 m³, and the concentrations of each nuclide	H-3	8.2E+05		4.1E+11	
Mn-54 3.8E-02 1.9E+04 1.7E+05 1.7E+05 3.8E-00	C-14	1.8E+01		9.0E+06	
Ni-63	Mn-54	3.8E-02		1.9E+04	of the daily discharge volume
Ni-63 8.5E+00 4.3E+06 7.5E+05 Se-79 1.5E+00 7.5E+05 Sr-90 3.6E-02 1.8E+04 Y-90 3.6E-02 1.8E+04 To-99 1.2E+00 6.0E+05 Ru-106 1.4E+00 7.0E+05 Cd-113m 8.5E-02 4.3E+04 Sb-125 2.3E-01 1.2E+05 I-129 1.2E+00 6.0E+05 I-129 1.2E+00 6.0E+05 Cs-134 7.6E-02 3.8E+04 Cc-134 7.6E-02 3.8E+04 Pm-147 8.0E-01 4.0E+05 Sm-151 1.1E-02 5.5E+03 Eu-154 1.1E-01 5.5E+04 Eu-155 3.4E-01 1.7E+04 U-234 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-239 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	Co-60	3.3E-01		1.7E+05	
Sr-90 3.6E-02 Y-90 3.6E-02 Tc-99 1.2E+00 Ru-106 1.4E+00 Cd-113m 8.5E-02 Sb-125 2.3E-01 Te-125m 2.3E-01 I-129 1.2E+05 I-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04	Ni-63	8.5E+00		4.3E+06	
Y-90 3.6E-02 1.8E+04 Tc-99 1.2E+00 6.0E+05 Ru-106 1.4E+00 7.0E+05 Cd-113m 8.5E-02 4.3E+04 Sb-125 2.3E-01 1.2E+05 Te-125m 2.3E-01 1.2E+05 I-129 1.2E+00 6.0E+05 Cs-134 7.6E-02 3.8E+04 Cs-137 1.9E-01 9.5E+04 Ce-144 5.7E-01 9.5E+04 Pm-147 8.0E-01 4.0E+05 Sm-151 1.1E-02 5.5E+03 Eu-154 1.1E-01 5.5E+03 Eu-155 3.4E-01 1.7E+05 U-234 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-238 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	Se-79	1.5E+00		7.5E+05	
Tc-99 1.2E+00 Ru-106 1.4E+00 Cd-113m 8.5E-02 Sb-125 2.3E-01 Te-125m 2.3E-01 1-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04 1.7E+04 Com-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04	Sr-90	3.6E-02		1.8E+04	
Ru-106 1.4E+00 Cd-113m 8.5E-02 Sb-125 2.3E-01 Te-125m 2.3E-01 I-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04	Y-90	3.6E-02		1.8E+04	
Cd-113m 8.5E-02 Sb-125 2.3E-01 Te-125m 2.3E-01 I-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04	Tc-99	1.2E+00		6.0E+05	
Sb-125 2.3E-01 Te-125m 2.3E-01 1-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04	Ru-106	1.4E+00		7.0E+05	
Te-125m 2.3E-01 I-129 1.2E+00 Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04	Cd-113m	8.5E-02		4.3E+04	
1-129	Sb-125	2.3E-01		1.2E+05	
Cs-134 7.6E-02 Cs-137 1.9E-01 Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 U-238 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04	Te-125m	2.3E-01		1.2E+05	
Cs-137 1.9E-01 9.5E+04 Ce-144 5.7E-01 2.9E+05 Pm-147 8.0E-01 4.0E+05 Sm-151 1.1E-02 5.5E+03 Eu-154 1.1E-01 5.5E+04 Eu-155 3.4E-01 1.7E+05 U-234 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-238 3.3E-02 1.7E+04 Pu-239 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	I-129	1.2E+00		6.0E+05	
Ce-144 5.7E-01 Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 U-238 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04	Cs-134	7.6E-02		3.8E+04	
Pm-147 8.0E-01 Sm-151 1.1E-02 Eu-154 1.1E-01 Eu-155 3.4E-01 U-234 3.3E-02 U-238 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04 1.7E+04 1.7E+04	Cs-137	1.9E-01		9.5E+04	
Sm-151 1.1E-02 5.5E+03 Eu-154 1.1E-01 5.5E+04 Eu-155 3.4E-01 1.7E+05 U-234 3.3E-02 1.7E+04 U-238 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-238 3.3E-02 1.7E+04 Pu-239 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	Ce-144	5.7E-01		2.9E+05	
Eu-154 1.1E-01 5.5E+04 Eu-155 3.4E-01 1.7E+05 U-234 3.3E-02 1.7E+04 U-238 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-238 3.3E-02 1.7E+04 Pu-239 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	Pm-147	8.0E-01		4.0E+05	
Eu-155 3.4E-01 1.7E+05 U-234 3.3E-02 1.7E+04 U-238 3.3E-02 1.7E+04 Np-237 3.3E-02 1.7E+04 Pu-238 3.3E-02 1.7E+04 Pu-239 3.3E-02 1.7E+04 Pu-240 3.3E-02 1.7E+04 Pu-241 1.2E+00 6.0E+05 Am-241 3.3E-02 1.7E+04 Cm-243 3.3E-02 1.7E+04	Sm-151	1.1E-02		5.5E+03	
U-234 3.3E-02 U-238 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04	Eu-154	1.1E-01		5.5E+04	
U-238 3.3E-02 Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04	Eu-155	3.4E-01		1.7E+05	
Np-237 3.3E-02 Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04	U-234	3.3E-02		1.7E+04	
Pu-238 3.3E-02 Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04 1.7E+04	U-238	3.3E-02		1.7E+04	
Pu-239 3.3E-02 Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04	Np-237	3.3E-02		1.7E+04	
Pu-240 3.3E-02 Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04	Pu-238	3.3E-02		1.7E+04	
Pu-241 1.2E+00 Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04	Pu-239	3.3E-02		1.7E+04	
Am-241 3.3E-02 Cm-243 3.3E-02 1.7E+04 1.7E+04	Pu-240	3.3E-02		1.7E+04	
Cm-243 3.3E-02 1.7E+04	Pu-241	1.2E+00		6.0E+05	
	Am-241	3.3E-02		1.7E+04	
Cm-244 3.3E-02 1.7E+04	Cm-243	3.3E-02		1.7E+04	
	Cm-244	3.3E-02		1.7E+04	

Table 6-2-3 Source term based on the nuclide composition of measured values (J1-G tank group) (Case 1)

	T	-	ink group) (oas	·
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	2.7E+05	5.0E+05	1.4E+11	The daily discharge amount
C-14	1.6E+01		8.0E+06	was calculated from the product of the maximum value
Mn-54	3.8E-02		1.9E+04	of the daily discharge volume
Co-60	2.3E-01		1.2E+05	of water in normal operation, 500 m ³ , and the concentrations
Ni-63	8.8E+00		4.4E+06	of each nuclide
Se-79	1.5E+00		7.5E+05	
Sr-90	3.2E-02		1.6E+04	
Y-90	3.2E-02		1.6E+04	
Tc-99	1.3E+00		6.5E+05	
Ru-106	4.8E-01		2.4E+05	
Cd-113m	8.6E-02		4.3E+04	
Sb-125	1.4E-01		7.0E+04	
Te-125m	1.4E-01		7.0E+04	
I-129	3.3E-01		1.7E+05	
Cs-134	6.7E-02		3.4E+04	
Cs-137	3.3E-01		1.7E+05	
Ce-144	5.5E-01		2.8E+05	
Pm-147	7.2E-01		3.6E+05	
Sm-151	1.0E-02		5.0E+03	
Eu-154	1.0E-01		5.0E+04	
Eu-155	1.8E-01		9.0E+04	
U-234	2.8E-02		1.4E+04	
U-238	2.8E-02		1.4E+04	
Np-237	2.8E-02		1.4E+04	
Pu-238	2.8E-02		1.4E+04	
Pu-239	2.8E-02		1.4E+04	
Pu-240	2.8E-02		1.4E+04	
Pu-241	1.0E+00		5.0E+05	
Am-241	2.8E-02		1.4E+04	
Cm-243	2.8E-02		1.4E+04	
Cm-244	2.8E-02		1.4E+04	

Case 2 (Tank damage)

Leaked ALPS treated water is the one which is usually discharged after dilution, and the source term was calculated from the product of the composition of nuclides based on the measured value and the daily discharge volume of water (30,000 m³/day). Tables 6-2-4 to 6-2-6 show the source term used for the assessment.

Table 6-2-4 Source term based on the nuclide composition of measured values (K4 tank group) (Case 2)

	T	,	n group, (ouco	<u>'</u>
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	1.9E+05	3.0E+07	5.7E+12	It was assumed that all of 3
C-14	1.5E+01		4.5E+08	tank groups for measurement/confirmation were
Mn-54	6.7E-03		2.0E+05	damaged and whole capacity
Co-60	4.4E-01		1.3E+07	(30,000 m³) leaked in 1 day • The daily discharge amount
Ni-63	2.2E+00		6.6E+07	was calculated from the product
Se-79	1.5E+00		4.5E+07	of the daily discharge volume of water, 30,000 m ³ , and the nuclide
Sr-90	2.2E-01		6.6E+06	concentration
Y-90	2.2E-01		6.6E+06	
Tc-99	7.0E-01		2.1E+07	
Ru-106	1.6E+00		4.8E+07	
Cd-113m	1.8E-02		5.4E+05	
Sb-125	3.3E-01		9.9E+06	
Te-125m	3.3E-01		9.9E+06	
I-129	2.1E+00		6.3E+07	
Cs-134	4.5E-02		1.4E+06	
Cs-137	4.2E-01		1.3E+07	
Ce-144	6.3E-02		1.9E+06	
Pm-147	1.9E-01		5.7E+06	
Sm-151	9.0E-04		2.7E+04	
Eu-154	1.2E-02		3.6E+05	
Eu-155	3.3E-02		9.9E+05	
U-234	6.3E-04		1.9E+04	
U-238	6.3E-04		1.9E+04	
Np-237	6.3E-04		1.9E+04	
Pu-238	6.3E-04		1.9E+04	
Pu-239	6.3E-04		1.9E+04	
Pu-240	6.3E-04		1.9E+04	
Pu-241	2.8E-02		8.4E+05	

Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
Am-241	6.3E-04		1.9E+04	
Cm-243	6.3E-04		1.9E+04	
Cm-244	6.3E-04		1.9E+04	

Table 6-2-5 Source term based on the nuclide composition of measured values (J1-C tank group) (Case 2)

		-		-
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
H-3	8.2E+05	3.0E+07	2.5E+13	It was assumed that all of 3
C-14	1.8E+01		5.4E+08	tank groups for measurement/confirmation were
Mn-54	3.8E-02		1.1E+06	damaged and whole capacity
Co-60	3.3E-01		9.9E+06	(30,000 m ³) leaked in 1 day • The daily discharge amount
Ni-63	8.5E+00		2.6E+08	was calculated from the product
Se-79	1.5E+00		4.5E+07	of the daily discharge volume of water, 30,000 m ³ , and the nuclide
Sr-90	3.6E-02		1.1E+06	concentration
Y-90	3.6E-02		1.1E+06	
Tc-99	1.2E+00		3.6E+07	
Ru-106	1.4E+00		4.2E+07	
Cd-113m	8.5E-02		2.6E+06	
Sb-125	2.3E-01		6.9E+06	
Te-125m	2.3E-01		6.9E+06	
I-129	1.2E+00		3.6E+07	
Cs-134	7.6E-02		2.3E+06	
Cs-137	1.9E-01		5.7E+06	
Ce-144	5.7E-01		1.7E+07	
Pm-147	8.0E-01		2.4E+07	
Sm-151	1.1E-02		3.3E+05	
Eu-154	1.1E-01		3.3E+06	
Eu-155	3.4E-01		1.0E+07	
U-234	3.3E-02		9.9E+05	
U-238	3.3E-02		9.9E+05	
Np-237	3.3E-02		9.9E+05	
Pu-238	3.3E-02		9.9E+05	
Pu-239	3.3E-02		9.9E+05	
Pu-240	3.3E-02		9.9E+05	

Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
Pu-241	1.2E+00		3.6E+07	
Am-241	3.3E-02		9.9E+05	
Cm-243	3.3E-02		9.9E+05	
Cm-244	3.3E-02		9.9E+05	

Table 6-2-6 Source term based on the nuclide composition of measured values (J1-G tank group) (Case 2)

	values (0.1 & taling group) (Case 2)					
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks		
H-3	2.7E+05	3.0E+07	8.1E+12	It was assumed that all of 3		
C-14	1.6E+01		4.8E+08	tank groups for measurement/confirmation were		
Mn-54	3.8E-02		1.1E+06	damaged and whole capacity		
Co-60	2.3E-01		6.9E+06	(30,000 m³) leaked in 1 day • The daily discharge amount		
Ni-63	8.8E+00		2.6E+08	was calculated from the product		
Se-79	1.5E+00		4.5E+07	of the daily discharge volume of		
Sr-90	3.2E-02		9.6E+05	water, 30,000 m ³ , and the nuclide concentration		
Y-90	3.2E-02		9.6E+05			
Tc-99	1.3E+00		3.9E+07			
Ru-106	4.8E-01		1.4E+07			
Cd-113m	8.6E-02		2.6E+06			
Sb-125	1.4E-01		4.2E+06			
Te-125m	1.4E-01		4.2E+06			
I-129	3.3E-01		9.9E+06			
Cs-134	6.7E-02		2.0E+06			
Cs-137	3.3E-01		9.9E+06			
Ce-144	5.5E-01		1.7E+07			
Pm-147	7.2E-01		2.2E+07			
Sm-151	1.0E-02		3.0E+05			
Eu-154	1.0E-01		3.0E+06			
Eu-155	1.8E-01		5.4E+06			
U-234	2.8E-02		8.4E+05			
U-238	2.8E-02		8.4E+05			
Np-237	2.8E-02		8.4E+05			
Pu-238	2.8E-02		8.4E+05			
Pu-239	2.8E-02		8.4E+05			

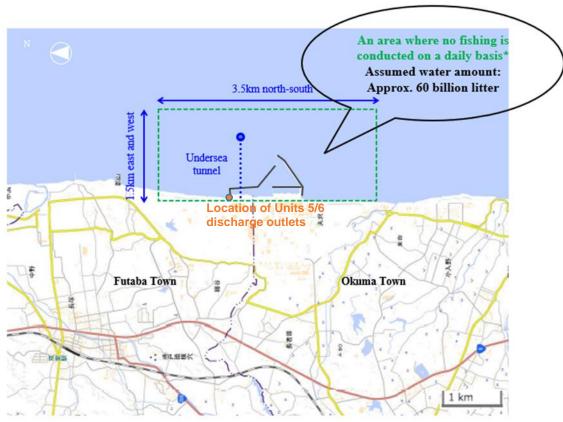
Target nuclide	Nuclide concentration (Bq/L)	Daily discharge volume of water (L/day)	Daily discharge amount (Bq/day)	Remarks
Pu-240	2.8E-02		8.4E+05	
Pu-241	1.0E+00		3.0E+07	
Am-241	2.8E-02		8.4E+05	
Cm-243	2.8E-02		8.4E+05	
Cm-244	2.8E-02		8.4E+05	

(3) Modeling of diffusion and transfer, and exposure pathways

In the assessment of potential exposure, the location of discharge into the sea changes from 1 km offshore to the coast, but these discharge destinations are the same sea area and diffusion and advection are assumed as same as those of the normal exposure, so the migration pathways are the same as those of the normal exposure set in 6-1-2.(2). Though the same model is also used for simulation, the calculation result based on discharge from near the Units 5/6 discharge outlets was used because it is the leakage from the coast. The location of the Units 5/6 discharge outlets are shown in Figure 6-2-1.

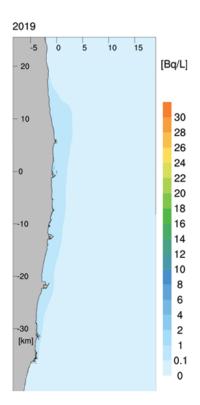
The target regions, sea areas, and migration pathways are the same, so exposure pathways are the same as those of the normal exposure.

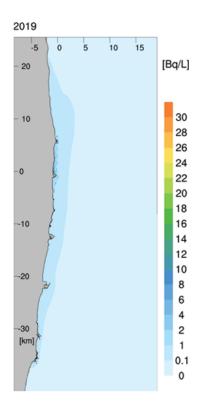
Figures 6-2-2 to 4 show the comparison figures of dispersion simulation results (annual mean concentration) for the different water discharge location. No significant difference in dispersion of the wide area are observed, but in the coastal area near the FDNPS the concentration is higher in the case of discharge from Units 5/6 discharge outlets.



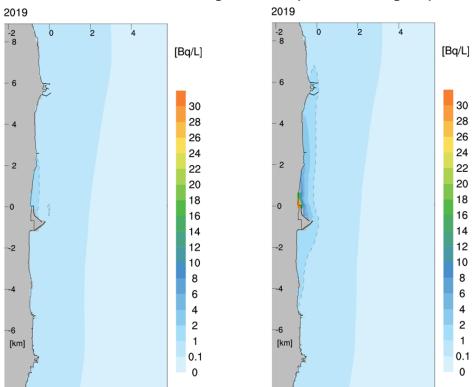
Source: Prepared by Tokyo Electric Power Company Holdings, Inc. based on the map developed by the Geospatial Information Authority of Japan (Electronic territory web)

Figure 6-2-1 Discharge location in present plan and the location of Units 5/6 discharge outlets

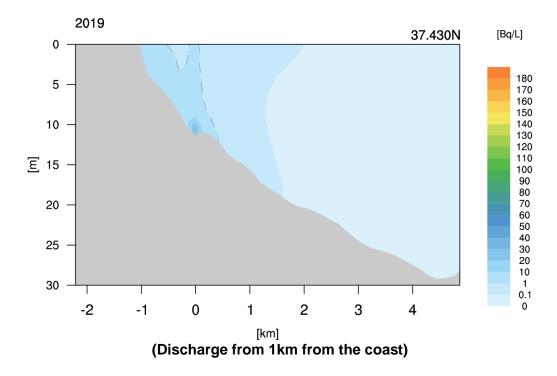


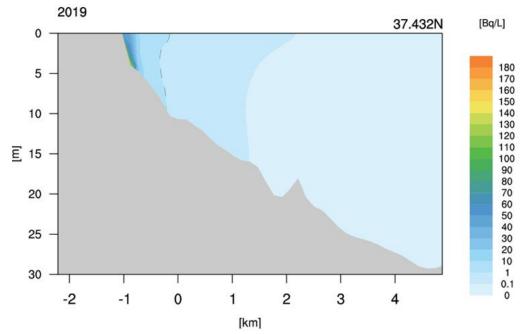


(Discharge from 1km from the coast) (Discharge from the Units 5/6 discharge outlets)
Figure 6-2-2 comparison of annual mean concentration distribution figures by the
difference in discharge location (wide area diagram)



(Discharge from 1km from the coast) (Discharge from the Units 5/6 discharge outlets) Figure 6-2-3 comparison of annual mean concentration distribution figures by the difference in discharge location (enlarged diagram)





(Discharge from the Units 5/6 discharge outlets)
Figure 6-2-4 comparison of annual mean concentration distribution figures by the difference in discharge location (cross-section diagram)

(4) Setting of the representative person

For the representative person subject to the potential exposure assessment, the region, sea area, migration pathways, and exposure pathways are the same, so the same as 6-1-2.(4) are applied and the representative person keeps the same living habit in case of the potential exposure. After leakage of ALPS treated water, diffusion proceeds due to tidal currents and the concentration immediately drops, but in this assessment, it is assumed conservatively that the same concentration in the seawater and the exposure will continue for one week even after the outflow end, considering the case that the flow velocity continues to be small for 3 to 4 days. For each case, the exposure time, etc., was set by a time proportional calculation of the exposure continuation period from the annual operation hours, etc. The set exposure time, etc., are as shown in Table 6-2-7.

Table 6-2-7 Exposure time of the representative person used for the potential exposure assessment, etc.

Item	Case 1 (27 days)	Case 2 (8 days)
Operation hours on a ship	210 hours	63 hours
Swimming time	7.1 hours	2.1 hours
Coastline stay time	37 hours	11 hours
Operation hours near fishing nets	140 hours	42 hours
Ingestion of seafood	Ingestion of persons who consume a large amount of seafood in 27 days	Ingestion of persons who consume a large amount of seafood in 8 days

The exposure assessment point is near the beach assessment point to the north of the FDNPS used for the normal exposure, where is the nearest habitable area from the Units 5/6 discharge outlets. In the case of the normal exposure assessed throughout the year, the entire area of 10km×10km surrounding the FDNPS was selected as the assessment area for the exposure pathways related to fishing (sea surface, hull, fishing nets, and seafood ingestion) because fishing is conducted in a wide area. However, in the case of the potential exposure, because the period of exposure could be short and fishing may be conducted mainly in areas with higher concentrations in seawater, the concentration of radioactive materials in the seawater used in the assessment is the concentration of radioactive materials in the seawater at the beach assessment point for all pathways.

(5) Dose assessment method

The exposure amount of the representative person is compared with 5mSv, which is the typical decision criteria for simple assessment based on conservatively defined potential exposure scenarios for facilities and activities as described in 5.69 of GSG-10.

6-2-2. Assessment result

(1) Concentration in the seawater used for the assessment

The concentration in the seawater is the concentration near the beach assessment point to the north of the FDNPS calculated based on the result of simulation of the case of discharge from the Unit 5/6 discharge outlets of a total of 22 TBq (2.2E+13Bq) of tritium per year at an even pace throughout the year (equivalent to 6.0E+10Bq/day) as follows.

Case 1 (Piping rupture)

We calculated the 20 days moving average of the daily average tritium concentration at the assessment point from the simulation results of tritium of 2014 and 2019, and then calculated the maximum value of each year. Table 6-2-8 shows the result. We selected the result of 2014, of which concentration is higher, 5.6Bq/L from the results of the two years. Since this concentration assumed the daily discharge amount of tritium 6.0E+10Bq/day, we calculated the concentration of each nuclide by comparing the daily discharge amount of each nuclide in Tables 6-2-1 to 3. Tables 6-2-9 to 6-2-11 show the concentration of each nuclide used for the assessment.

Case 2 (Tank damage)

From the simulation results of tritium of 2014 and 2019, we calculated the maximum daily average tritium concentration of each year at the assessment point. Table 6-2-8 shows the result. We selected the higher result, namely 15Bq/L in 2014, from the results of two years. Since this concentration assumed the daily discharge amount of tritium 6.0E+10Bq/day, we calculated the concentration of each nuclide by comparing the daily discharge amount of each nuclide in Tables 6-2-4 to 6. Tables 6-2-9 to 6-2-11 show the concentration of each nuclide used for the assessment.

Table 6-2-8 Concentration of tritium in the seawater near the beach assessment point on which the potential exposure assessment is based (Calculated daily average concentration from a simulation of the case of discharge from the Unit 5 and 6 discharge outlets at an even pace throughout the year of a total of 22 TBq (2.2E+13Bq) per year)

	Case 1 (Piping rupture)	Case 2 (Tank damage)	
Assessment year	Maximum value of the 20-day moving average concentration (Bq/L)	Maximum value of the daily average concentration (Bq/L)	
2014	5.6	15	
2019	5.5	12	

Table 6-2-9 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

			 	· • • • • • • • • • • • • • • • • • • •
	Case 1 (Pip	Case 1 (Piping rupture)		nk damage)
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	9.5E+10	8.8E+00	5.7E+12	1.4E+03
C-14	7.5E+06	7.0E-04	4.5E+08	1.1E-01
Mn-54	3.4E+03	3.1E-07	2.0E+05	5.0E-05
Co-60	2.2E+05	2.0E-05	1.3E+07	3.3E-03
Ni-63	1.1E+06	1.0E-04	6.6E+07	1.6E-02
Se-79	7.5E+05	7.0E-05	4.5E+07	1.1E-02
Sr-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
Y-90	1.1E+05	1.0E-05	6.6E+06	1.6E-03
Tc-99	3.5E+05	3.3E-05	2.1E+07	5.2E-03
Ru-106	8.0E+05	7.4E-05	4.8E+07	1.2E-02
Cd-113m	9.0E+03	8.4E-07	5.4E+05	1.3E-04
Sb-125	1.7E+05	1.5E-05	9.9E+06	2.5E-03
Te-125m	1.7E+05	1.5E-05	9.9E+06	2.5E-03
I-129	1.1E+06	9.8E-05	6.3E+07	1.6E-02
Cs-134	2.3E+04	2.1E-06	1.4E+06	3.4E-04
Cs-137	2.1E+05	2.0E-05	1.3E+07	3.1E-03
Ce-144	3.2E+04	2.9E-06	1.9E+06	4.7E-04
Pm-147	9.5E+04	8.8E-06	5.7E+06	1.4E-03
Sm-151	4.5E+02	4.2E-08	2.7E+04	6.7E-06
Eu-154	6.0E+03	5.6E-07	3.6E+05	9.0E-05
Eu-155	1.7E+04	1.5E-06	9.9E+05	2.5E-04
U-234	3.2E+02	2.9E-08	1.9E+04	4.7E-06
U-238	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Np-237	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-238	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-239	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-240	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-241	1.4E+04	1.3E-06	8.4E+05	2.1E-04
Cm-242	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Cm-243	3.2E+02	2.9E-08	1.9E+04	4.7E-06

	Case 1 (Pip	ing rupture)	Case 2 (Tank damage)		
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	
Cm-244	3.2E+02	2.9E-08	1.9E+04	4.7E-06	

Table 6-2-10 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-C tank group)

	Case 1 (Pi	ping rupture)	Case 2 (Tank damage)		
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	
H-3	4.1E+11	3.8E+01	2.5E+13	6.1E+03	
C-14	9.0E+06	8.4E-04	5.4E+08	1.3E-01	
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04	
Co-60	1.7E+05	1.5E-05	9.9E+06	2.5E-03	
Ni-63	4.3E+06	3.9E-04	2.6E+08	6.3E-02	
Se-79	7.5E+05	7.0E-05	4.5E+07	1.1E-02	
Sr-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04	
Y-90	1.8E+04	1.7E-06	1.1E+06	2.7E-04	
Tc-99	6.0E+05	5.6E-05	3.6E+07	9.0E-03	
Ru-106	7.0E+05	6.5E-05	4.2E+07	1.0E-02	
Cd-113m	4.3E+04	3.9E-06	2.6E+06	6.3E-04	
Sb-125	1.2E+05	1.1E-05	6.9E+06	1.7E-03	
Te-125m	1.2E+05	1.1E-05	6.9E+06	1.7E-03	
I-129	6.0E+05	5.6E-05	3.6E+07	9.0E-03	
Cs-134	3.8E+04	3.5E-06	2.3E+06	5.7E-04	
Cs-137	9.5E+04	8.8E-06	5.7E+06	1.4E-03	
Ce-144	2.9E+05	2.6E-05	1.7E+07	4.3E-03	
Pm-147	4.0E+05	3.7E-05	2.4E+07	6.0E-03	
Sm-151	5.5E+03	5.1E-07	3.3E+05	8.2E-05	
Eu-154	5.5E+04	5.1E-06	3.3E+06	8.2E-04	
Eu-155	1.7E+05	1.6E-05	1.0E+07	2.5E-03	
U-234	3.2E+02	2.9E-08	1.9E+04	4.7E-06	
U-238	3.2E+02	2.9E-08	1.9E+04	4.7E-06	

	Case 1 (Piping rupture)		Case 2 (Tank damage)	
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
Np-237	3.2E+02	2.9E-08	1.9E+04	4.7E-06
Pu-238	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-239	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-240	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Pu-241	6.0E+05	5.6E-05	3.6E+07	9.0E-03
Am-241	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Cm-243	1.7E+04	1.5E-06	9.9E+05	2.5E-04
Cm-244	1.7E+04	1.5E-06	9.9E+05	2.5E-04

Table 6-2-11 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-G tank group)

	Case 1 (Piping rupture)		Case 2 (Tank damage)	
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)
H-3	1.4E+11	1.3E+01	8.1E+12	2.0E+03
C-14	8.0E+06	7.4E-04	4.8E+08	1.2E-01
Mn-54	1.9E+04	1.8E-06	1.1E+06	2.8E-04
Co-60	1.2E+05	1.1E-05	6.9E+06	1.7E-03
Ni-63	4.4E+06	4.1E-04	2.6E+08	6.6E-02
Se-79	7.5E+05	7.0E-05	4.5E+07	1.1E-02
Sr-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04
Y-90	1.6E+04	1.5E-06	9.6E+05	2.4E-04
Tc-99	6.5E+05	6.0E-05	3.9E+07	9.7E-03
Ru-106	2.4E+05	2.2E-05	1.4E+07	3.6E-03
Cd-113m	4.3E+04	4.0E-06	2.6E+06	6.4E-04
Sb-125	7.0E+04	6.5E-06	4.2E+06	1.0E-03
Te-125m	7.0E+04	6.5E-06	4.2E+06	1.0E-03
I-129	1.7E+05	1.5E-05	9.9E+06	2.5E-03
Cs-134	3.4E+04	3.1E-06	2.0E+06	5.0E-04

	Case 1 (Pip	ping rupture)	Case 2 (Tank damage)		
Target nuclide	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	Daily discharge amount (Bq/day)	Concentration in the seawater near the beach assessment point (Bq/L)	
Cs-137	1.7E+05	1.5E-05	9.9E+06	2.5E-03	
Ce-144	2.8E+05	2.6E-05	1.7E+07	4.1E-03	
Pm-147	3.6E+05	3.3E-05	2.2E+07	5.4E-03	
Sm-151	5.0E+03	4.6E-07	3.0E+05	7.5E-05	
Eu-154	5.0E+04	4.6E-06	3.0E+06	7.5E-04	
Eu-155	9.0E+04	8.4E-06	5.4E+06	1.3E-03	
U-234	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
U-238	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Np-237	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Pu-238	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Pu-239	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Pu-240	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Pu-241	5.0E+05	4.6E-05	3.0E+07	7.5E-03	
Am-241	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Cm-243	1.4E+04	1.3E-06	8.4E+05	2.1E-04	
Cm-244	1.4E+04	1.3E-06	8.4E+05	2.1E-04	

(2) Exposure assessment result

Table 6-2-12 to 13 shows the potential exposure result calculated using the concentration in the seawater calculated in (1). The result is 0.0002 (2E-04) mSv to 0.01(1E-02) mSv, which falls below 5mSv, which is the standard at the time of accident.

Table 6-2-12 Results of the potential exposure assessment

	Course	Case 1 (Piping rupture)		Case 2 (Tank damage)			
	Source term	K4 tank group	J1-C tank group	J1-G tank group	K4 tank group	J1-C tank group	J1-G tank group
o se	Inge stion of seaf ood	Large	Large	Large	Large	Large	Large
	Sea surface	4.1E-09	5.4E-09	3.6E-09	2.0E-07	2.6E-07	1.7E-07
	Hull	3.8E-09	5.2E-09	3.5E-09	1.9E-07	2.5E-07	1.7E-07
e (mSv) B	During swimmi ng	3.9E-10	5.0E-10	3.4E-10	1.8E-08	2.4E-08	1.6E-08
	Beach sand	6.7E-07	8.7E-07	5.9E-07	3.2E-05	4.2E-05	2.8E-05
	Fishing net	2.0E-06	2.6E-06	1.8E-06	9.8E-05	1.3E-04	8.6E-05
	Ingesti on of water	2.4E-07	9.9E-07	3.3E-07	1.2E-05	4.7E-05	1.6E-05
Internal exposur e (mSv)	Inhal ation of spra y	6.8E-08	6.2E-07	4.0E-07	3.2E-06	3.0E-05	1.9E-05
(msv)	Inge stion of seaf ood	2.4E-04	2.3E-04	1.5E-04	1.1E-02	1.1E-02	7.1E-03
Tot (mS		2E-04	2E-04	2E-04	1E-02	1E-02	7E-03

Table 6-2-13 Results of the internal exposure assessment by age

Table 6-2-13 Results of the Internal exposure assessment by age							
	Source	Case	1 (Piping rup	ture)	Case	2 (Tank dama	ige)
Assesse d case	term	K4 tank group	J1-C tank group	J1-G tank group	K4 tank group	J1-C tank group	J1-G tank group
	Ingesti on of seafoo d	Large	Large	Large	Large	Large	Large
Internal exposur	Adult	2.4E-07	9.9E-07	3.3E-07	1.2E-05	4.7E-05	1.6E-05
e by ingestio n of	Child	4.2E-07	1.7E-06	5.7E-07	2.0E-05	8.1E-05	2.7E-05
water (mSv)	Infant	-	ı	-	-	-	-
Internal exposur	Adult	6.8E-08	6.2E-07	4.0E-07	3.2E-06	3.0E-05	1.9E-05
e by inhalatio n of spray (mSv)	Child	4.5E-08	3.5E-07	2.2E-07	2.1E-06	1.7E-05	1.0E-05
	Infant	2.9E-08	2.0E-07	1.2E-07	1.4E-06	9.7E-06	5.5E-06
Internal exposur e by ingestio n of seafood (mSv)	Adult	2.4E-04	2.3E-04	1.5E-04	1.1E-02	1.1E-02	7.1E-03
	Child	2.3E-04	2.3E-04	1.6E-04	1.1E-02	1.1E-02	7.8E-03
	Infant	1.4E-04	2.3E-04	1.8E-04	6.7E-03	1.1E-02	8.7E-03

7. Assessment regarding environmental protection

The assessment method of environmental protection is as shown in GSG -10 Annex I. In this report, environmental protection was assessed according to the procedure of GSG -10 Annex I.

7-1. Concept of assessment

The assessment for protection of plants and animals in the normal operation is performed according to GSG -10 Annex I.

7-1-1. Assessment procedure

The assessment is performed according to the procedure shown in Figure 7-1.

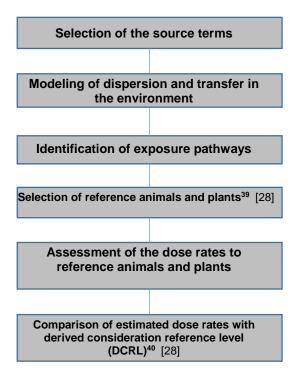


Figure 7-1 Environmental protection assessment procedure (prepared from GSG-10)

³⁹ Reference animals and plants: Specific types of animals and plants assumed in order to associate radiation exposure from the environment with the dose and impact.

⁴⁰ Derived consideration reference level (DCRL): Range of the dose rates within a range of one digit specified for each species advocated by ICRP. Dose rate level at which the impact has to be considered if is exceeded.

7-2. Assessment method

7-2-1. Source term

Use the same source term as the one shown in 6-1-2.(1) Source term.

7-2-2. Modeling of diffusion and transfer after discharge

(1) Selection of the migration model

As the migration model of radioactive materials discharged into the sea, the following was selected from the migration model of human exposure assessment, considering habitat environment of marine plants and animals, referring to GSG-10.

- i. Advection and diffusion by tidal currents, etc.
 Selected because advection and diffusion will occur after discharge into the sea.
- ii. Advection and diffusion by tidal currents, etc. -> Migration to seabed sediment Selected because ALPS treated water will migrate to seabed sediment, etc., due to advection and diffusion caused by tidal currents, etc., after discharge into the sea.
- iii. Advection and diffusion by tidal currents, etc. -> Intake and concentration by marine plants and animals such as fish

Selected because migration to and concentration in fish, etc. will occur after discharge into the sea.

(2) Assessment of advection and diffusion in the sea area

The same model as that for the human protection assessment is used.

7-2-3. Setting of exposure pathways

The following pathways were selected according to GSG -10 Annex I-21.

- Internal exposure from radioactive materials ingested or inhaled by plants and animals
- ii. External exposure from the surrounding seawater
- iii. External exposure from the surrounding seabed sediment

The following shows the specific assessment method.

(1) Internal exposure from radioactive materials ingested or inhaled by plants and animals Equation (7-1) shows the calculation equation of the absorbed dose rate $D_{\rm int}$ (mGy/day) of radiation from radioactive materials ingested from the seawater by standard animals and plants.

$$D_{int} = \sum_{i} (DCF_{int})_{ki} \cdot (x_9)_i \cdot (CR)_{ki}$$
(7-1)

where

 $(DCF_{int})_{ki}$ is the internal exposure dose conversion factor to marine plants and animals k of nuclide i ((mGy/day)/(Bq/kg))

 $(x_9)_i$ is the concentration of nuclide i in seawater (Bq/L)

 $(CR)_{ki}$ is the ration of the concentration in the seawater to marine plants and animals k in nuclide i ((Bq/kg)/(Bq/L))

(2) External exposure from the seawater and seabed sediment

The absorbed dose rate $D_{\text{ext,sw}}$ (mGy/day) of plants and animals surrounded by the seawater is calculated by equation (7-2).

$$D_{ext,sw} = \sum_{i} (DCF_{ext})_{ki} \cdot \frac{(x_9)_i}{\rho_w} (7-2)$$

where

 $(DCF_{ext})_{ki}$ is the external exposure dose conversion factor to marine plants and animals k of nuclide i ((mGy/day)/(Bq/kg))

 $(x_9)_i$ is the concentration of nuclide i in seawater (Bq/L)

 $\rho_{\rm w}$ is the density of seawater (kg/L)

Similarly, the absorbed dose rate $D_{\text{ext,sed}}$ (mGy/day) of plants and animals surrounded by seabed sediment is calculated by equation (7-3).

$$D_{ext.sed} = \sum_{i} (DCF_{ext})_{ki} \cdot (x_9)_i \cdot (K_d)_i \tag{7-3}$$

where

 $(DCF_{ext})_{ki}$ is the external exposure dose conversion factor to marine plants and animals k of nuclide i ((mGy/day)/(Bq/kg))

 $(x_9)_i$ is the concentration of nuclide *i* in seawater (Bq/L)

 $(K_d)_i$ is the concentration distribution coefficient from seawater to sediment of nuclide i ((Bq/kg)/(Bq/L))

External exposure in the case of exposure from the seawater and seabed sediment D_{ext} is the total of both, but plants and animals that live on the seabed are exposed to half each of the seawater of upper half and the seabed sediment of the lower half, respectively, so it is calculated by Equation (7-4).

$$D_{ext} = 0.5 \cdot D_{ext,sw} + 0.5 \cdot D_{ext,sed}$$
 (7-4)

The internal and external exposure dose conversion factors to plants and animals⁴¹ is excerpted from ICRP Publication 136 "Dose Coefficients for Non-human Biota Environmentally Exposed to Radiation"(ICRP,2017) [29] (hereinafter called "ICRP pub.136") and the BiotaDC program of ICRP [30] (See Tables 7-2-1 and 7-2-2). The concentration ratios of plants and animals and the seawater⁴² are excerpted from ICRP Publication 114 "Environmental Protection: Transfer Parameters for Reference Animals and Plants"(ICRP,2009) [31] (hereinafter called "ICRP pub.114") and IAEA Technical report series No.479 "Handbook of Parameter Values for the Prediction of Radionuclide Transfer to Wildlife" (hereinafter called "TRS-479"). (See Table 7-2-3). For the concentration distribution coefficients of the seawater and seabed sediment, those specified in 2.3.OCEAN MARGIN *Kd*s of TRS-422 [26] are used (See Table 7-2-4).

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Dose conversion factor to plants and animals: Value set for simplified calculations of internal and external exposure doses to organism by radioactive nuclides in the environment.

Concentration ratio (CR): The ratio of the radioactive nuclides in aquatic organisms living in hydrosphere to the underwater concentration in the environment for the assessment of radiation exposure to plants and animals from the environment (ICPR, 2009). Unlike the concentration factor, it is not limited to the edible part.

7-2-4. Selection of reference plants and animals (organisms to be assessed)

Small seaweed beds mainly consisting of Eisenia bicyclis, which is a perennial marine alga, are distributed on the coast of Fukushima, in which the FDNPS is located [32]. There is no special sea area like a habitat of a marine plant or animal designated as a protected species around the FDNPS [33] so the following plants and animals are selected as those clarified in ICRP Pub.136.

- Reference flat fish (Left-eyed and right-eyed flounders widely inhabit in the sea area around the FDNPS)
- Reference crabs ((Ovalipes punctatus and Portunus trituberculatus widely inhabit in the sea area around the FDNPS)
- Reference brown seaweeds (Sargassum and Eisenia bicyclis widely inhabit in the sea area around the FDNPS)

These plants and animals are widely distributed in the sea area around the FDNPS, so the radioactive material concentration in the seawater used for the assessment is the annual average concentration of 10 km × 10 km around the FDNPS, which matches 100-400 km² as recommended in I-23. of GSG -10 Annex I. In addition, in the assessment of plants and animals, the concentration near the seabed (bottom layer) is used because the impact of external exposure from radioactive materials migrated to the seabed sediment is greater than in the seawater and the selected standard flatfish live on the seabed.

7-2-5. Dose assessment

The dose is assessed by comparison with the derived consideration reference level (DCRL) shown in ICRP Publication 124 "Protection of the Environment under Different Exposure Situations" for each type of the reference plants and animals.

Table 7-2-1 Internal exposure conversion factor to marine plants and animals

(ICRP Pub.136 and others are shown in remarks)

	Target			conversion	D. w. d.
	nuclide	Flatfish	rgy/day)/(вq/ Crab	Brown seaweed	Remarks
1	H-3	7.9E-08	7.9E-08	7.9E-08	
2	C-14	7.0E-07	7.0E-07	7.0E-07	
3	Mn-54	1.1E-06	1.4E-06	9.4E-07	
4	Co-60	3.8E-06	5.0E-06	3.6E-06	
5	Ni-63	2.4E-07	2.4E-07	2.4E-07	
6	Se-79	7.2E-07	7.2E-07	7.2E-07	
7	Sr-90	1.4E-05	1.5E-05	1.4E-05	
8	Y-90	_	_	_	Contained in the parent nuclide Sr-90
9	Tc-99	1.4E-06	1.4E-06	1.4E-06	
10	Ru-106	1.7E-05	1.9E-05	1.7E-05	
11	Cd-113m	2.5E-06	2.5E-06	2.4E-06	Calculated from BiotaDC
12	Sb-125	2.0E-06	2.2E-06	1.9E-06	
13	Te-125m	1.7E-06	1.8E-06	1.6E-06	Calculated from BiotaDC
14	I-129	1.0E-06	1.1E-06	1.0E-06	
15	Cs-134	4.1E-06	4.8E-06	3.8E-06	
16	Cs-137	4.1E-06	4.3E-06	4.1E-06	
17	Ce-144	1.6E-05	1.7E-05	1.6E-05	
18	Pm-147	8.6E-07	8.6E-07	8.5E-07	Calculated from BiotaDC
19	Sm-151	2.8E-07	2.8E-07	2.8E-07	Calculated from BiotaDC
20	Eu-154	5.0E-06	5.8E-06	5.0E-06	
21	Eu-155	1.0E-06	1.0E-06	9.8E-07	
22	U-234	6.7E-05	6.7E-05	6.7E-05	
23	U-238	6.0E-05	6.0E-05	6.0E-05	
24	Np-237	6.7E-05	6.7E-05	6.7E-05	
25	Pu-238	7.7E-05	7.7E-05	7.7E-05	
26	Pu-239	7.2E-05	7.2E-05	7.2E-05	
27	Pu-240	7.2E-05	7.2E-05	7.2E-05	
28	Pu-241	7.4E-08	7.4E-08	7.4E-08	
29	Am-241	7.7E-05	7.7E-05	7.7E-05	
30	Cm-243	8.4E-05	8.4E-05	8.4E-05	
31	Cm-244	8.2E-05	8.2E-05	8.2E-05	

Table 7-2-2 External exposure conversion factor to marine plants and animals

(ICRP Pub.136 and others are shown in remarks)

	Target	Exter	External exposure dose conversion factor ((mGy/day)/(Bq/kg))		Remarks
	nuclide	Flatfish	Crab	Brown seaweed	
1	H-3	1.9E-14	2.4E-16	2.4E-16	
2	C-14	4.3E-10	5.3E-10	5.3E-10	
3	Mn-54	1.1E-05	1.0E-05	1.1E-05	
4	Co-60	3.1E-05	3.1E-05	3.4E-05	
5	Ni-63	2.6E-11	4.1E-11	4.1E-11	
6	Se-79	4.8E-10	5.8E-10	6.2E-10	
7	Sr-90	1.2E-06	5.5E-07	1.2E-06	
8	Y-90	_	_	_	Contained in the parent nuclide Sr-90
9	Tc-99	3.1E-09	3.4E-09	3.6E-09	
10	Ru-106	5.3E-06	3.8E-06	5.3E-06	
11	Cd-113m	1.7E-08	1.6E-08	1.4E-07	Calculated from BiotaDC
12	Sb-125	5.5E-06	5.3E-06	5.5E-06	
13	Te-125m	2.9E-07	2.4E-07	4.3E-07	Calculated from BiotaDC
14	I-129	2.2E-07	1.9E-07	2.4E-07	
15	Cs-134	2.0E-05	1.9E-05	2.0E-05	
16	Cs-137	7.2E-06	7.0E-06	7.2E-06	
17	Ce-144	2.6E-06	1.5E-06	2.6E-06	
18	Pm-147	9.9E-10	1.1E-09	1.0E-08	Calculated from BiotaDC
19	Sm-151	7.7E-11	8.4E-11	7.6E-10	Calculated from BiotaDC
20	Eu-154	1.6E-05	1.5E-05	1.6E-05	
21	Eu-155	7.4E-07	7.0E-07	7.4E-07	
22	U-234	4.8E-09	4.1E-09	5.5E-09	
23	U-238	3.1E-09	2.6E-09	3.6E-09	
24	Np-237	3.1E-07	2.9E-07	3.1E-07	
25	Pu-238	4.6E-09	3.8E-F09	5.5E-09	
26	Pu-239	2.6E-09	2.3E-09	3.1E-09	
27	Pu-240	4.3E-09	3.6E-09	5.3E-09	
28	Pu-241	1.9E-11	1.9E-11	2.0E-11	
29	Am-241	2.9E-07	2.6E-07	2.9E-07	
30	Cm-243	1.6E-06	1.5E-06	1.6E-06	
31	Cm-244	4.8E-09	3.8E-09	5.5E-09	

Table 7-2-3 Concentration ratio to marine plants and animals (ICRP Pub.114 and others, shown in remarks)

	others, snown in remarks)				
	Target	Concentration ratio ((Bq/kg-f.w)/(Bq/L))		g-f.w)/(Bq/L))	Remarks
	nuclide	Flatfish	Crab	Brown seaweed	
1	H-3	1.0E+00	1.0E+00	3.7E-01	Excerpted from ICRP Pub.114
2	C-14	1.2E+04	1.0E+04	8.0E+03	Excerpted from ICRP Pub.114
3	Mn-54	2.6E+03	4.5E+04	1.1E+04	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)
4	Co-60	1.1E+04	5.5E+03	1.7E+03	Excerpted from TRS-479
5	Ni-63	2.7E+02	6.4E+03	2.0E+03	Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and crab brown seaweed)
6	Se-79	1.0E+04	1.0E+04	4.3E+02	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)
7	Sr-90	4.4E+01	1.5E+02	4.3E+01	Excerpted from TRS-479 (crab and brown seaweed) Excerpted from ICRP Pub.114 (fish)
8	Y-90	-	-	-	Assessed with the parent nuclide Sr-90.
9	Tc-99	8.0E+01	1.8E+04	5.3E+04	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)
10	Ru-106	2.9E+01	1.6E+03	1.2E+03	Excerpted from TRS-479
11	Cd-113m	2.9E+04	1.3E+05	1.6E+03	Excerpted from TRS-479 (fish and crab) Excerpted from ICRP Pub.114 (brown seaweed)
12	Sb-125	6.0E+02	4.7E+02	1.5E+03	Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and brown seaweed)
13	Te-125m	1.0E+03	1.0E+03	1.0E+04	Excerpted from ICRP Pub.114
14	I-129	9.0E+00	8.8E+03	4.2E+03	Excerpted from ICRP Pub.114 (fish) Excerpted from TRS-479 (crab and brown seaweed)
15	Cs-134	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479
16	Cs-137	1.2E+02	6.3E+01	9.6E+01	Excerpted from TRS-479
17	Ce-144	3.9E+02	2.2E+03	2.1E+03	Excerpted from TRS-479
18	Pm-147	7.3E+02	2.4E+04	5.9E+03	Excerpted from ICRP Pub.114
19	Sm-151	7.3E+02	2.4E+04	5.9E+03	Excerpted from ICRP Pub.114
20	Eu-154	7.3E+02	2.4E+04	1.4E+03	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)
21	Eu-155	7.3E+02	2.4E+04	1.4E+03	Excerpted from TRS-479 (brown seaweed) Excerpted from ICRP Pub.114 (fish and crab)
22	U-234	8.8E+00	3.5E+01	8.3E+01	Excerpted from TRS-479
23	U-238	8.8E+00	3.5E+01	8.3E+01	Excerpted from TRS-479

	Target	Concentration ratio ((Bq/kg-f.w)/(Bq/L))		g-f.w)/(Bq/L))	Remarks
	nuclide	Flatfish	Crab	Brown seaweed	
24	Np-237	2.1E+01	4.3E+02	5.4E+01	Excerpted from TRS-479 (crab) Excerpted from ICRP Pub.114 (fish and brown seaweed)
25	Pu-238	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479
26	Pu-239	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479
27	Pu-240	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479
28	Pu-241	2.5E+03	1.7E+03	4.1E+03	Excerpted from TRS-479
29	Am-241	3.2E+02	9.9E+03	4.3E+02	Excerpted from ICRP Pub.114
30	Cm-243	1.9E+02	3.2E+04	1.2E+04	Excerpted from TRS-479 (crab and brown seaweed) Excerpted from ICRP Pub.114 (fish)
31	Cm-244	1.9E+02	3.2E+04	1.2E+04	Excerpted from TRS-479 (crab and brown seaweed) Excerpted from ICRP Pub.114 (fish)

Table 7-2-4 Concentration distribution coefficient of the seawater and seabed sediment (Excerpted from TRS-422)

	Target nuclide	Concentration distribution coefficient ((Bq/kg)/(Bq/L))	Remarks
1	H-3	1.0E+00	
2	C-14	1.0E+03	
3	Mn-54	2.0E+06	
4	Co-60	3.0E+05	
5	Ni-63	2.0E+04	
6	Se-79	3.00E+03	
7	Sr-90	8.0E+00	
8	Y-90	-	Assessed with the parent nuclide Sr-90
9	Tc-99	1.0E+02	
10	Ru-106	4.0E+04	
11	Cd-113m	3.0E+04	
12	Sb-125	2.0E+03	
13	Te-125m	1.0E+03	
14	I-129	7.0E+01	
15	Cs-134	4.0E+03	
16	Cs-137	4.0E+03	
17	Ce-144	3.0E+06	
18	Pm-147	2.0E+06	
19	Sm-151	3.0E+06	
20	Eu-154	2.0E+06	
21	Eu-155	2.0E+06	
22	U-234	1.00E+03	
23	U-238	1.00E+03	
24	Np-237	1.00E+03	
25	Pu-238	1.0E+05	
26	Pu-239	1.0E+05	
27	Pu-240	1.0E+05	
28	Pu-241	1.0E+05	
29	Am-241	2.0E+06	
30	Cm-243	2.0E+06	
31	Cm-244	2.0E+06	

7-3. Assessment result

7-3-1. Concentration in the seawater used for the assessment

As with the human protection assessment, the concentration in the seawater used for the exposure assessment of each nuclide was calculated by proportion calculation with the calculation result of advection and diffusion of tritium and the annual discharge amount of each nuclide. Here the concentration of the bottom layer is used because the impact of seabed sediment is considered in the exposure assessment.

Table 7-3-1 shows the concentration of tritium in the seawater in the bottom layer within 10 km \times 10 km around the FDNPS (annual discharge amount) in the case of the annual discharge amount of 22 TBq (2.2E+13Bq) of tritium. The concentration for the assessment is the concentration based on the 2019 meteorological and oceanographic data as with the human exposure assessment.

Tables 7-3-2 to 4 show this result, and the concentration in the seawater used for the exposure assessment of each nuclide calculated from the source terms shown in Tables 6-1-1 to 3.

Table 7-3-1 Tritium concentration in the seawater in the case of the annual tritium discharge amount of 2.2E+13Bq

		Calcu	ulation result (Bq/L	.)	
Assessment point	Depth	2014 Meteorological and oceanographic data	2019 Meteorological and oceanographic data	Difference (%)	Concentration for assessment (Bq/L)
Average concentration within 10 km × 10 km around the FDNPS	Bottom layer	5.0E-02	6.0E-02	19	6.0E-02

Table 7-3-2 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group)

Target	Annual discharge	Concentration in the seawater used for the assessment (within 10 km × 10 km)
nuclide	nuclide amount (Bq)	Average concentration of the bottom layer (Bq/L)
H-3	2.2E+13	6.0E-02
C-14	1.7E+09	4.7E-06
Mn-54	7.8E+05	2.1E-09
Co-60	5.1E+07	1.4E-07
Ni-63	2.5E+08	6.9E-07
Se-79	1.7E+08	4.7E-07
Sr-90	2.5E+07	6.9E-08
Y-90	2.5E+07	6.9E-08

Target nuclide	Annual discharge amount (Bq)	Concentration in the seawater used for the assessment (within 10 km × 10 km) Average concentration of the bottom layer (Bq/L)
Tc-99	8.1E+07	2.2E-07
Ru-106	1.9E+08	5.1E-07
Cd-113m	2.1E+06	5.7E-09
Sb-125	3.8E+07	1.0E-07
Te-125m	3.8E+07	1.0E-07
I-129	2.4E+08	6.6E-07
Cs-134	5.2E+06	1.4E-08
Cs-137	4.9E+07	1.3E-07
Ce-144	7.3E+06	2.0E-08
Pm-147	2.2E+07	6.0E-08
Sm-151	1.0E+05	2.8E-10
Eu-154	1.4E+06	3.8E-09
Eu-155	3.8E+06	1.0E-08
U-234	7.3E+04	2.0E-10
U-238	7.3E+04	2.0E-10
Np-237	7.3E+04	2.0E-10
Pu-238	7.3E+04	2.0E-10
Pu-239	7.3E+04	2.0E-10
Pu-240	7.3E+04	2.0E-10
Pu-241	3.2E+06	8.8E-09
Am-241	7.3E+04	2.0E-10
Cm-243	7.3E+04	2.0E-10
Cm-244	7.3E+04	2.0E-10
	exposure sment	Environmental protection

Table 7-3-3 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-C tank group)

Target nuclide Annual discharge amount (Bq) H-3 Concentration in the seave for the assessment (within 10 km × 10 Average concentration of layer (Bq/L) H-3 2.2E+13 6.0E-02 C-14 4.8E+08 1.3E-06	ent km)
H-3 2.2E+13 6.0E-02	
C-14 4.8E+08 1.3E-06	
Mn-54 1.0E+06 2.8E-09	_
Co-60 8.9E+06 2.4E-08	
Ni-63 2.3E+08 6.2E-07	
Se-79 4.0E+07 1.1E-07	
Sr-90 9.7E+05 2.6E-09	
Y-90 9.7E+05 2.6E-09	
Tc-99 3.2E+07 8.8E-08	
Ru-106 3.8E+07 1.0E-07	
Cd-113m 2.3E+06 6.2E-09	
Sb-125 6.2E+06 1.7E-08	
Te-125m 6.2E+06 1.7E-08	
I-129 3.2E+07 8.8E-08	
Cs-134 2.0E+06 5.6E-09	
Cs-137 5.1E+06 1.4E-08	
Ce-144 1.5E+07 4.2E-08	
Pm-147 2.1E+07 5.9E-08	
Sm-151 3.0E+05 8.0E-10	
Eu-154 3.0E+06 8.0E-09	
Eu-155 9.1E+06 2.5E-08	
U-234 8.9E+05 2.4E-09	
U-238 8.9E+05 2.4E-09	
Np-237 8.9E+05 2.4E-09	
Pu-238 8.9E+05 2.4E-09	
Pu-239 8.9E+05 2.4E-09	
Pu-240 8.9E+05 2.4E-09	
Pu-241 3.2E+07 8.8E-08	
Am-241 8.9E+05 2.4E-09	
Cm-243 8.9E+05 2.4E-09	
Cm-244 8.9E+05 2.4E-09	

Target	Annual discharge	Concentration in the seawater used for the assessment (within 10 km × 10 km)
nuclide	amount (Bq)	Average concentration of the bottom layer
		(Bq/L)
Target exposure assessment		Environmental protection

Table 7-3-4 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the J1-G tank group)

Target nuclide	Annual discharge amount (Bq)	Concentration in the seawater used for the assessment (within 10 km × 10 km) Average concentration of the bottom layer (Bq/L)
H-3	2.2E+13	6.0E-02
C-14	1.3E+09	3.6E-06
Mn-54	3.1E+06	8.4E-09
Co-60	1.9E+07	5.1E-08
Ni-63	7.2E+08	2.0E-06
Se-79	1.2E+08	3.3E-07
Sr-90	2.6E+06	7.1E-09
Y-90	2.6E+06	7.1E-09
Tc-99	1.1E+08	2.9E-07
Ru-106	3.9E+07	1.1E-07
Cd-113m	7.0E+06	1.9E-08
Sb-125	1.1E+07	3.1E-08
Te-125m	1.1E+07	3.1E-08
I-129	2.7E+07	7.3E-08
Cs-134	5.5E+06	1.5E-08
Cs-137	2.7E+07	7.3E-08
Ce-144	4.5E+07	1.2E-07
Pm-147	5.9E+07	1.6E-07
Sm-151	8.1E+05	2.2E-09
Eu-154	8.1E+06	2.2E-08
Eu-155	1.5E+07	4.0E-08
U-234	2.3E+06	6.2E-09
Np-237	2.3E+06	6.2E-09
Pu-238	2.3E+06	6.2E-09

Target nuclide	Annual discharge amount (Bq)	Concentration in the seawater used for the assessment (within 10 km × 10 km) Average concentration of the bottom layer (Bq/L)
Pu-239	2.3E+06	6.2E-09
Pu-240	2.3E+06	6.2E-09
Pu-241	8.1E+07	2.2E-07
Am-241	2.3E+06	6.2E-09
Cm-243	2.3E+06	6.2E-09
Cm-244	2.3E+06	6.2E-09
Target exposure assessment		Environmental protection

7-3-2. Exposure assessment result

Table 7-3-5 shows the result of the exposure assessment of reference plants and animals. All results are low dose rates that are lower than 1/100,000 of the minimum limit value of the derived consideration reference level.

 Table 7-3-5
 Assessment result regarding environmental protection

Assessed case		Source term based on measured values					
		i. K4 tank group	ii. J1-C tank group	iii. J1-G tank group			
	Flatfish	9E-07	5E-07	1E-06			
Exposure (mGy/day)	Crab 9E-07		4E-07	1E-06			
	Brown seaweed 1E-06		5E-07	1E-06			

Derived consideration reference level (DCRL) [29]

Flatfish: 1-10 mGy/day Crab: 10-100 mGy/day

Brown seaweed: 1-10 mGy/day

8. Discussion about the uncertainty of the assessment

This assessment was performed adding various data related to the disposal plan of ALPS treated water, assumptions of the exposure assessment, etc., to the assessment model including parameters created from obtained findings, etc. The assessment model including these parameters, the data, the set assumptions, etc., include uncertainty. So does the assessment result.

Generally, the uncertainty is roughly divided into (1) aleatory uncertainty (or variability) and (2) epistemic uncertainty. "Aleatory uncertainty (or variability)" is uncertainty caused by statistical distribution such as initial variation in data, and cannot be reduced even if data and knowledge to be obtained in the future are considered. "Epistemic uncertainty" is uncertainty due to lack of knowledge, though there is considered to be the one and only state. The following shows the result of consideration of the degree of uncertainty referring to the result of simulation performed in each assessment process for each type, etc.

8-1. Uncertainty included in the selection of the source term

The following items are examples of uncertainty of the source term.

8-1-1. Uncertainty of the composition of nuclide (epistemic uncertainty)

The treated water to be purified in storage is planned to be subject to secondary treatment by ALPS, etc., and the composition of nuclides is unknown until measurement is performed after secondary treatment. Though it is guaranteed that the sum of the ratios to regulatory concentrations limits is less than 1, the composition of nuclides depends on various factors such as the composition and concentration of radioactive materials at the ALPS inlet at the time of treatment, the stage of the adsorbent in the ALPS adsorption vessel in the performance life period at the time of treatment, etc. The same applies to the contaminated water generated in the future.

On the other hand as a result of the revision of target nuclides, the impact by undetected nuclides to the value of exposure assessment smaller. Among the exposure assessment value by three source terms, there is about four-fold difference between the source terms based on the K4 tank group and J1-C tank group, which could be occurred due to the fact that volume of the ALPS treated water discharged based on the K4 tank group is about four times larger than J1-C tank group due to the difference in the tritium concentration of each tank group. On the other hand, the difference in the exposure assessment values between the source terms based on the K4 tank group and J1-G tank group, where the difference in tritium concentrations is small iw about two-fold. Since the difference in the tritium

concentration is not large, this difference is mainly caused by the difference in the composition of nuclides, but the difference caused by the composition of nuclides is small. The sum of the ratios to regulatory concentrations limits of the composition of nuclides in the three tanks is around 0.1 to 0.3, and the sum of the ratios to regulatory concentrations limits of the composition of the nuclides of the K4 tank group with the highest exposure assessment value is 0.28. The limit value in discharge control is the sum of the ratios to regulatory concentrations limits of less than 1, so if ALPS treated water in which the sum of the ratios to regulatory concentrations limits is close to 1, exposure may become 3 to 4 times larger.

If the tritium concentration in ALPS treated water is low, the discharge volume of water instead increases, so there is uncertainty due to the tritium concentration that exposure increases due to an increase in the discharge amount of nuclides other than tritium, but the discharge volume of water is, even if the tritium concentration is low, limited to up to 500 m³/day due to the capacity of facility and the annual discharge volume of water is maximum 1.5E+08L (capacity factor: 80%), which is just 1.25 times larger than that of the K4 tank group (annual discharge volume of water: 1.2E+08L) and about 2 times larger than the J1-G tank group (annual discharge volume of water: 8.1E+07L).

8-1-2. Uncertainty of analysis (aleatory uncertainty)

The compositions of nuclides of the three tank groups used for the setting of the source term includes uncertainty of analysis. To verify the impact of the uncertainty of analysis on the exposure assessment value, we applied the expanded uncertainty calculated from the analysis result of the J1-C tank group to the measurement result of the K4 tank group with a high exposure assessment value for the normal exposure assessment. Table 8-1 shows the composition of nuclides considering expanded uncertainty in the composition of nuclides of the K4 tank group. Table 8-2 shows the concentration in the seawater used for the set source term and assessment. Table 8-3 shows the exposure assessment result.

The exposure assessment result of the source term considering the uncertainty of analysis is about 1.5 times larger than that not considering the uncertainty, so the uncertainty of the exposure assessment due to the uncertainty of the analysis is considered to be less than 2 times greater.

8-1-3. Summary of the uncertainty of the source term

As for the uncertainty of the source term, the difference due to the composition of nuclides of the tank group is about ±2-fold centering on the source term based on the J1-G group, the uncertainty of tritium concentration is about 2-fold and the uncertainty of analysis is considered to be about ±1.5-fold.

Table 8-1 Composition of nuclides considering the uncertainty of detection for the composition of nuclides of the K4 tank group

Target nuclide	Regulatory concentration limit (Bq/L)	Composition of nuclides of the K4 tank group (Bq/L)	Composition of nuclides of the k4 tank group considering expanded uncertainty (Bq/L)	Ratio to regulatory concentration limit	
H-3	6.0E+04	2.7E+05	2.7E+05	-	
C-14	2.0E+03	1.6E+01	2.0E+01	1.0E-02	
Mn-54	1.0E+03	3.8E-02	6.4E-02	6.4E-05	
Co-60	2.0E+02	2.3E-01	2.7E-01	1.4E-03	
Ni-63	6.0E+03	8.8E+00	9.2E+00	1.5E-03	
Se-79	2.0E+02	1.5E+00	1.6E+00	7.8E-03	
Sr-90	3.0E+01	3.2E-02	4.2E-02	1.4E-03	
Y-90	3.0E+02	3.2E-02	4.2E-02	1.4E-04	
Tc-99	1.0E+03	1.3E+00	1.3E+00	1.3E-03	
Ru-106	1.0E+02	4.8E-01	6.1E-01	6.1E-03	
Cd-113m	4.0E+01	8.6E-02	9.0E-02	2.2E-03	
Sb-125	8.0E+02	1.4E-01	2.0E-01	2.5E-04	
Te-125m	9.0E+02	1.4E-01	2.0E-01	2.2E-04	
I-129	9.0E+00	3.3E-01	3.8E-01	4.2E-02	
Cs-134	6.0E+01	6.7E-02	1.1E-01	1.9E-03	
Cs-137	9.0E+01	3.3E-01	4.0E-01	4.5E-03	
Ce-144	2.0E+02	5.5E-01	9.4E-01	4.7E-03	
Pm-147	3.0E+03	7.2E-01	1.2E+00	4.1E-04	
Sm-151	8.0E+03	1.0E-02	1.7E-02	2.1E-06	
Eu-154	4.0E+02	1.0E-01	1.7E-01	4.3E-04	
Eu-155	3.0E+03	1.8E-01	3.0E-01	1.0E-04	
U-234	2.0E+01	6.3E-04	7.5E-04	3.8E-05	
U-238	2.0E+01	6.3E-04	7.5E-04	3.8E-05	
Np-237	9.0E+00	6.3E-04	7.5E-04	8.4E-05	
Pu-238	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
Pu-239	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
Pu-240	4.0E+00	2.8E-02	3.3E-02	8.4E-03	
Pu-241	2.0E+02	1.0E+00	1.2E+00	6.0E-03	
Am-241	5.0E+00	2.8E-02	3.3E-02	6.7E-03	
Cm-243	6.0E+00	2.8E-02	3.3E-02	5.6E-03	

Target nuclide	Regulatory concentration limit (Bq/L)	Composition of nuclides of the K4 tank group (Bq/L)	Composition of nuclides of the k4 tank group considering expanded uncertainty (Bq/L)	Ratio to regulatory concentration limit
Cm-244	7.0E+00	2.8E-02	3.3E-02	4.8E-03
Sum o	3.2E-01			

Table 8-2 Concentration in the seawater used for the assessment (Source term based on the composition of nuclides in the K4 tank group reflecting the uncertainty of detection)

	Source term	Concentration in the		a accessment (Dar/L)			
	(annual	Concentration in the seawater used for the assessment (Bq/L)					
Target nuclide	discharge amount) (Bq)	Within 10 x 10 km Average of all layers	Within 10 x 10 km Average of the top layers	Beach assessment point Average of all layers			
H-3	2.2E+13	5.6E-02	1.2E-01	9.0E-01			
C-14	6.1E+08	1.5E-06	3.3E-06	2.5E-05			
Mn-54	1.7E+06	4.4E-09	9.4E-09	7.0E-08			
Co-60	1.0E+07	2.7E-08	5.7E-08	4.3E-07			
Ni-63	2.4E+08	6.1E-07	1.3E-06	9.7E-06			
Se-79	1.8E+08	4.6E-07	9.9E-07	7.3E-06			
Sr-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08			
Y-90	1.3E+06	3.2E-09	6.9E-09	5.2E-08			
Tc-99	3.3E+07	8.3E-08	1.8E-07	1.3E-06			
Ru-106	4.7E+07	1.2E-07	2.6E-07	1.9E-06			
Cd-113m	2.4E+06	6.1E-09	1.3E-08	9.7E-08			
Sb-125	8.9E+06	2.3E-08	4.8E-08	3.6E-07			
Te-125m	8.9E+06	2.3E-08	4.8E-08	3.6E-07			
I-129	3.7E+07	9.4E-08	2.0E-07	1.5E-06			
Cs-134	3.4E+06	8.7E-09	1.9E-08	1.4E-07			
Cs-137	6.2E+06	1.6E-08	3.4E-08	2.5E-07			
Ce-144	2.6E+07	6.6E-08	1.4E-07	1.1E-06			
Pm-147	3.6E+07	9.3E-08	2.0E-07	1.5E-06			
Sm-151	5.0E+05	1.3E-09	2.7E-09	2.1E-08			
Eu-154	5.0E+06	1.3E-08	2.7E-08	2.1E-07			
Eu-155	1.5E+07	3.9E-08	8.3E-08	6.3E-07			
U-234	8.7E+04	2.2E-10	4.8E-10	3.5E-09			
U-238	8.7E+04	2.2E-10	4.8E-10	3.5E-09			

	Source term	Concentration in the seawater used for the assessment (Bq/L)					
Target nuclide	(annual discharge amount) (Bq)	Within 10 x 10 km Average of all layers	Within 10 × 10 km Average of the top layers	Beach assessment point Average of all layers			
Np-237	8.7E+04	2.2E-10	4.8E-10	3.5E-09			
Pu-238	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Pu-239	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Pu-240	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Pu-241	3.8E+07	9.8E-08	2.1E-07	1.6E-06			
Am-241	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Cm-243	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Cm-244	1.1E+06	2.7E-09	5.8E-09	4.3E-08			
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray			

Table 8-3 Exposure assessment result based on the composition of nuclides in the K4 tank group reflecting the uncertainty of detection (Assessment area: $10 \text{ km} \times 10 \text{ km}$)

	Source	(1) Source t	(2) Source term considering the					
Assessed case	term	i. K4 tank group		ii. J1-C tank group		iii. J1-G tank group			
Case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	Average	Large
	Sea surface	7.6E-10		2.3E-10		4.8E-10		9.6E-10	
	Hull	7.2E-10		2.2E-10		4.6E-10		9.0E-10	
External exposure (mSv/year)	During swimming	5.2E-10		1.6E-10		3.2E-10		6.6E-10	
	Beach sand	9.1E-07		2.7E-07		5.6E-07		1.1E-06	
	Fishing net	1.8E-07		5.3E	5.3E-08		E-07	2.2E-07	
	Ingestion of water	3.3E-07		3.1E-07		3.1E-07		3.3E-07	
Internal exposure (mSv/year)	Inhalation of spray	9.1E-08		1.9E-07		3.8E-07		9.5E-08	
	Ingestion of seafood	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	5.5E-06	2.4E-05
Total (mSv/year)		6E-06	2E-05	2E-06	5E-06	3E-06	1E-05	7E-06	3E-05

Table 8-4 Results of internal exposures assessment by age based on the composition of nuclides in the J1-G tank group reflecting the uncertainty of detection (Assessment area: $10 \text{ km} \times 10 \text{ km}$)

arour rolling									
Assessed case	Source term	(1) Source term based on measured values						(2) Source term considering the	
		i. K4 tank group		ii. J1-C tank group		iii. J1-G tank group		uncertainty of analysis (J1-G)	
	Ingestion of seafood	Average	Large	Average	Large	Average	Large	Average	Large
Internal	Adult	3.3E	E-07	3.1E-07		3.1E-07		3.3E-07	
exposure from ingestion of water	Child under school age	5.7E-07		5.3E-07		5.4E-07		5.7E-07	
(mSv/year)	Infant	-		-		-		-	
Internal	Adult	9.1E-08		1.9E-07		3.8E-07		9.5E-08	
exposure from inhalation of spray	Child under school age	6.0E-08		1.1E	1.1E-07		≣-07	6.3E-08	
(mSv/year)	Infant	3.9E-08		6.3E-08		1.1E-07		4.0E-08	
Internal	Adult	4.7E-06	2.0E-05	1.0E-06	4.5E-06	2.1E-06	9.0E-06	5.5E-06	2.4E-05
exposure from ingestion of seafood (mSv/year)	Child under school age	4.6E-06	2.0E-05	1.1E-06	4.5E-06	2.4E-06	9.9E-06	5.3E-06	2.3E-05
	Infant	2.9E-06	1.2E-05	1.0E-06	4.5E-06	2.5E-06	1.1E-05	3.3E-06	1.4E-05

- 8-2. Uncertainty of modeling of diffusion and transfer in the environment
- 8-2-1. Uncertainty of meteorological and oceanographic data, etc. (aleatory uncertainty)

The diffusion simulation is considered to include uncertainty caused by variations such as the annual variations of meteorological and oceanographic data.

For this assessment, the meteorological and oceanographic data of 2014 to 2020 are used, but the biggest observed difference in the annual average concentration of $10 \text{ km} \times 10 \text{ km}$ used for the assessment is up to about 20%. A document that simulated the diffusion of cesium using the same model to reproduce the monitoring results shows no difference in the shape of diffusion of each year and that the scale of uncertainty is not twice as great.

8-2-2. Uncertainty of the simulation model itself (epistemic uncertainty)

The diffusion simulation model does not reproduce all of the natural phenomena and scientific findings that the model is constructed based on is not complete. However, the model used this time has been verified by a reproduction calculation of the cesium concentration in the same sea area and the simulation result matches the measured value well. There could be a charge to verify this with another modeling to confirm the magnitude of uncertainty more accurately, but the uncertainty of the model itself is estimated to be not so great.

8-2-3. Uncertainty in the selection of migration pathways (epistemic uncertainty)

In the external exposure assessment, the external exposure from radioactive materials migrated to hulls, beach sand, and fishing nets are assessed. The factor of migration to hulls, beaches, and fishing nets are excerpted from domestic cases such as past guidelines, but not all data regarding the nuclides required for this assessment was obtained. The assessment was based on the data of limited nuclides.

Though there are few findings about these migration factors, the migration to sandy beaches can be assessed by the method of TECDOC-1759 (using the external exposure dose conversion factor of FGR15 issued by U.S. Environmental Protection Agency), so the exposure from sandy beaches was calculated and the result of this report was about 8 times larger. However, it turned out that as the contribution to the overall exposure, the contribution of external exposure is smaller than internal exposure and the total exposure value does not differ so much from that of this report. Attachment XI "Conservativeness of the external exposure dose conversion factor" shows the details of the assessment result using the

external exposure dose conversion factor of FGR15 issued by U.S. Environmental Protection Agency.

8-2-4. Uncertainty in the concentration factor of seafood and the distribution coefficient of seabed sediment (epistemic uncertainty)

The concentration coefficient of fish, etc. used for internal exposure from ingestion of seafood shown in TRS-422 is calculated assuming that the concentration in the seawater and marine organisms are in the equilibrium state from the investigation results of the concentration in the seawater and fish, etc.

However, while the process of migration to organisms and seabed sediment takes much time, whereas movement of the seawater is fast, and it is uncertain whether they were in the equilibrium state at the time of the investigation. In addition, there are also great deal of variations depending on the type of fishes and seabed sediment, and survey locations, and TRS-422 indicates that insufficient reliable data are available to allow accurate assessments of ranges around a recommended value for most element—organism combinations. On the other hand, where a reliable database does exist for a given element and type of organism, in nearly every case the range of minimum and maximum CFs is one order of magnitude (or less) from the recommended value. Therefore, TRS-422 indicate that maximum and minimum CFs are one order of magnitude above and below the recommended value. This is same for the distribution coefficient of seabed sediment, where a range of values is required, maximum and minimum values could be assumed to be a factor of 10 higher and lower than the recommended value.

- 8-3. Uncertainty in the setting of exposure pathways
- 8-3-1. Uncertainty in the selection of exposure pathways (epistemic uncertainty)

The setting of exposure pathways may be insufficient. In TECDOC-1759, most of the pathways set as external exposure ones such as exposure from the sea surface and hulls in this assessment are not subject to the assessment, but pathways not set in this report such as ingestion of beach sediment, ingestion of seawater, and inhalation of seawater spray are picked up. As a result of a verification calculation of unselected pathways by the method of TECDOC-1759, pathways of which exposure assessment results exceeded the pathways selected in this report were found such as ingestion of seawater and inhalation of seawater spray, so they were added as pathways. However, the total value did not change because the impact of internal exposure from ingestion of seafood is great in the exposure assessment. For the result of the verification calculation., see Attachment VI "Transfer pathways and exposure pathways other than the assessment targets." Please note that the difference from TECDOC-1759 is due to the inclusion of modeling of dispersion and transfer.

- 8-4. Uncertainty in the selection of the representative person
- 8-4-1. Uncertainty in the actual life of the representative person (aleatory uncertainty)

In this assessment, the life habit data of the critical group in the case of exposure simulation from domestic nuclear power plants is used. The latest data of the national health and nutrition survey is used for the ingestion of seafood, which has a slight annual variation of about 10 to 20%. However, considering this uncertainty, ingested fish assessed in this report is assumed to be consumed immediately after being caught in the area around the FDNPS without considering market dilution, decay of radioactive nuclides after catching, etc., so there is considered to be not uncertainty which may lead to underestimation.

8-4-2. Uncertainty in the selection of the representative pathway (epistemic uncertainty)

The area around the FDNPS is still in the middle of reconstruction: e.g. even now Difficult-to-Return Zones are set. It is still prohibited to live in Difficult-to-Return Zones. Even for the other zones, return of residents is very limited. Under such circumstances, it is very difficult to ascertain detailed life habits available for the setting of the representative person including the prediction of the future situation.

Therefore, in this assessment, the life habit data of the critical group used in the case of simulation of exposure from domestic nuclear power plants is used, but it includes uncertainty due to the difference from the actual life habits of residents in the surrounding area after reconstruction.

On the other hand, in this assessment, the reprocessing plant located in Aomori, which is also in Tohoku, applies the setting based on the social environment survey and the time of exposure from fishing nets is longer than that of this assessment, but it is less than two times longer. Moreover, the impact of external exposure is smaller than that of internal exposure from the ingestion of seafood, so there is no impact on the exposure assessment. For the ingestion of seafood which affects the internal exposure result, nation-wide statistical data aggregated by age is used and about 10% different from the data of Tohoku. Fish and invertebrates (total of shellfish, cephalopods, and crustacea at reprocessing plant) of the reprocessing plant are 20 to 30% more and seaweeds of this report are 30% more, but the uncertainty of the food ingestion is unlikely to be two times greater and ingested fish assessed in this report is assumed to be consumed immediately after being caught in the area around the FDNPS without considering market dilution, decay of radioactive nuclides after catching, etc., so there is considered to be no uncertainty which may lead to underestimation.

8-4-3. Uncertainty depending on the range of the sea area to be assessed (epistemic uncertainty)

The further it is from the discharge outlet, the lower the concentration in the seawater becomes in the case of discharge of ALPS treated water, so there is uncertainty of variation of the concentration in the seawater used for the assessment depending on the scale of the range to be assessed.

To verify the impact due to the scale of the range to be assessed, we calculated the annual average concentration within 5 km \times 5 km and 20 km \times 10 km in addition to 10 km \times 10 km and assessed exposure of human under normal conditions. The exposure assessment result of 20 km \times 10 km has small difference to that of 10 km \times 10 km. That of 5 km \times 5 km was about 3 times higher than that of 10 km \times 10 km. In reality, it is unlikely that fishing is performed only within 5 km \times 5 km around the FDNPS; and in this report, exposure is assessed assuming that only seafood caught in the assessed sea area but in reality, it is unlikely that only fish caught in the area around the FDNPS is ingested, so it is considered to be unnecessary to consider uncertainty about the range of the sea area. Attachment XII "Impact of the assessment range of concentrations in seawater used for the assessment of exposures" shows the result of the exposure assessment of 5 km \times 5 km and 20 km \times 10 km from the power station.

8-5. Summary about uncertainty

Table 8-5 summarizes these contents.

There is great uncertainty in the composition of nuclides in the source term and migration pathways such as the concentration factor of fish, but the exposure assessment result is sufficiently lower than the dose constraint and it is considered that the conservativeness of the assessment is not lost.

Table 8-5 Summary of uncertainty in this assessment

Item	Details of uncertainty	Assessment of uncertainty		
Selection of the source terms	The composition of nuclides of ALPS treated water is unknown until secondary treatment and measurement is completed, so it has epistemic uncertainty.	The exposure assessment result of the K4 tank group with the highest sum of the ratios to regulatory concentration limits in the source term based on the measured value is about 2-fold of the J1-G tank group with the lowest one. On the other hand, the sum of ratios to regulatory concentration limit of the K4 tank group is 0.28. If the sum of the ratios to regulatory concentration limit is 1 with the same nuclide ratio, exposure will be about 3 to 4 times greater.		
	The measured value incudes aleatory uncertainty based on uncertainty of analysis.	The impact of uncertainty of analysis seems to be less than double.		
Modeling of diffusion and transfer in the environment	The meteorological and oceanographic data has annual variations and includes aleatory uncertainty.	We calculated the average concentration of 10 km x 10 km of 7 years and found a difference of about 20%. In the comparison with the measured value, the parts with high concentrations match well, so uncertainty is assumed to be less than		
	The diffusion simulation model has epistemic uncertainty in the model itself.	two times greater in the calculation of the average calculation of 10 km × 10 km.		
For the migration pathways	and the migration factor of external exposure, differences in elements are not considered, so the dose conversion factor of external exposure has epistemic uncertainty which does not cover all nuclides.	We calculated exposure from beaches from the method of TECDOC-1759 (using the external exposure dose conversion factor of FGR15) and it turned out that the result of the radiological environmental impact assessment report was 8 to 9 times. Even so, the effect of external exposure on exposure is smaller than that of internal exposures, and the total exposure value does not differ so much from that of this report.		
	The concentration factor of fish used for the internal exposure assessment from ingestion of seafood includes epistemic uncertainty due to insufficiency of data.	For the concentration factor, TRS-422 indicate that maximum and minimum CFs are one order of magnitude above and below the recommended value in the case of existence of reliable data for element–organism combination, and for the distribution coefficient, maximum and minimum values could be assumed to be a factor of 10 higher and lower than the recommended value.		
Exposure pathways	There are epistemic uncertainties because the selected migration and exposure pathways do not cover all the pathways.	We calculated the unselected exposure pathways by the method of TECDOC-1759 and added pathways with higher exposure assessments than those of the selected pathways. However, the total value did not change because the impact of internal exposure from ingestion of seafood is great.		
Selection of a representative person	The area around the FDNPS is undergoing reconstruction, so we used life habit data from domestic precedent cases. As a result, it includes epistemic uncertainty due to the difference in the actual life habits. The food ingestion is set from nationwide data and also includes epistemic uncertainty.	The external exposure time is shorter than that of the Rokkasho reprocessing plant, but it is smaller than internal exposure from ingestion of seafood and does not affect the exposure assessment result. For the ingestion of seafood which affects the internal exposure result, nation-wide statistical data aggregated by age is used and about 10% different from the data of Tohoku, but in the report, all ingested fish are assumed to have been caught in the area around the FDNPS in the assessment, so there is considered to be not uncertainty which may lead to underestimation.		
	It includes epistemic uncertainty about the range of the appropriate area as the sea area to be assessed.	We assessed 5 km \times 5 km, which is smaller, and 20 km \times 10 km, which is larger, than 10 km \times 10 km and it turned out that the exposure is about three times greater in the range of 5 km \times 5 km and not much different in the range of 20 km \times 20 km. Actually, it is unrealistic to perform fishing only within the range of 5 km \times 5 km and the assessment in this report assumes that all ingested fish are caught in the area around the FDNPS, so it is considered to be unnecessary to consider uncertainty due to the setting of the assessed sea area.		

Monitoring to be performed in response to discharge of ALPS treated water into the sea

This section describes our analytical capabilities at the FDNPS as well as the plan of monitoring to be performed inside and outside the site in relation to the discharge of ALPS treated water of the FDNPS (as of the issuance of this revised report; to be revised as needed).

All of these enhance and expand the monitoring program which has been performed continuously since the accident at the FDNPS.

Through the monitoring activity in the site, we will ensure that ALPS treated water discharged into the environment is safe. Through the monitoring activity outside the site, we shall correctly ascertain the impact of discharge of ALPS treated water into the sea on the environment.

9-1. Analytical capability in the Fukushima Daiichi Nuclear Power Station

In the site of the FDNPS, the environment control building for environmental sample analysis and the Unit 5/6 analysis rooms (hot lab.) for analysis of samples with high activity concentration, which have been operated before the earthquake, are still in operation. In addition to these, we started the operation of the chemical analysis building for samples with low activity concentration for which measures to prevent contamination in the site and eliminate the impact of the environmental dose were performed in 2013. The analysis and measurement functions of the environment control building were terminated due to the contamination state of the facility and facility aging, and only the pretreatment function remains.

After the earthquake, initially we especially focused on handling of samples with high activity concentration in order to deal with the problem of contaminated water. However, in July 2013, when the chemical analysis building was completed and environmental samples were able to be analyzed, we started to develop human resources to analyze samples of which radioactive concentrations had been confirmed to be low such as the seawater. After that, as drainage of groundwater bypass water (hereinafter called "groundwater bypass") and treated water of the purification facilities such as the subdrain (hereinafter called "subdrain") to reduce the contaminated water generation, we have been expanding the training of workers for the Unit 5/6 analysis rooms and the chemical analysis building in parallel. For discharge of ALPS treated water into the sea, we will enhance and expand the analysis framework in terms of facilities and competence.

9-1-1. Analytical capability in terms of facilities

Since all analyses related to discharge of ALPS treated water into the sea are classified into analyses of samples with low activity concentration, it is planned to perform analyses and assessments using the facilities of the chemical analysis building. The layout arrangement, addition of analysis devices, etc., for the chemical analysis building shall be performed flexibly as needed. Table 9-1 shows the overview and functions of the analysis facilities in

the site of the FDNPS. Table 9-2 shows the overview of the analysis devices installed in the chemical analysis buildings.

Table 9-1 Overview and functions of the analysis facility

Facility name	Function	Overview of the facility	Remarks
Environmental management building	Pretreatment (pretreatment of fish)	Analysis room + Measurement room: 480m ² Experimental table: 4	 Before the earthquake, we analyzed environmental samples but transferred the functions to the chemical analysis building and the Unit 5/6 analysis rooms after the earthquake The functions are limited to pretreatment
Units 5/6 analysis room	Analysis of samples with high activity concentration	Analysis room + Measurement room: 850m ² Experimental table: 23 Fume hood: 26	 Expanded the facility which had been operated since before the earthquake in 2016
Chemical analysis building	Analysis of samples with low activity concentration	Analysis room + Measurement room: 1,000m ² Experimental table: 15 Fume hood: 35	 This facility was put into use in 2013. The analysis of ALPS treated water is planned to be performed here
Chemical analysis building (for expansion, planned)	Pretreatment operation and analysis of a sample of a low radioactive concentration	Analysis room + Measurement room: About 600 m² [Facility proposal] Experimental table: 8 Fume hood: 21 Rotary evaporator: 5 Electrolytic condenser: 10 Lyophilizer: 6 H-3 -> He converter: 2	 The construction work is scheduled to be completed by the end of FY 2023. The number of analyzers, etc. may be changed in the future

Table 9-2 Analyzers in the chemical analysis building (including those planned to be expanded in the future)

Sample handled	Analyzer	Target nuclides to be measured	Number of units deployed
	Ge semiconductor detector	γ-ray emitting nuclides (e.g. Cs -134.137)	12
	Automatic α-measuring device	Total α	2
Monitoring samples:	Low back gas flow counter	Total β, Sr -90	5
seawater, etc.	β-nuclide analysis equipment	Sr-90	2
Drainage sample: Groundwater bypass and sub-drain	Low background liquid scintillation counter	Tritium, C -14 Cd-113 m, Ni-63	9 (Three more to be expanded)
ALPS outlet water: last stage	Inductively coupled plasma mass spectrometer (ICP-MS)	I-129, Tc-99	2
etc.	Noble gas mass spectrometer (He-MS)	Tritium	2 (To be expanded)
	High purity Ge semiconductor detector for low energy photons (LEPS)	Low-energy γ-ray emitting nuclide (including Fe-55)	2 (To be expanded)

For the measuring instruments used for measurement, we verify the detection efficiency with the standard source and the standard solution as daily inspections at the start of work to maintain the device performance and measure samples. Table 9-3 shows the overview of

daily inspections of the measuring instruments installed in the FDNPS (verification of the detection efficiency).

Table 9-3 Verification of the detection efficiency in the daily inspection of measuring instruments

Measuring instrument	Standard source	Confirmation method
Ge semiconductor detector	Co-57, Ba-133, Cs-137, Mn-54, Co-60	Frequency: At the beginning of daily work Method: Obtain the detection efficiency for each
Automatic α-measuring device	Am-241	nominal energy of the standard source and confirm that it is within the judgment value
β-nuclide analysis equipment	Sr-90 Cs-137	(±10%) Actions to be taken in case of deviation: The
Low background liquid scintillation counter	Tritium	measured sample after the value judged last time is evaluated again, and the sample during the deviation period is measured if necessary
Inductively coupled plasma mass spectrometer (ICP-MS)	Li, Co, Y, Tl	Frequency: Each use Method: Measure the strength of each element. After checking the judged value or above, prepare a calibration curve before measurement. Strength of standard solution: Li: >1000 Co, Y: >200 TI: >800

9-1-2. Analytical capability in terms of competence

The analysis work led by us shall be consigned to Tokyo Power Technology⁴³ (hereinafter called "TPT"). We shall formulate the plan for analysis and prepare resources suitable for the plan, supervise the work by TPT, judge the possibility of discharge based on the analysis result, manage and announce analysis data, etc.

Our employees who supervise analysis work shall have been certified to have skill levels sufficient for their roles through the on-site technique and skills certification system, and competence is secured in a planned manner by periodic competence assessments and effectiveness reviews.

On the other hand, TPT, which is the consignee of the analysis work, increases and secure competent analysts in order to maintain the capabilities to surely analyze the nuclides for which high skills are required (hereinafter called "difficult-to-measure nuclides") such as C-14. Moreover, to have objective confirmation of skills from the viewpoint of a third party, we shall participate in IAEA Proficiency Test Exercise⁴⁴ and continuously conduct crosschecking, etc., with analytical institutes inside Japan.

In the chemical analysis building, ISO/IEC-17025 certification⁴⁵ for Cs-134, Cs-137, and tritium has been acquired and maintained and it is planned to acquire certification for the Sr-

⁴³ We are a wholly owned subsidiary of Tokyo Electric Power Company Holdings, Inc. and have advantages in terms of design, construction, operation, and maintenance of electricity-related facilities including our company; environment investigation measurements and their assessments; investigations/analyses and measurements of substances, etc.; control of radioactive materials and radiation; decontamination in general; processing treatment/disposal of radioactive waste, etc.

⁴⁴ The IAEA prepares a sample with a known result for the test and provide it to each participating analysis institute. Then, each institute analyzes it and the IAEA compares the result with the components of the sample for the test to assess the accuracy of the analysis by each institute.

⁴⁵ Examining authority examine the ability of test places and correction organizations to authorize their capability.

90 analysis as well. In addition, the appropriateness of the data to be used for decision of discharge was confirmed by comparison with the analysis value of the third-party institute specified as the consignee by us. Table 9-4 shows the certification acquisition status by the certification institute for us (TPT) and each consignee analysis institute.

Table 9-4 Certification acquisition statuses of us (TPT) and consignee analysis institutes

Organization	Certification	Acquisition status (17025)
TPT (Fukushima Daichi)	ISO/IEC17025 ISO9001	(Chemical analysis building) Cs-134,Cs-137,H-3
KAKEN Co.,Ltd.	ISO/IEC17025	Cs-134,Cs-137 I-131 Sr-90 H-3
Japan Chemical Analysis Center	ISO/IEC17025 ISO9001	Gamma-emitting nuclide H-3 Radioactive strontium Plutonium
Tohoku Greening Environmental Conservation Co., Ltd.	ISO/IEC17025 ISO9001	Cs-134,Cs-137 I-131 H-3

To ascertain the competence of each analyst, we increase those who can deal with analyses of difficult-measure nuclides by OJT and verify the competence with the Z score (within two times wider range as detected concentration ± standard deviation), which is an ISO review method, by measurements using samples with known concentrations once a year for the nuclides subject to ISO/IEC-17025 authentication ⁴⁶ for all the personnel in charge of tritium and cesium (See Figure 9-1).

⁴⁶ "Analytical test of radionuclide (including Cs134/Cs137 and H-3) in public waters, wastewater, soil, ash and sludge" (Certification institute: Perry Johnson Laboratory Accreditation Inc., Certificate: L22-389)

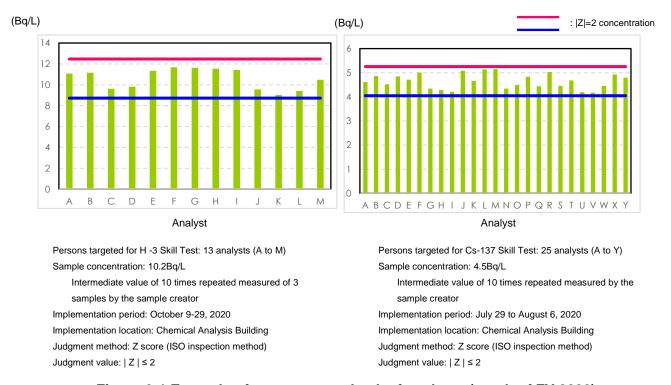


Figure 9-1 Example of competence check of analysts (result of FY 2020)

9-1-3. Our management and supervision

We request consignees to comply with the determined analysis procedures and secure the competence of analysts based on contracts, and receive and verify analysis procedures and competence control records.

Figure 9-2 shows the overview of the system that maintains the flow and quality of analysis, which means that the quality of the analysis process is kept constant and a mechanism to detect abnormalities of data is constructed.

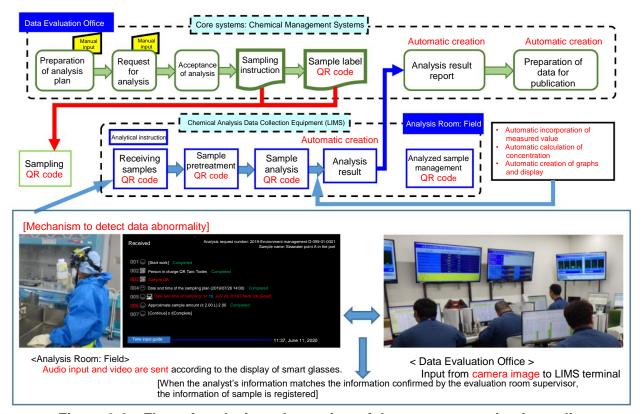


Figure 9-2 Flow of analysis and overview of the system to maintain quality

In addition, the following activities are performed.

- Usage status of procedures and the implementation status of specifications are regularly checked in all analysis rooms (it is applied to all analytical work performed within the premises of the FDNPS)
- In order to ensure the quality of operation and work safety, it is stipulated as a requirement that work can be performed with the same procedure even when an analyst is replaced.
- Methods for checking procedures are standardized.
- The third-party organizations are required to submit work procedures in their specifications as well, and our company's involvement in the quality control of work processes will be enhanced.
- Guidance is given to contractors for identifying risks in the prior safety assessment before starting operation. TEPCO explains previous nonconformity cases and gives guidance to raise their awareness and ensure the thorough compliance with the rules

- Every month, TEPCO discusses with contractors on issues in analytical operation and the implementation status of the preventive measures for the recurrence of previous nonconformities to maintain performance
- Every month, TEPCO conducts on-site observations for analysis work with contractors to identify unsafe conditions to ensure safety at the site and maintain work quality
- Implementation status of analysis procedures established by contractors, is checked, and guidance is given for the identification and correction of the area to be improved in the work.

9-2. Monitoring within the premises of the Fukushima Daiichi Nuclear Power Station

The following three activities are to be performed at the site: (1) measurement and assessment of 64 nuclides by the measurement/confirmation facility of which results are used to judge the possibility of discharge and determine the dilution ratio (source monitoring), (2) monitoring with samples collected at the discharge vertical shaft (upper-stream storage) to confirm the dilution and mixing states of treated water with the seawater used for judgment of discharge immediately after the start of discharge, and (3) monitoring with samples collected from the seawater piping performed to confirm the dilution state every day during continuous discharge, all of which are led by us. This section describes the procedures, etc., used for maintaining the accuracy of monitoring as well.

Figure 9-3 shows monitoring to be performed within the premises of the FDNPS.

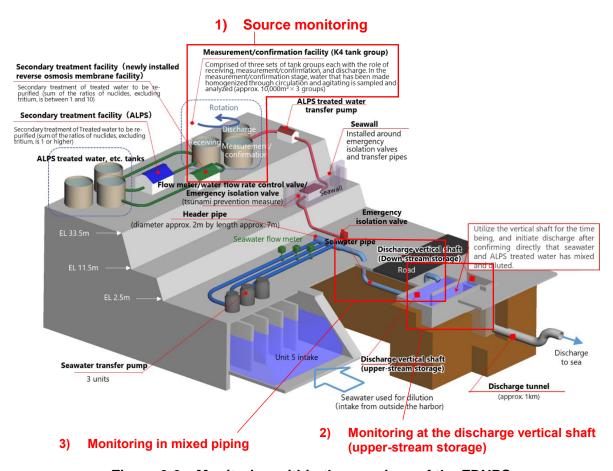


Figure 9-3 Monitoring within the premises of the FDNPS

9-2-1. Source monitoring

Source monitoring is monitoring of the source term (annual discharge amount (total amount) of each nuclide contained in the ALPS treated water, which is diluted and discharged into the sea). In this analysis, we collect samples after homogenization of ALPS treated water every time the measurement/confirmation facility is fully filled with ALPS treated water, and all nuclides to be measured in ALPS treated water (the 30 nuclides subject to measurement and assessment when ALPS treated water is discharged into the sea, tritium, and other nuclides subject to removal by ALPS, except for the 30 nuclides) are analyzed and assessed⁴⁷. From the analysis results, we verified that:

- The sum of the ratios to regulatory concentrations limits⁴⁸ of the concentrations of 30 nuclides subject to measurement and assessment for discharge of ALPS treated water into the sea nuclides excluding tritium falls below 1, which is the regulatory standard
- This is the basis for the determination of the flow rate of the ALPS treated amount to be diluted and discharged based on the measured tritium concentration to surely make the concentration after dilution less than 1,500Bq/L, which is the concentration specified in the fundamental policy of the government.

Therefore, the homogeneity of ALPS treated water stored in the measurement/confirmation facility is extremely important for securing the representativeness of collected samples. The measurement/confirmation facility where samples are collected consists of three tank groups each of which consists of 10 tanks with capacity of about 1,000 m³ connected by connecting piping so that they can be managed uniformly. For each tank group, the circulation/stirring facility is installed to stir and circulate the ALPS treated water stored in the tanks for homogenization. By operating the facility properly, we secure the representativeness of samples.

Samples are analyzed by TPT analysts in the chemical analysis building installed in the site of the FDNPS and planned to be expanded in the future (See Table 9-2). In addition, the mechanism for multiple parties to verify the analysis result has been established involving the analysis institute we designated as a third party; an analysis laboratory designated as a third

⁴⁷ Some of the nuclides to be measured take time and actually took about two months for the measurement and assessment in the secondary treatment performance verification test (We are considering how to shorten the required time). Therefore, we plan to secure the storage capacity of about 10,000 m³ (amount generated in 2 months (150 m³/day)) as the capacity of the measurement/confirmation facility.

⁴⁸ See Reference A "Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws"

party by the government; and the IAEA laboratories and the analysis laboratories of the member countries specified by the IAEA as a part of review of discharge of ALPS treated water. The framework of analysis led by the government and the IAEA is now being discussed by the government and the IAEA. The results are also planned to be announced. Table 9-5 shows the measurement and assessment method of each nuclides in the measurement/confirmation facility. Table 9-6 shows the minimum limit value and compliance method of each nuclide

Table 9-5 Measurement and assessment methods of each nuclide

	Table 9-5 Measurement and assessment methods of each nuclide			
	No.	Nuclide	Measurem ent object	Measurement or assessment method
	-	Tritium (FWT)	β-	Isolated by distillation, mixed scintillator and counted by low-back liquid scintillation counter
a 0	1	C-14	β-	Converted to CO2, collected and isolated on absorbent, mixed with a scintillator, and counted by a low back liquid scintillation counter.
he s	2	Mn-54	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
into t	3	Co-60	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
Discharge into the sea	4	Ni-63	β-	Isolated with resin, mixed with scintillators, and counted with a low-back liquid scintillation counter
isch	5	Se-79	β-	Isolated with resin, mixed with scintillators, and counted with a low-back liquid scintillation counter
	6	Sr-90	β-	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish
t dur	7	Y-90	-	[Evaluation value] Concentration assessment as radioactive equilibrium with Sr-90
smen	8	Tc-99	Mass	Samples are diluted with dilute nitric acid and counted with the inductively coupled plasma mass spectrometry (ICP-MS).
sess	9	Ru-106	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ent/a	10	Cd-113m	β-	Isolated by ion exchange, mixed with a scintillator, and counted by a low back liquid scintillation counter.
urem	11	Sb-125	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
Meas	12	Te-125m	-	[Evaluation value] Concentration assessment as radioactive equilibrium with Sb-125
ater Target nuclides for Measurement/assessment during	13	I-129	Mass	Samples were counted with the inductively coupled plasma mass spectrometry (ICP-MS) after adjusting to iodate ion by the addition of reagents.
nucli	14	Cs-134	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ırget	15	Cs-137	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ter Ta	16	Ce-144	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ted wat	17	Pm-147	-	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated nuclide abundance ratio.
ALPS treated w	18	Sm-151	-	[Assessed value] Assessed from the measured value of the radioactive concentration of congener Eu-154 and the calculated nuclide abundance ratio
AL	19	Eu-154	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.

	No.	Nuclide	Measurem ent object	Measurement or assessment method
	20	Eu-155	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	21	U-234	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	22	U-238	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the $ZnS\alpha$ automatic measuring device is used as it is without proportionate division with other nuclides
	23	Np-237	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	24	Pu-238	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	25	Pu-239	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	26	Pu-240	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	27	Pu-241	-	[Evaluation value] Assessed from the total α discrete value and the isotopic ratio of Pu-238
	28	Am-241	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	29	Cm-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
	30	Cm-244	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
		Fe-59	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ALP		Co-58	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ct to		Zn-65	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ubje oval		Rb-86	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
des subj Removal		Sr-89	β-	Isolated with resin and recovered from sedimentation are mounted and counted by β nuclide analyzer in a stainless steel dish.
Other nuclides subject to ALPS Removal		Y-91	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
ther		Nb-95	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
0		Ru-103	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.

No.	Nuclide	Measurem ent object	Measurement or assessment method
	Rh-103m	-	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-103γ
	Rh-106	-	[Evaluation value] Concentration assessment as radioactive equilibrium with Ru-106
	Ag-110m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Cd-115m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Sn-119m	-	[Evaluation value] Assessed from the measured value of the radioactive concentration of Sn-123 and the calculated nuclide abundance ratio
	Sn-123	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Sn-126	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Sb-124	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Te-123m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Te-127	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector, and evaluated using the half-life of the parent nuclide (Te-127m).
	Te-127m	-	[Evaluation value] Assessed from the measured value of the radioactive concentration of Te-127 and the calculated nuclide abundance ratio
	Te-129	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector., and evaluated using the half-life of the parent nuclide (Te-129m).
	Te-129m	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Cs-135	-	[Evaluation value] Assessed from the measured value of the of the calculated nuclide abundance ratio
	Cs-136	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Ba-137m	γ1	[Evaluation value] Concentration assessment as radioactive equilibrium with Cs-137
	Ba-140	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Ce-141	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Pr-144	-	[Evaluation value] Concentration assessment as radiation equilibrium with Ce-144, using half-life of parent nuclide (Pr-144m)
	Pr-144m	-	[Evaluation value] Concentration assessment as radioactive equilibrium with Ce-144
	Pm-146	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Pm-148	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Pm-148m	γ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Eu-152	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Gd-153	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Tb-160	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
	Am-242m	-	[Evaluation value] Assessed from the isotopic ratio of Am-241

	No.	Nuclide	Measurem ent object	Measurement or assessment method
		Am-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
		Cm-242	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
a)		CI-36	β-	Sedimentation with silver chloride, mixed with scintillator, counted by low-back liquid scintillation counter, or counted by β -nuclide analyzer
to be		Fe-55	X	Isolated with resin and counted by Ge detector for low-energy $\boldsymbol{\gamma}$ and \boldsymbol{X} rays
lides tored		Nb-93m	Υ	Isolated with resin and counted by Ge detector for low-energy γ and X rays
t nuclides monitored		Mo-93	Υ	Isolated with resin and counted by Ge detector for low-energy γ-rays and X rays
Target nuclides monitored		Nb-94	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.
—		Ba-133	Υ	Homogenized sample is collected in marinelli containers and counted by a Ge detector.

Table 9-6 Target detection limit and compliance method of each analyzed nuclide

Nuclide	Analysis method	Target minimum limit of detection value ⁴⁹	Applicable technique
γ-ray emitting nuclides	Samples are dispensed in a Marinelli container and measured with a Ge semiconductor detector.	0.07Bq/L Set in Cs-137 ⁵⁰	Series of Radioactivity Measuring Methods. No. 7 (Gamma ray spectrometry with germanium semiconductor detector)
Sr-89/90	Sr was refined by Sr resin, precipitated and recovered as carbonate, and measured with a β-nuclide analysis equipment.	0.04Bq/L Set in Sr-90 ⁵¹	JAEA-Technology2009-051 (Simple and rapid analytical method for nuclides, contained in waste from research facilities, etc. (analytical guidelines))
I-129	Hypochlorous acid was added to the sample to adjust it to iodic acid ion, and then measured with an inductively coupled plasma mass analysis equipment.	0.2Bq/L	Series of Radioactivity Measuring Methods. No. 32 (Method for rapid analysis of iodine 129 in environmental samples)
Tritium	After mixing the sample from which impurities have been removed by distillation with the scintillator, measurement is performed with a low back liquid scintillation counter.	30Bq/L	Series of Radioactivity Measuring Methods. No. 9 (Tritium analysis method)
C-14	The sample is heated by adding concentrated nitric acid and potassium persulfate, and the generated CO2 is collected in an absorbent, mixed with a scintillator, and measured by a low back liquid scintillation counter.	10Bq/L	Series of Radioactivity Measuring Methods. No. 25 (Radiocarbon Analysis Method) JGC: Radiochemical Analysis of Radioactive Waste
Tc-99	The sample is diluted with nitric acid and measured with an inductively coupled plasma mass spectrometer.	2Bq/L	Radioactive waste management funding and research center: Research on upgrading and streamlining of radiochemical analytical technique
Total-α radioactivity	After α-nuclide is coprecipitated with iron hydroxide and iron is removed by extraction, it is evaporated to dryness and then baked to the stainless plate, and measured with an α automatic measuring device	0.04Bq/L	Manual of standard procedures for analysis of radioactive effluents and gases from Tokai Works of Power Reactor and Nuclear Fuel Development Corporation
Cd-113m	Cd is refined and recovered by ion exchange, mixed with a scintillator, and measured by a low back liquid scintillation counter.	0.2Bq/L	Analytical Chemistry, vol.63, No. 4. (Review of Analysis method with β-rays measurement method using low back liquid scintillation counter for ^{113m} Cd in stagnant water in FDNPS)

⁴⁹Value for each nuclide set to confirm that the sum of the ratios to regulatory concentrations limits is less than 1

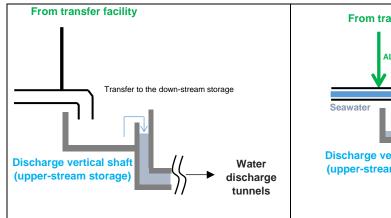
 $^{^{50}}$ Other nuclides vary with baseline, interfering nuclides, background and gamma ray emission rate

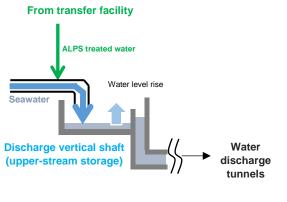
⁵¹Sr-89 varies with Sr-90 concentration

Nuclide	Analysis method	Target minimum limit of detection value ⁴⁹	Applicable technique
Ni-63	Ni is refined and recovered by Ni resin, mixed with a scintillator, and measured by a low back liquid scintillation counter.	20Bq/L	JAEA-Technology2009-051 (Simple and rapid analytical method for nuclides, contained in waste from research facilities, etc. (analytical guidelines))

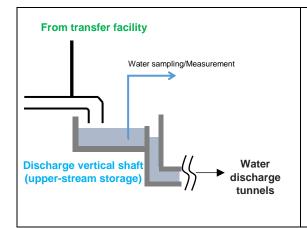
9-2-2. Monitoring at the discharge vertical shaft (upper-stream storage)

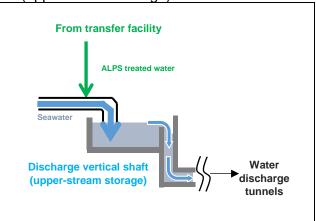
ALPS treated water to be discharged into the sea is treated by ALPS until the sum of the ratios to regulatory concentrations limits of nuclides excluding tritium fall below 1, in order to ensure the safety of ALPS treated water to be discharged into the environment. On the other hand, to the extent of the available knowledge, ALPS treated water, etc., contains 0.15 to 2.16 million Bg/L of tritium, which exceeds the regulatory concentration limit (60,000 Bg/L), which is the upper limit on the discharge into the environment specified by laws. In addition, the Basic Policy of the government in April 2021 stipulates that the tritium concentration be less than 1,500 Bg/L as with the groundwater bypass and subdrain. In response to it, we decided to dilute ALPS treated water, etc., with a lot of seawater before discharge in order to meet the regulatory concentration limit and dispel concerns of consumers, etc., as much as possible for minimization of reputation damage. Tritium is a nuclide that emits week beta rays, which cannot be monitored continuously, unlike gamma rays from Cs-137. Therefore, the appropriateness of dilution is verified by collecting samples and measurement with the liquid scintillation counting device. To start discharge into the sea, for the time being, we shall verify that appropriate dilution is performed by the dilution facility by the procedure shown in Figure 9-4 below and the tritium concentration is less than 1,500 Bq/L at the discharge vertical shaft (upper-stream storage) immediately before discharge into the environment, for each type of ALPS treated water (about 10,000 m³/tank group) of which sum of the ratios to regulatory concentrations limits of 30 nuclides other than tritium is less than 1 by the analysis and assessment by the measurement/confirmation facility (See 9-2-1).





- (1) Empty the discharge vertical shaft (upper-stream storage).
- (2) Store ALPS treated water transferred by the transfer facility and diluted by the dilution facility, in the discharge vertical shaft (upper-stream storage).





- (3) Stop the pump before the discharge vertical shaft (upper-stream storage) is fully filled with water, and collect and measure sample water in the discharge vertical shaft (upper-stream storage) (suspend the discharge until the result is given).
- (4) Verify that the actual concentration is comperable to the calculated tritium concentration and less than 1,500 Bq/L.
- (5)Activate two or more seawater pumps. After getting stable volume of seawater flow, countinuously discharge the water into the sea by activating the transfer pumps of ALPS treated water as the step 2. Stored water in the discharge vertical shaft (upperstream storage) will be drained into the discharge facility.

Figure 9-4 Analysis and discharge procedure at the discharge vertical shaft (upperstream storage)

9-2-3. Monitoring in seawater piping

After verification of the appropriateness of dilution described in 9-2-2. above, dilute the remaining ALPS treated water (about 10,000 m³/tank group), transfer it to the discharge vertical shaft (upper-stream storage), and discharge it continuously or intermittently. The capacity of the ALPS treated water transfer pump is 500 m³/day. Considering the capacity of each tank group of the measurement/confirmation facility (about 10,000 m³/tank group), it takes about 20 days to discharge the whole of the remaining ALPS treated water measured even by continuous discharge.

Collect samples every day by the sampling facility installed in the seawater piping, analyze the tritium concentration, and, in principle, announce the result on the following day, in order to verify the appropriateness of dilution of tritium during this discharge period.

To verify whether appropriate dilution mixing is performed in the seawater piping, mass concentration of injected ALPS treated water in each section of piping was calculated by fluid analysis (seawater flow rate of 340,000 m³/day and ALPS treated water flow rate of 500 m³/day, the theoretical mass concentration of 0.14%). As a result of the assessment, it was verified that 100 or more times higher dilution effect than the target of this facility was obtained at 04: Down elbow outlet in Figure 9-5 in the downstream side from the ALPS treated water injection position.

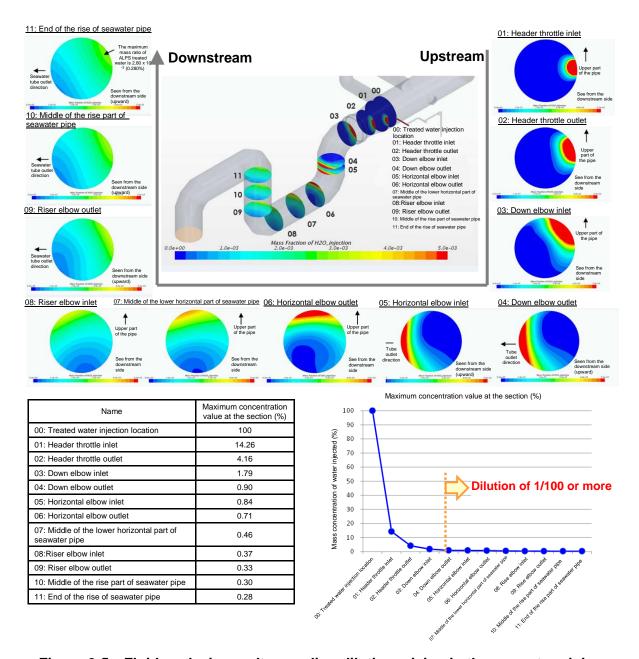


Figure 9-5 Fluid analysis result regarding dilution mixing in the seawater piping

9-3. Monitoring outside of the premises of the Fukushima Daiichi Nuclear Power Station

After the accident at the FDNPS, the "Monitoring Coordination Meeting" was set up under the Nuclear Emergency Response Headquarters of the government and the "Comprehensive Radiation Monitoring Plan" was formulated in August 2011 for secure and planned implementation of find monitoring about the environment⁵². Based on this plan, we have been monitoring mainly Cs-134, Cs-137, and Sr-90 in the sea area for the purpose of ascertaining the states of diffusion and advection of radioactive materials discharged into the environment, etc., in cooperation with each monitoring executing body such as the related ministries, local governments, and us (hereinafter called "implementation entity"). The Comprehensive Radiation Monitoring Plan defines the division of roles of each implementation entity and each implementation entity has been fulfilling their roles according to the definition.

After the announcement of the Basic Policy on handling of the ALPS treated water in April 2021, each implementation entity has been considering enhancement and expansion of sea area monitoring (See 9-3-1 and 9-3-2). We recognize that in discharging ALPS treated water into the sea, it is important to enhance and expand sea area monitoring from the viewpoints of compliance with legal regulatory standards, etc., and actions based on international laws and practices, as well as prevention of reputation damage, dispelling of concerns of people inside and outside Japan, and deepening of understanding. Our consideration result was reflected in the Comprehensive Radiation Monitoring Plan at the Monitoring Coordination Meeting held on March 30, 2022. Figure 9-6 shows the position of monitoring by each implementation entity.

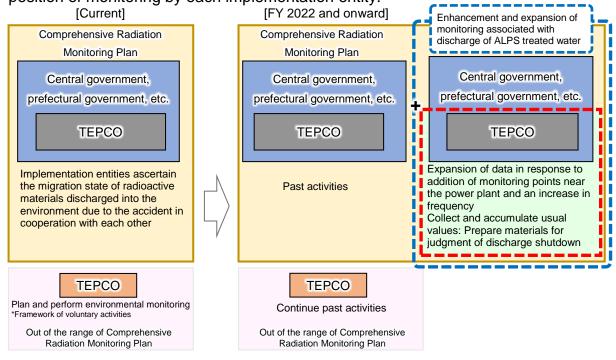


Figure 9-6 Position of sea area monitoring by each implementation entity

151

⁵² Monitoring Coordination Meeting of the Nuclear Emergency Response Headquarters (revised on March 30, 2022) https://radioactivity.nsr.go.jp/en/list/274/list-1.html

The following shows the monitoring plan conducted and to be performed in the future by each implementation entity as of the end of March 2022. Each plan is stipulated in the Government's Comprehensive Radiation Monitoring Plan.

9-3-1. Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO

In the past, we performed the following monitoring as a part of the total monitoring plan.

Table 9-7 Overview of our sea area monitoring based on the past total monitoring plan

Target	Target nuclide	Measurement frequency (depending on the location and nuclide)
Seawater	Cs-134/137, strontium, tritium, and plutonium	Every day or every six months
Seabed sediment	Cs-134/137, strontium, and plutonium	Every month or every six months
Fish, etc.	Cs-134/137	Once a month

Based on the Basic Policy of the government in April 2021, in the same month, we announced "TEPCO's Action in response to Government's Policy" including further enhancement and expansion of sea area monitoring in order to minimize reputation damage associated with discharge of ALPS treated water into the sea⁵³.

After that, we announced sea area monitoring (plan) in August 2021, as the executing body of discharge of ALPS treated water into the sea⁵⁴, and then assessed the state of diffusion of ALPS treated water by simulation in the radiological impact assessment in November 2021. We considered sea area monitoring for verification of the diffusion state and the migration state of radiological materials to fish and seaweeds in the sea area off the coast of Fukushima centering on the area adjacent to the FDNPS, in which the tritium concentration was assessed to change⁵⁵.⁵⁶

To continuously get data for comparison with the diffusion state and migration state after discharge, it is planned to formulate the sea area monitoring plan setting the detection limit in addition to the consideration result announced in August 2021. Understanding the environmental status before actual discharge is important to assess environmental impact after the beginning of the discharge. Therefore we started the implementation of the plan in April 2022 before starting discharge, for the purpose of understanding the variation range as

⁵³ TEPCO Holdings' Action in Response to the Government's Policy on the Handling of ALPS Treated Water from the Fukushima Daiichi Nuclear Power Station

https://www.tepco.co.jp/en/hd/newsroom/press/archives/2021/20210416_01.html

⁵⁴ Status of Review Regarding the Handling of ALPS Treated Water https://www.tepco.co.jp/en/hd/newsroom/press/archives/2021/pdf/210825e0101.pdf

⁵⁵ However, the change in the concentration is assessed to be 1 to 2Bq/L, which is as little as 1/10,000 to 1/5,000 of 10,000Bq/L, which is the WHO Guidelines for Drinking Water Quality.

⁵⁶ The sampling points are added from the diffusion simulation result in March 2020, and consequently the results showed this assessment requires no change. The frequency to ascertain usual values increased as well as enhance the verification of the state of migration to marine organisms

a baseline monitoring. For this monitoring (sampling, radiation measurement, etc.), it is planned to ask agriculture, forestry and fisheries workers, related parties in local governments, etc. participate in and observe monitoring, and request an analysis by a third party organization specified by us and involvement of the IAEA as with source monitoring in order to secure objectivity and reliability of the monitoring result.

We plan to monitor not only the seawater but also fish and seaweeds to verify the state of migration of radioactive materials to marine plants and animals due to discharge.

As a result of considerations based on the results of this radiological environmental impact assessment, TEPCO selected sites and nuclides to be monitored in light of following points:

- The result of dispersion simulation showed that there was no area where the
 concentration is significantly higher than that of the surroundings, because
 dispersion was carried out quickly in the environment after the discharge at the
 discharge point.
- The concentration of each nuclide in the ALPS treated water is below the detection limit, except for the seven major nuclides, tritium, and C-14. In addition, the ALPS treated water containing those nuclides will be discharged from the outlet after being diluted more than 100 times, and the diluted water will be dispersed in the environment. Therefore, even if environmental distribution or concentration are considered, the concentration in environmental samples of these nuclides of which concentration in the treated water is below the detection limit is very low, and even if the detection limit is lowered to a feasible extent, it is considered difficult to detect the concentrations.
- Therefore, it is appropriate to screen a wide range of nuclides to be monitored, focucing on those that are particularly easy to observe (in addition to H-3 and Cs-137, and I-129 which tends to accumulate in seaweed) among the detected nuclides described above, to analyzed in detail if abnormal values are found.

We decided to enhance and expand sea area monitoring as follows. Figure 9-7 shows the details of enhancement and expansion of our sea area monitoring. The items shown below are implemented as part of the Government's Comprehensive Radiation Monitoring Plan.

- Increase in measurement points and targets
 - Considering that we are the executing body of discharge of ALPS treated water into the sea, we decided to perform monitoring focusing on the area around the discharge outlet and added a total of 13 tritium measurement points of the

- seawater and marine organisms (fish) in the area near the FDNPS and the coast of Fukushima (See red and orange boxes in Figure 9-7).
- For seawater monitoring, we added three new monitoring points on the boundary of the "area where no fishing is conducted on a daily basis" considered in this assessment of radiological impact on human and environment (See the red texts in Figure 9-7).
- For fish, we currently analyze cesium, which is representative⁵⁷ in the measurement of radiological environmental impact, based on samples collected in 11 locations within 20 km off the coast of Fukushima (in one of which tritium analysis is still performed), and will analyze tritium in fish caught in a total of 11 locations including 10 new locations where currently tritium is not analyzed, in order to verify the impact of concentration of tritium (See orange boxes in the right figure in Figure 9-7). Tritium analysis is also performed for the seawater on the point.
- We will collect and analyze seaweeds in two new locations outside the port as well as the location in the port where currently gamma nuclides are analyzed (See green boxes in Figure 9-7). We shall add tritium to the measured nuclides, verify whether it concentrates, etc., and add iodine, which is easy to concentrate in seaweeds, to the measured nuclides.
- ➤ We will continue the current measurements of nuclides other than tritium and I-129, of which measurements are to be enhanced and expanded (Cs-134, Cs-137, Sr-90, Pu-238, and Pu-239+240)⁵⁸.

 $^{^{57}}$ This is because there are some nuclides which emit strong gamma rays.

⁵⁸ We shall perform monitoring of mainly tritium considering the migration and advection processes in the environment, but if any abnormality is found in the enhanced monitoring, we shall consider the necessity for additional monitoring of such nuclides and C-14.

- Increase in the frequency
 - As measurement points increase, the frequency is increased at points where tritium in the seawater has been measured (For measurement points, see blue boxes in Figure 9-7. For the frequency, see Table 9-9).
- The detection limit is set to match the target value set by the government
 - ➤ To verify the diffusion state of radioactive materials in the seawater and the state of marine organisms, the minimum limit values of detection of tritium and iodine 129 are reduced to be consistent with the target detection limit set by the government (For measurement points, see black boxes in Figure 9-7. For the detection limit, see Table 9-9)

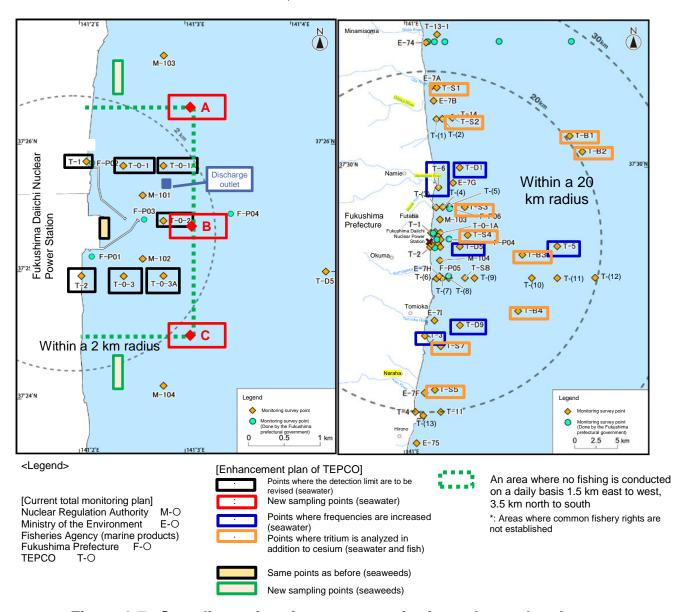


Figure 9-7 Sampling point of sea area monitoring enhanced and expanded by us (Near the FDNPS/Coast within a 20 km radius)

Moreover, we decided to perform monitoring in 9 new points even in "Outside the area of 20 km off the coast of the FDNPS," in which tritium has not been analyzed and the concentration is estimated not to exceed the background of seawater in our marine diffusion simulation.

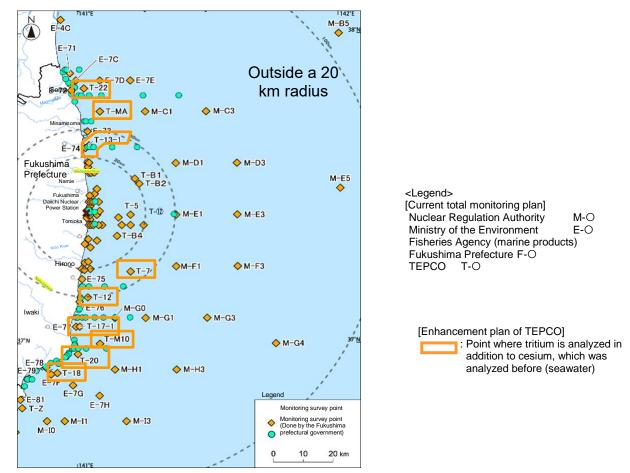


Figure 9-8 Sampling point of sea area monitoring enhanced and expanded by us (Coast outside a 20 km radius)

Based on the above, the frequency and the number of sampling points of tritium analysis in sea area monitoring by us increases as shown in Table 9-8 below compared to the previous sea area monitoring.

Table 9-8 Frequency and the number of sampling points of tritium analysis in sea area monitoring near the FDNPS and in the coastal sea area by us

	Tritium analysis				
Implementation entity	Measurement frequency	Number of samples			
		Seawater	Fish	Seaweeds	
Tokyo Electric Power Company Holdings	Once a week	17 -> 20	-	-	
	Twice/month -> Once a week	6	-	-	
	Once a month	1 -> 20	1 -> 11	-	
	Three times/year	-	-	0 -> 2	

The detection limit is set as shown in the following table including the past analysis targets associated with enhancement and expansion of this sea area monitoring.

Table 9-9 Samples and nuclides to be measured, and detection limit (The parts in thick frames indicate the points to be enhanced and expanded)

Target	Sampling site	Number of samples	Nuclides to be measured	Measurement frequency	Target detection limit
	Mithin the nort	10	Cs-134/137	Every day	0.4 Bq/L
	Within the port	10	Tritium	Once a week	3 Bq/L
		2	Cs-134/137	Once a week	0.003 Bq/L
	Outside the port		C5-134/137	Every day	1 -> 0.4 Bq/L
	Within a 2 km radius	5 -> 8	Cs-134/137	Once a week	1 -> 0.4 Bq/L
		7 -> 10	H-3	Once a week	1 -> 0.4 Bq/L*1
Seawater	Coast Within a		Cs-134/137	Once a week	0.003 Bq/L
(Surface layer)	20 km radius	6	Tritium	Twice/month -> Once a week*2	0.4 -> 0.1 Bq/L*3
	Coast within a	1	Tritium	Once a month	0.1 Bq/L
	20 km radius (fish catching point)	0 -> 10	Tritium	None -> Once a month	0.1 Bq/L
	Coast outside a 20 km radius	9	Cs-134/137	Once a month	0.003 Bq/L
		0 -> 9	Tritium	None -> Once a month	0.1 Bq/L
	Coast Within a 20 km radius		Cs-134/137	Once a month	10 Bq/kg (raw)
		11	Sr-90 (Only the top five samples in terms of the Cs concentration)	Quarterly	0.02 Bq/kg (raw)
Fish		1	Tritium (FWT)	Once a month	0.1 Bq/L
			Tritium (OBT)	Office a month	0.5 Bq/L
		0 -> 10	Tritium (FWT)*4	None ->	0.1 Bq/L ^{*6}
			Tritium (OBT)*5	Once a month	0.5 Bq/L
	Within the port	1	Cs-134/137	Once a year -> Three times/year	0.2 Bq/kg (raw)
	Outside the port Within a 2 km		Cs-134/137		0.2 Bq/kg (raw)
Seaweeds			I-129	None -> Three	0.1 Bq/kg (raw)
	radius		Tritium (FWT)	times/year	0.1 Bq/L
			Tritium (OBT)		0.5 Bq/L

^{*1:} Get the value of detection by the electrolytic concentration method (concentration method making use of the characteristic of tritium being hard to be decomposed by an electric current) as needed.

^{*2:} The measurement with the detection limit set to 0.1Bg/L is performed once/month

^{*3:} Performed at 0.4Bq/L for the time being depending on the state of the installation of the electrolytic condenser.

^{*4:} Tritium which exists as water in tissues of organisms. It does not remain in organisms for a long time.

^{*5:} Tritium which is connected to tissues in organisms. It remains in organisms longer than organization free water.

^{*6:} The measurement is performed at 0.4Bq/L for the time being depending on the state of the installation of the electrolytic condenser.

For all of these measurements, analyses by not only us but also a third party organization specified by us are performed to secure objectivity and transparency.

For the announcement of measurement data, we will perform the following activities to deepen understanding from inside and outside Japan.

- Announce the results of the measurement and assessment correctly and timely in our web site as soon as they are prepared.
- Announce data in a manner easy for local and domestic consumers to understand Moreover, describe the safety-related information regarding the announced measurement values.
- Prepare a report describing the monitoring result and the assessment, and plan to make it available in our web site, etc., every quarter.
- In the assessment, verify, for example, whether the result is within the marine diffusion simulation result, whether the result is equivalent to the concentration used for the radiological environmental impact assessment, etc., and express them in an easy-to-understand manner.
- Also plan to report the result in opportunities where related parties in local governments, etc. and academics confirm and assess it.

9-3-2. Monitoring by the government and Fukushima prefecture

(1) Previous sea area monitoring performed by the government and Fukushima

This section covers sea area monitoring by implementation entities other than us in the Comprehensive Radiation Monitoring Plan, namely the government (mainly the Ministry of the Environment, the Nuclear Regulation Authority, and the Fisheries Agency), Fukushima prefecture, etc. based on disclosed information. The relevant Ministries and Agencies started monitoring immediately after the accident and has been announcing the result⁵⁹ in cooperation with Fukushima, research institutes, fisheries cooperatives, etc., and reviewing the contents, measurement points, etc., of monitoring and announcing the result⁶⁰. Table 9-10 shows the details of sea area monitoring by implementation entities other than us⁶¹. In the previous plan, sea area monitoring was performed for seawater, seabed sediment, and marine organisms in the following areas:

- (1) Sea area vicinity of FDNPS (within about 3 km from the middle between the Unit 2 and 3 exhaust stacks)
- (2) Coastal sea area (within about 30 km from the coastline from a part of Aomori and Iwate to Miyagi, Fukushima, and Ibaraki (including the estuary, excluding the vicinity sea area))
- (3) Offshore sea area (sea area within about 30 to 90 km from the coastline)
- (4) Ocean area (sea area within about 90 km to 300 km from the coastline)
- (5) Tokyo Bay (bay about 200 km away from FDNPS)

Table 9-10 Previous sea area monitoring by implementation entities other than us

a. Seawater

Implementation entity	Measurement point	Measured nuclide	Measurement frequency (depending on the location and nuclide)
Government (mainly the Nuclear Regulation	Vicinity sea area, coastal sea area,	Cs-134/137, Sr-90, tritium	Every month to every year
Authority and the Ministry of the Environment)	offshore sea area, ocean sea area, and Tokyo Bay	unum	year
Fukushima Prefecture	Vicinity sea area and coastal sea area	Cs-134/137, Sr-90, tritium, Pu- 238/239+240	Every month
(Reference) Tokyo Electric Power Company HD	Vicinity sea area and coastal sea area	Cs-134/137, Sr-90, tritium, Pu- 238/239+240	Every day or every six months

⁵⁹ Radiation monitoring information https://radioactivity.nsr.go.jp/en/

60 Comprehensive Radiation Monitoring Plan

https://radioactivity.nsr.go.jp/en/contents/16000/15098/24/274_20210401_s.pdf

⁶⁰ Comprehensive Radiation Monitoring Plan https://radioactivity.nsr.go.jp/en/list/191/list-1.html

⁶¹ Attachment of the total monitoring plan formulated at the monitoring adjustment meeting, which is chaired by the Minister of the Environment

b. Seabed sediment

Implementation entity	Measurement point	Measured nuclide	Measurement frequency (depending on the location and nuclide)
Government (mainly the Nuclear Regulation Authority and the Ministry of the Environment)	Coastal sea area, offshore sea area, and Tokyo Bay	Cs-134/137	Every month to every year
Fukushima Prefecture	Vicinity sea area and coastal sea area	Cs-134/137, Sr-90, Pu- 238/239+240	Every month to every six months
(Reference) Tokyo Electric Power Company HD	Vicinity sea area and coastal sea area	Cs-134/137, Sr-90, Pu- 238/239+240	Every month to every six months

c. Marine organisms

Implementation entity	Measurement point	Measured nuclide	Measurement frequency (depending on the location and nuclide)
Government (Fisheries Agency and Ministry of the Environment)	Coastal sea area, offshore sea area, and ocean area	Cs-134/137	Every week to every three or four months
(Reference) Tokyo Electric Power Company HD	Coastal sea area	Cs-134/137	Every month

(2) Sea area monitoring enhanced and expanded by the government in response to discharge of ALPS treated water

In response to the Basic Policy of the government announced in April 2021, the future sea area monitoring was discussed at the Surveillance and Measurement Task Force of the sea area environment set up under the Monitoring Coordination Meeting, in which the relevant Ministries and Agencies such as the Nuclear Regulation Authority and the Ministry of Environment and the Sea Area Monitoring Expert Meeting on ALPS treated water set up under the Ministry of Environment. Then, the Comprehensive Radiation Monitoring Plan was revised at the Monitoring Coordination Meeting held in March 2022. They plan to enhance and expand the sea area monitoring before and after discharge of ALPS treated water such as setting of more sampling points within 10 km from the discharge outlet considering our discharge plan and the contents of this report⁶². The plan is as follows.

a. Seawater

(1) Perform monitoring to ascertain the variation of the tritium concentration in the sea area before and after discharge.

- There is considered to be almost no significant difference from the condition before discharge in a location about 10 km away from the discharge outlet

⁶² Material 1 of the monitoring coordination meeting (March 30, 2022) for enhancement and expansion of sea area monitoring by the government

http://www.env.go.jp/water/shorisui/monitoring/014/mat01.pdf

(The result of the diffusion simulation by TEPCO shows a possibility of a minor variation even in a location about 30 km away depending on the day)

- Set more sampling points within 10 km from the discharge outlet.
- To be on safeside, also perform monitoring at sampling points 30 km and 50 km away, offshore to the south of Miyagi, and offshore to the north of Ibaraki.
- Also perform monitoring at nearby swimming beaches.
- (2) Basically, the measurement frequency of newly added points will be four times a year (considering seasonal variations). Immediately after discharge, the frequency of the measurement is increased including the bulletin figure with the detection limit raised.
- (3) To be on safeside, measure the seven major nuclides (Cs-134, Cs-137, Co-60, Ru-106, Sb-125, Sr-90, and I-129) four times a year in some sampling points. In addition, perform it once a year for a wide range of related nuclides⁶³.

Table 9-11 shows the sea area monitoring plan for seawater of FY 2022.

Table 9-11 Sea area monitoring plan of the government for seawater enhanced and expanded

Target nuclide	Sampling point	Sampling depth*1	Analysis frequency	Target detection limit	Analysis method
Tritium	Near the discharge outlet (about 300m from the discharge outlet)	Surface layer/Bottom layer	Four times a year	0.1Bq/L*3	Electrolytic concentration method
	1 km to 10 km from the discharge outlet	Surface layer/Bottom layer	Four times a year	0.1Bq/L*3	Electrolytic concentration method
	About 30 km to 50 km from the discharge outlet, offshore to the south of Miyagi, and offshore to the north of Ibaraki	Surface layer/Bottom layer*2	Four times a year	0.1Bq/L*3	Electrolytic concentration method
	Bathing beaches (Two points in each of the north and south are selected considering the opening conditions)	Surface layer	Twice a year (before and during the season)	0.1Bq/L*3	Electrolytic concentration method
Seven major nuclides	Three points on the boundary with the area switch fishery rights (north, south, and east)	Surface layer/Bottom layer	Four times a year	Basically, follow the radioactivity measurement method series (Set the detection limit of Cs-134, Cs-137, and Sr-90 to 0.001Bq/L)	
Other related nuclides (basically 62 nuclides subject to removal by ALPS, and C-14)	Three points on the boundary with the area switch fishery rights (north, south, and east)	Surface layer/Bottom layer	Once a year	Basically, foll radioactivity r method serie detection limi Cs-137, and 0.001Bq/L)	neasurement s (Set the t of Cs-134,

^{*1:} Surface layer: Sea surface to about 2 m, Bottom layer: About 2 m to 5 m or 10 m to 40 m from the seabed depending on the water depth

^{*2:} Surface layer only for sampling points shown by blue stars and green circles outside the 50 km radius

^{*3:} A detection limit of about 0.05Bq/L (specifically 0.02-0.07Bq/L) was obtained from the result of the measurement of seawater consigned by the Nuclear Regulation Authority based on this target detection limit.

⁶³ Basically C-14 and 62 nuclides subject to removal by ALPS.

b. Marine biota

- (1) Perform monitoring of tritium in marine biota (FWT and OBT) near the boundary with the area switch fishery right.
- (2) Also perform monitoring at the same points as (1) for C-14 in fish and I-129 in seaweeds.

Table 9-12 and Figures 9-9 and 9-10 show the sea area monitoring plan for marine biota of FY 2022.

Table 9-12 Sea area monitoring plan of the government for marine biota enhanced

and expanded

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Target nuclide	Sampling point	Target organisms	Analysis frequency	Target detection limit	Analysis method	
Tritium*1	Three points on the boundary with the area switch fishery rights (north, south, and east)	Fish (demersal fish)	Four times a year	FWT: 0.1Bq/L*2 OBT: 0.5Bq/L	FWT: Electrolytic concentration method OBT: Distillation method	
I-129	Three points on the boundary with the area switch fishery rights (north, south, and east)	Seaweeds	Four times a year	0.1Bq/kg (raw)	ICP-MS	
C-14	Three points on the boundary with the area switch fishery rights (north, south, and east)	Fish (demersal fish)	Four times a year	2Bq/kg (raw)	Follow the radiation measurement series (beta ray analysis)	

^{*1:} Freeze-dry or burn aquatic organism samples to measure the concentration of tritium in water

^{2:} Aim to measure up to 0.05Bq/L, if possible

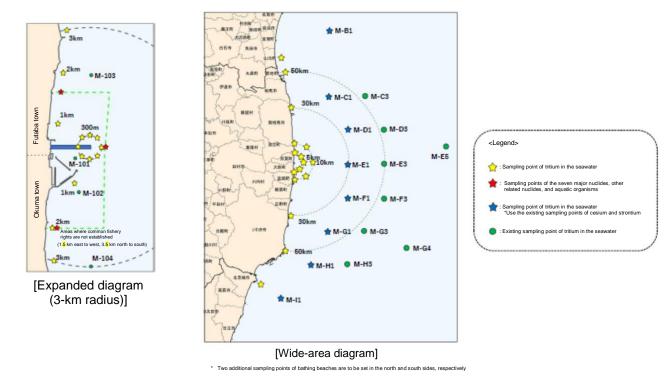


Figure 9-9 Sea area monitoring sampling point diagram of the government enhanced and expanded

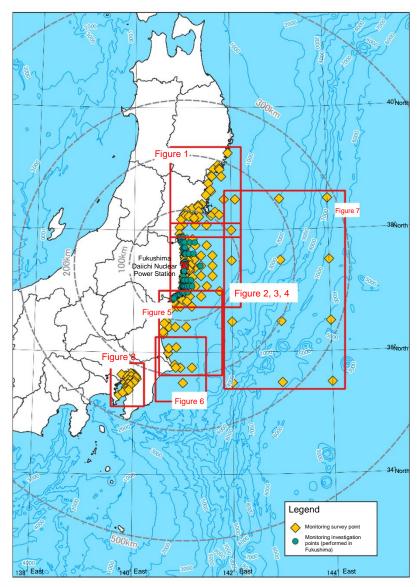


Figure 9-10 Sea area monitoring sampling point diagram enhanced and expanded (wide area)

(3) Seawater monitoring enhanced and expanded by Fukushima prefecture in response to discharge of ALPS treated water

In response to discharge of ALPS treated water into the sea, Fukushima prefecture plans to monitor seawater in a wide observation area which consists a total of 9 locations, namely the existing 6 locations around the FDNPS and 1 additional location in each of the northern, eastern, and southern directions, as shown in Table 9-13 in the range where the concentration was assessed to be higher than the tritium concentration in the seawater in the surrounding sea water (0.1 to 1 Bq/L) considering the assessment of the advection and diffusion simulation in our report. Figure 9-11 shows the sampling points⁶⁴.

Table 9-13 Seawater monitoring in relation to ALPS treated water by Fukushima prefecture (FY 2-22)

Sampling point	Sampling depth	Analysis frequency	Measurement item	Target detection limit	Analysis method
Existing locations near the FDNPS (six locations)	Surface layer	12 times a year	γ-nuclides Tritium	Approx. 0.001 to 0.002Bq/L (Cs-134/137) Approx. 0.3 to 0.5Bq/L	Based on the Series of Radioactivity Measuring
Additional locations (3 locations)		Four times a year (Before discharge) 12 times a year	Total-β Sr-90 Pu-	Approx. 0.01Bq/L Approx. 0.0005Bq/L Approx. 0.000003 to	Methods
		(After discharge)	238/239+240	0.00001Bq/L	

Table 9-14 shows the monitoring to be performed by Fukushima as other seawater monitoring not related to discharge of ALPS treated water into the sea.

Table 9-14 Other seawater monitoring (FY 2022)

Investigation		Number of	Nuclides and frequency						
Investigation type	Location	Location points	γ-ray emitting nuclides	Tritium	Total-β radioactivity	Sr-90	Pu-238	Pu-239+240	
Surveillance	Near the Fukushima Daiichi NPS	9 points	Additional points Be			12 times ts Before d After dis	ischarge	4 times a year 12 times a year	
investigation around the nuclear power	Near the Fukushima Daini NPS	2 points					nce a year		
plant	Comparison points	1 point	Once a year						
Port/Sea	Important port	3 points	12 times a	-	-	-	-	-	
surface fishing	Fishing ports	13 points	year	-	-	-	-	-	
ground investigation	Shallow fishing ground	7 points	(Cs-134, Cs- 137)		es a year points)	-	-	-	
Bathing beach investigation	Bathing beach	13 points	Twice a year (Cs-134, Cs- 137)	Cs-134, Cs-		-	-	-	
Public water area investigation	Sea area	15 points (surface layer and bottom layer)	-	Twice a year	-	-	-	-	

⁶⁴ 35th Environmental Monitoring and Evaluation Sub-committee of the Safety Monitoring Council on Decommissioning of the Nuclear Power Station of Fukushima Prefecture Material 2-1, p.1 (Revised after discussion) http://www.pref.fukushima.lg.jp/uploaded/attachment/507135.pdf

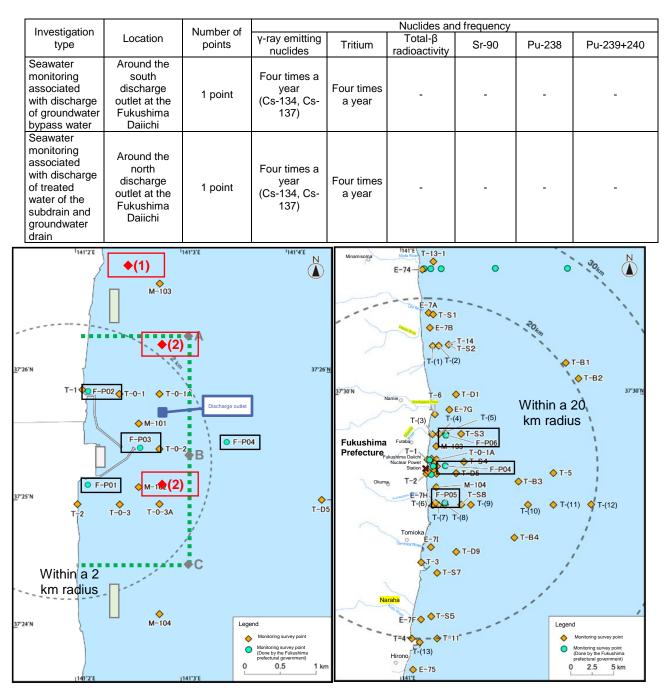


Figure9-11 Investigation points of seawater monitoring for ALPS treated water by Fukushima Prefecture

(4) Cooperation with the IAEA for sea area monitoring by the government and IAEA marine monitoring

Since 2014, the government has been conducting the IAEA Marine Monitoring with the aim of obtaining objective evaluation from the IAEA on the appropriateness of monitoring implementation methods and analytical capabilities of Japan's laboratories participating in sea area monitoring conducted by the government.

In the IAEA Marine Monitoring, samples of seawater, sediment off the coast of the FDNPS, and marine biota unloaded in Fukushima Prefecture which had been collected off the coast of the FDNPS were collected in the presence of the IAEA and occasionally from third-country laboratories. The samples were divided into analytical laboratories and analyzed individually, and an interlaboratory comparison (ILC) was conducted to compare the results. ILC Report (2017-2020)⁶⁵ published in August 2021 states that "Japan's sample collection procedures follow the appropriate methodological standards required to obtain representative samples" and "The results obtained demonstrate a continued high level of accuracy and competence on the part of the Japanese laboratories involved in the analyses of radionuclides in marine samples for the Sea Area Monitoring Plan." IAEA marine monitoring will be continued in the future.

⁶⁵ IAEA, Preliminary Report 2021 Interlaboratory Comparisons 2017–2020: Determination of Radionuclides in Seawater, Sediment and Fish

https://www.iaea.org/sites/default/files/21/07/preliminary-report-2021-interlaboratory-comparison-2017-2020-determination-of-radionuclides-in-seawater-sediment-and-fish.pdf

9-4. Actions to be taken in case of abnormalities

Verify that it is within the assumed range, by comparison with the marine diffusion simulation result, the concentration used for the radiological environmental impact assessment, etc., for the sea area monitoring described in 9-3. If it exceeds the variation range of usual values, verify the results of other implementation entities of monitoring for the investigation of the cause. If any greatly exceeding the variation range of usual values is observed, stop discharge into the sea, measure the corresponding points again, tentatively expand the range and frequency, and verify that there is no abnormality in the surrounding sea area. Therefore, we will accumulate the analysis results of sea area monitoring from April 2022 to ascertain them as usual values before discharge into the sea.

9-5. Summary of monitoring

As mentioned above, while the government, Fukushima prefecture and we are proceeding with sea area monitoring, sea area monitoring is enhanced and expanded before and after discharge of ALPS treated water. If any significant difference to the variation range of baseline monitoring is detected in enhanced and expanded sea area monitoring or any abnormal value is detected in monitoring, we will make sure to stop discharge until it is verified that discharge can be performed safely.

10. Summary

For planned discharge of ALPS treated water into the sea in the FDNPS, the exposure assessment on human and environment is performed based on the current information (construction stage).

The result of a calculation setting multiple source terms and multiple food ingestions assuming that 0.05mSv/year is equivalent to the dose constraint with the optimization based on the Basic Policy of the government in April 2021, shows the annual exposure amount of the set representative person 2E-06 to 2E-05mSv/year, which is much smaller than 1mSv/year, which is the dose limit to public shown in the ICRP recommendation, as well as 0.05mSv/year deemed by the Nuclear Regulation Authority to be equivalent to the dose constraint.

The result of a calculation setting multiple source terms for the impact on the environment as with the assessment for the human shows that the value for the reference plants and animals set based on the ICRP recommendation is 4E-07 to 1E-06mGy/day, which is much lower than 1 to 10mGy/day for flatfish and brown seaweeds and 10 to 100mGy/day for crabs, which as the derived consideration reference levels (DCRL) shown in the ICRP recommendation for the reference plants and animals.

Chapter 8 shows the uncertainty of this assessment result.

We will optimize the risks associated with disposal further as needed by the progress of design and implementation of the plan including rigorous selection of measurement target nuclides, using the knowledge obtained through reviews by experts of the IAEA, cross-checking with third parties, etc., and appropriately reflecting the opinions from various fields. Accordingly, we plan to revise the assessment of this report as needed.

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Terms

rerms	
Term	Description
Advanced liquid	Water treatment facility which can purify 62 types of radioactive materials
processing	other than tritium contained in contaminated water up to a level which
system (ALPS)	meets the standard set by laws. (Multi-Nuclide Removal Facility)
	Water purified by ALPS, etc. so that the radioactive materials other than
ALPS treated	tritium surely fall below the regulatory standards for safety. (The sum of the
water	ratios to regulatory concentrations limits of nuclides excluding tritium is less
	than 1)
	Water which is purified by ALPS, etc., but does not meet the regulatory
Treated water to	standard for safety (The sum of the ratios to regulatory concentrations
be purified	limits of nuclides excluding tritium is less than 1)
ALPS treated	
water, etc.	Generic term for ALPS treated water and treated water to be purified
Strontium treated	
water	Contaminated water with most of the cesium and strontium removed.
water	Direif de a tracta directa da la munificad de cubiale madio activa matariale athan
Secondary	Purifying treated water to be purified in which radioactive materials other
treatment	than tritium are not purified until the sum of the ratios to regulatory
	concentrations limits is less than 1 by ALPS, etc.
	Measure to reduce the amount of groundwater approaching the reactor
Groundwater	building, etc., by pumping groundwater flowing from the mountain side to
bypass	the sea side from a well far away from the reactor building, etc., and
σγρασσ	discharging it to the sea after verification that the discharge standard is
	met.
	Measure to perform purification by pumping with the subdrain (well near
Subdrain	the building) and discharge the sea after verification that the discharge
Suburain	standard is met, in order to reduce the amount of contaminated water
	increased by inflow of groundwater into the reactor building, etc.
	Standard of discharge of radioactive waste into the sea set in
Danielatani.	"Pronouncement which set the dose limit based on the regulations such as
Regulatory	the Regulations on Business of Smelting of Nuclear Source Materials or
concentration	Nuclear Fuel Materials." If the corresponding radioactive waste contains
limit	radioactive materials, the sum of the ratios to regulatory concentrations
	limits has to be less than 1.
	Target control value set for each nuclide to be discharge in order to control
Target discharge	the amount of radioactive materials discharged by the nuclear power plant
control value	per year. For the FDNPS, the target discharge control value of tritium
Control value	before the accident is set to 22 TBq (2.2E+13Bq).
	Concentration limit value set by us for dose reduction for eight nuclides
Operation and	whose impacts on exposure are considered to be great at the time of
management	disposal of ALPS treated water. If any concentration over this is detected,
value	stop discharge and transfer the water to the storage tank.
	Guidelines for drinking water quality set by the World Health Organization
	for securing of the safety of drinking water. These guidelines show water
WHO Guidelines	
for Drinking	quality which do not cause any problem when a person keep drinking the
Water Quality	water from the viewpoints of radioactive materials, microorganisms,
_	chemical substances, etc. As radioactive material concentrations, 10Bq/L
International	and 10,000Bq/L are shown for Cs-137 and tritium, respectively.
International	
Commission on	Document that shows the Basic Policy (concept) of radiation protection
Radiological	recommended by ICRP and the basic numerical standards.
Protection (ICRP)	,
recommendation	

Term	Description
International Atomic Energy Agency (IAEA) safety standard document	Document issued by the IAEA which shows the standards for protection of safety such as human health, lives, and assets in using radiation and radioactive materials as activities for securing nuclear safety. It consists of the safety principles, the safety requirements, the safety guidelines, etc., and shows the policy, the standards, etc., to follow. The IAEA safety standard document is prepared reflecting the comments of all IAEA member countries.
Representative person	Virtual person set as the target of exposure in the exposure assessment of public for consideration of radiation protection. Consider environments, life habits, etc., in which the exposure amounts increase, etc.
Potential exposure	Exposure caused by possible events in operation or events or possible events sequences including accidents of radiation sources or failures and operation mistakes of equipment. It was considered for the future. It is used for consideration of radiation protection.
An area where no fishing is conducted on a daily basis	Area where members of fisheries cooperatives jointly use a certain water area and rights to perform fishing (common fishery rights) are not established. Areas where common fishery rights are not established.
Area sea model	Numerical analysis model of tidal currents developed in Rutgers University in the U.S.
Submersion model	External exposure dose calculation model assuming the state that people are surrounded by radioactive materials (submersion).
Concentration factor	Expedient factor indicating the relationship between the radioactive nuclide concentration in marine organisms (per wet weight) in marine organisms (in principle, edible parts) and the radioactive nuclide concentration in the seawater in the environment where such organisms live, which is used for the assessment model for migration to organisms.
Dose conversion factor for the effective dose	Conversion factor to assess the human exposure amount from radiation from radioactive materials.
Effective dose factor	Conversion factor to assess the human internal exposure dose from the inhalation amount and ingestion of radioactive nuclides.
Environmental protection	Protecting organisms other than human from adverse effects of ionizing radiation.
Reference plants and animals	Specific types of animals and plants assumed in order to associate radiation exposure from the environment with the dose and impact.
Dose conversion coefficients for plants and animals	Conversion factor for simplified calculations of internal and external exposure doses to organism by radioactive nuclides in the environment.
Derived consideration reference level (DCRL)	Range of the dose rate with a range of one order of magnitude set for each species advocated by ICRP. Dose rate level at which the impact has to be considered if is exceeded. (Derived consideration reference level)
Concentration ratio	Migration factor from an empirical calculation of the ratio of the (overall) radioactive nuclide concentration in aquatic organisms to the underwater concentration in the environment to be used for radiation exposure to plants and animals from the environment.
Distribution coefficient	Ratio of radioactive materials at which the concentration in the seawater (Bq/L) and the concentration in the seabed sediment (Bq/kg) are in the equilibrium state. It is used for the assessment of migration of radioactive materials from the seawater to seabed sediment.

Preparation member (as of November 1, 2022)

Gaku Sato

For preparation of this report, in-house personnel with knowledge on the radiological impact assessment were appointed and external experts were invited as members in three fields, which are especially important for the radiological impact assessment: human radiation protection, environmental protection, and marine dispersion calculation.

Sponsor
 Junichi Matsumoto (Tokyo Electric Power Company Holdings, Inc.)

• Assessment member

Team leader: Team members:	Tomomi Okamura Yuta Ichiba Itsumasa Urabe	(Tokyo Electric Power Company Holdings, Inc.) (Tokyo Electric Power Company Holdings, Inc.) (Professor Emeritus, Fukuyama University, Environmental impact assessment)
	Hideo Kiyooka Michiya Sasaki	(Tokyo Electric Power Company Holdings, Inc.) (Senior Research Fellow, Sustainable System Research Laboratory, Central Research Institute of
	Yutaka Tateda	Electric Power Industry, human exposure assessment) (Guest Research Fellow, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, marine animals and plants exposure assessment)
	Daisuke Tsumune	(Senior Research Scientist, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, dispersion calculation)
	Takatoshi Hattori	(Managing Director, Technological Strategy Group, Nuclear Damage Compensation and Decomissioning Facilitation Corporation, human exposure assessment)
	Yukio Masumoto	(Professor, The University of Tokyo, dispersion calculation)
	Kazuhiro Misumi	(Senior Research Fellow, Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry, dispersion calculation)
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	Tadafumi Koyama	(Distinguished Research Scientist, Central Research Institute of Electric Power Industry)
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(Tokyo Electric Power Company Holdings, Inc.)

Katsuhisa Matsuzaki (Tokyo Electric Power Company Holdings, Inc.)

Attachment I Rationale behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea

I-1. Overview

With regard to radionuclides other than tritium in ALPS treated water, the result of the analysis of the radioactivity concentrations of the seven major nuclidesplus carbon 14 and technetium 99 in ALPS treated water, and the measured value of gross β shows no discrepancies that would raise suspicion regarding radionuclides except for radionuclides of the current 64 nuclides. In addition, some of the nuclides subject to removal by ALPS will be considered sufficiently decayed and become less abundant by the time of the discharge of ALPS treated water into the sea. Therefore, the sum of the ratios to regulatory concentration limits is considered to satisfy less than 1.

In order to ensure that the sum of the ratios to regulatory concentration limits is less than 1, target nuclides to be measured and assessed (hereinafter "nuclides to be measured and assessed") are selected after thorough verification whether they are significantly present in contaminated water based on domestic knowledge of decommissioning and disposal facilities.

I-2. Policy on the selection of nuclides to be measured and evaluated For verification of nuclides which have possibility to be significantly contained in contaminated water at FDNPS, nuclide analyses are conducted based on the domestic knowledge on decommissioning and disposal facilities are conducted and inventory assessments are conducted considering to the fuel and structural materials in Units 1 to 3.

Table I-1 Elements considered in the selection of nuclides to be measured and assessed

Nuclide analysis

Verify whether or not the nuclides to be assessed in the research on decommissioning and disposal facilities are significantly present in contaminated water by actual analysis of water. Also verify the results of past nuclide analyses.

Inventory assessment

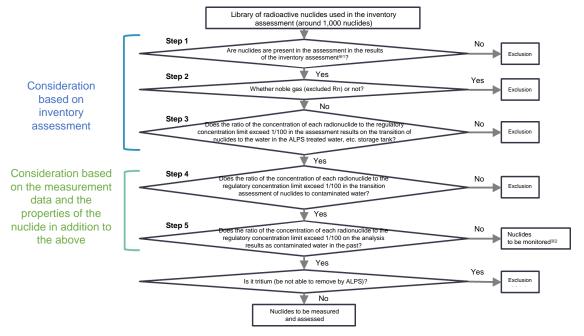
Assess an inventory of fission products in the same way as in the study of nuclides subject to removal by ALPS. Assess the inventory quantity generated by activation of such as structures in reactor pressure vessel based on the studies on decommissioning and disposal facilities. In the above assessments, taken into account the reduction of inventory quantity due to decay as the 12 years have passed since the earthquake until discharge.

Based on the above assessment results, verify the existence of nuclides that may be significantly contained in contaminated water, taking into account such as the ease of transfer to water.

Based on the results of nuclide analysis and inventory assessment, the nuclides to be measured and assessed are selected, taking into account the impacts on dose assessment.

- I-3. Selection of nuclides to be measured and assessed at the time of discharge of ALPS treated water into the sea
- I-3-1 Rationale behind the selection of nuclides subject to be measured and assessed for discharge of ALPS treated water into the sea

Based on the results of nuclide analysis and inventory assessment in section I-2 above, the nuclides to be measured and assessed are selected according to the flowchart, shown in Figure I-1.



%1: The decay period of the inventory evaluation is appropriately set according to the time when the
selection result is to be used. (First time set to 2023 (12 years after the accident))

%2: Nuclides were continuously confirmed whether are significantly presence in contaminated water

Figure I-1 Flowchart for selection of nuclides to be measured and assessed for discharge of ALPS treated water into the sea

I-3-2 Selection result

As a result of the selection process according to the above flowchart, the following 30 nuclides were selected.

Before discharging ALPS treated water into the sea, it will be confirmed that the nuclides selected for measurement and assessment based on the flowchart in Figure I-1 saticsfy the discharge criteria (sum of the ratios to regulatory concentration limit of nuclides other than tritium is less than 1.)

Table I-2 Nuclides to be measured and assessed (30 nuclides)

C-14	Mn-54	Co-60	Ni-63	Se-79	Sr-90
Y-90	Tc-99	Ru-106	Cd-113m	Sb-125	Te-125m
I-129	Cs-134	Cs-137	Ce-144	Pm-147	Sm-151
Eu-154	Eu-155	U-234	U-238	Np-237	Pu-238
Pu-239	Pu-240	Pu-241	Am-241	Cm-243	Cm-244

These nuclides to be measured and assessed are selected based on the results of past analyses. However, there is a possibility that the situation may change depending on the progress of the decommissioning work in the future. Therefore the following methods are used to confirm that there are no significant nuclides other than the selected nuclides to be measured and assessed (hereinafter "other nuclides"). If it is confirmed that other nuclides are significantly present during this confirmation process, re-assessment of the nuclides to be measured and assessed will be performed. The decay of radionuclides will be also reflected in the selection flowchart.

- When confirming that ALPS treated water meets the discharge limit, also confirm that no other nuclides are present significantly by measuring with gross α, gross β, and Ge semi-conductor detectors.
- Confirm that concentrations of radionuclides, regularly checked in contaminated water of downstream from the centralized radioactive waste building, are below the previously confirmed concentration and there is no change in the status of the transfer of radionuclides to contaminated water.
- The existence of other nuclides is investigated when the event with concern is confirmed in the above two cases. Even if such concerns are dispelled, check the presence of the nuclides subject to be monitored in contaminated water prior to ALPS treatment at a frequency of once a year in order to investigate the presence of other nuclides.

Attachment II Properties of ALPS treated water, etc.

At the FDNPS, the sequence of events of the station since the accident has led to various analyses. Various analyses also have been conducted on the treatment of contaminated water, which is very complicated.

This section describes the overview of contaminated water treatment and the analysis result of the properties of ALPS treated water.

II-1. Overview of the occurrence of contaminated water (stagnant water in the building) and the system of the contaminated water treatment facility

In the FDNPS, the residual fuel debris in the building is cooled with water, and mixing of the cooling water and the groundwater or rainwater entering the building causes contaminated water. The daily average amount of contaminated water was reduced to about 130m³ in the result of FY2021 thanks to the reduction of water entering the reactor building by countermeasures such as land side impermeable wall (frozen soil wall) and sub-drains.

To reduce the risks caused by radioactive materials contained in contaminated water, at first cesium and strontium were removed preferentially, which accounts for most of the radioactive materials contained in contaminated water, using cesium adsorption devices such as Kurion, SARRY and SARRY2. After that, the water desalinated with desalination devices is recirculated for cooling the burst slug in the core, and the residual concentrated water is treated with the advanced liquid processing system (hereinafter called "ALPS") as "strontium treated water (water before treated by ALPS)" to remove the 62 nuclides subject to removal¹, which accounts for most of the nuclides, other than tritium, and then stored in tanks installed on high ground.

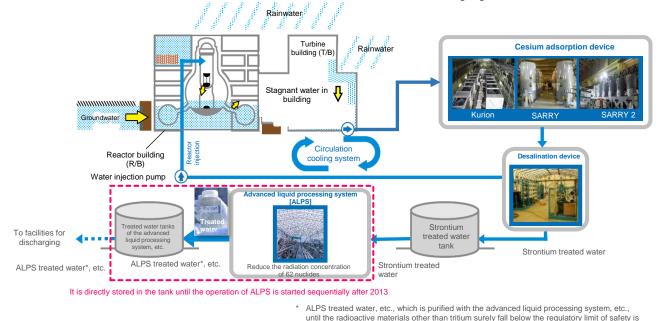


Figure II-1 Overall outline figure of contaminated water treatment

defined as "ALPS treated water," and the other water as "treated water to be purified

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For details of the selection process and the selected nuclides, see Attachment I "Rationale behind the selection of nuclides subject to removal by ALPS."

II-2. Overview of the system of ALPS

ALPS is designed to be able to remove up to less than the regulatory concentration limit without dilution of the 62 nuclides estimated to be contained in the above-mentioned strontium treated water at such high concentrations that they should be removed except tritium, which ALPS cannot remove, by treatment using physical and chemical properties such as coprecipitation with chemicals, adsorption by active carbon and physical materials, and filtration with a physical filter; this capability has already been demonstrated through the actual operation (For details of the performance, see II-3. "Performance of ALPS").

In the FDNPS, three types of ALPS are installed: existing ALPS, additional ALPS, and high-performance ALPS. Since all of them have similar removal performance (DF: decontamination factor), current treatment is performed mainly in the existing and additional ALPS considering ease of adjustments of the treatment amount. Table II-1 shows the overview of ALPS.

Put into Name Capacity **Characteristics** service 250m³/day/series × 3 **Existing** 2013.3 After putting into service, added adsorption vessels **ALPS** series (Total: 750m³/day) and changed the adsorption material to improve the performance Additional 2014.9 250m³/day/series × 3 Deleted iron coprecipitation by pretreatment with the **ALPS** series (Total: 750m³/day) existing ALPS and performed addition of adsorption vessels, change of the adsorption material, etc. High-2014.10 500m³/day/series × 1 Unlike the existing and additional ones, this has no performance series (Total: 500m³/day) coprecipitation process **ALPS**

Table II-1 Overview of the facility of ALPS

Table II-2 shows the overview of the nuclide removal system of ALPS.

Table II-2 Overview of the nuclide Removal system with ALPS

Removal system		Main nuclides subject to removal	Role	
Pretreatment facilities	Iron coprecipitation treatment (Existing ALPS only)	α nuclides, Co-60, and Mn-54	Decomposition of the complexes that inhibit adsorption, and remova of heavy metal and α nuclides, etc., by iron coprecipitation	
	Carbonate coprecipitation treatment (excluding the high-performance ALPS)	Adsorption inhibition ions (Mg, Ca, etc.) Sr-89/90	Remove the inhibition ions of Sr adsorption and improve the Sr removal performance by adsorption	
Advanced liquid	Active carbon	Colloidal nuclides (I-129, Co-60, etc.)	Remove the nuclides that have various ionic and colloidal forms	
processing system	Sr adsorbent	Sr-89/90	with multiple types of adsorption materials	
(Adsorption	Cs adsorbent	Cs-134/137		
vessel)	I,Sb adsorbent	I-129 (IO ³⁻), Sb-125		
	I adsorbent	I-129(I ⁻)		
	Ru adsorbent	Ru-106		

ALPS is operated efficiently by backing up the subsequent adsorption vessels in the case of break-through of the first vessel and changing the order of the adsorption vessels by merry-goround operation of some of the adsorption vessels. Figure II-2 shows an example of an adsorption vessel composition² and Figure III-3 the details of the merry-go-round operation of some of the adsorption vessels.

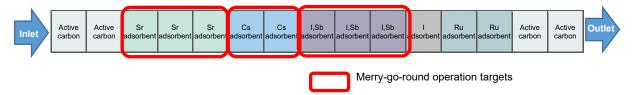


Figure II-2 Example of an adsorption vessel composition (example as of September 2018)

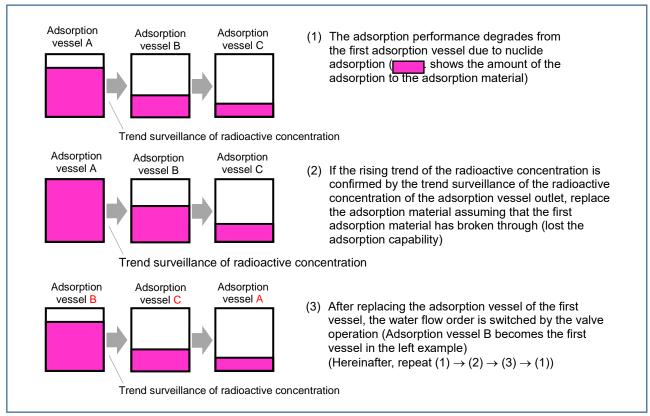


Figure II-3 Image of replacement and operation of the adsorption material (merry-goround operation) (for a composition of three adsorption vessels)

Attachment II-3

The composition of the adsorption vessels has been reassessed as needed according to the properties of water to be treated, etc.

II-3. Performance of ALPS

In ALPS, the concentrations of radioactive materials, mainly 7 nuclides (Cs-134, Cs-137, Co-60, Sb-125, Ru-106, Sr-90, I-129) which are nuclides to removal by ALPS and significantly detected nuclides through the process of treatment, at the facility inlet and outlet are measured ((1) and (7) in the figure) to verify the removal performance of radioactive materials, as well as in the middle of the treatment process to verify the break-through trend of the adsorption vessels ((2) to (6) in the figure)³. Details of this measurement are shown in Figure II-4.

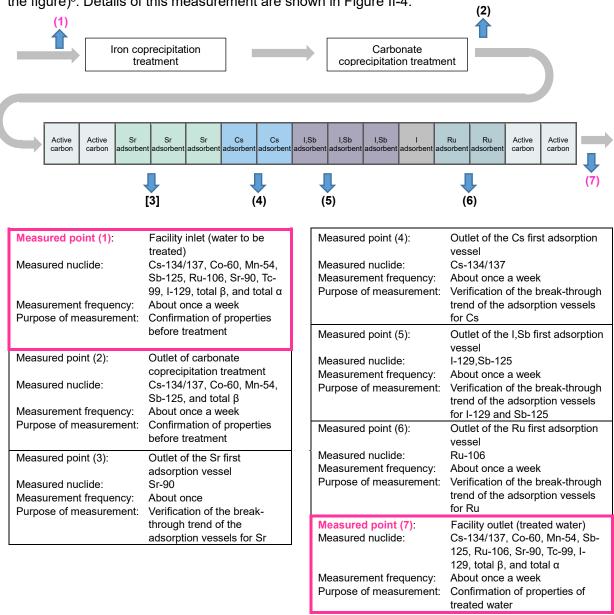


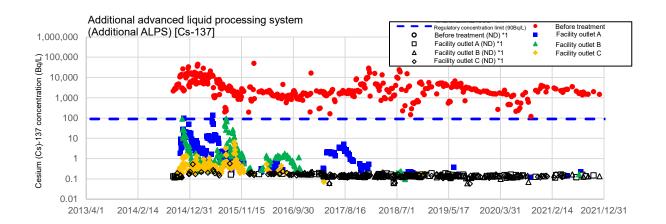
Figure II-4 Measurement performed in ALPS

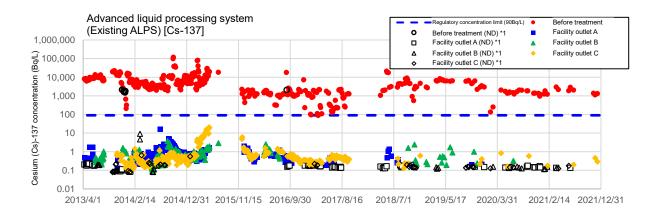
After the start of the operation of ALPS, about 70% of the treated water contains radioactive properties over the sum of the ratios to regulatory concentrations limits of 1 due to various circumstances (see II-7, "Reason for generation of treated water to be purified"), but ALPS has been working properly except special circumstances.

Figure II-5-1 to 13 show the trend regarding the measurement results of the inlet and outlet of

The measurement items and measurement frequency have been reassessed as needed according to the properties of water to be treated, etc.

ALPS for the seven major nuclides, etc. Especially after 2019, in which the above-mentioned special circumstances disappeared, ALPS has been operated stably and each nuclide has been removed stably and appropriately.





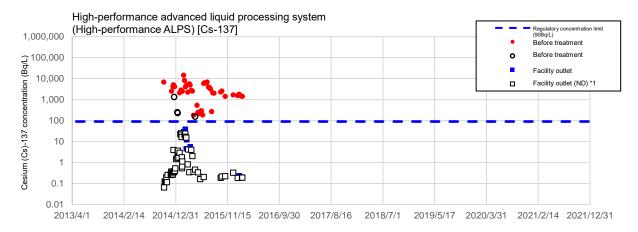
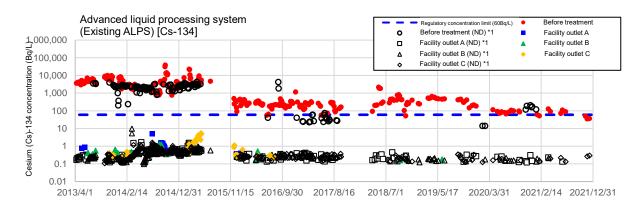
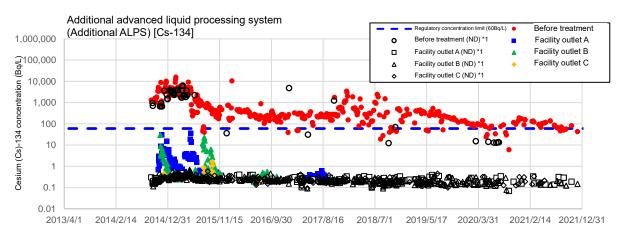


Figure II-5-1 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Cs-137)





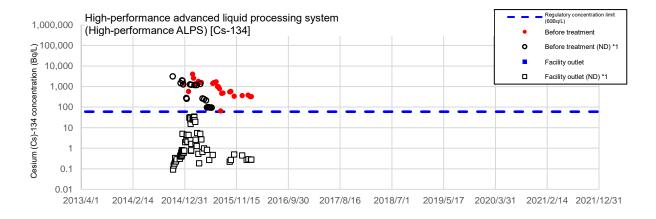
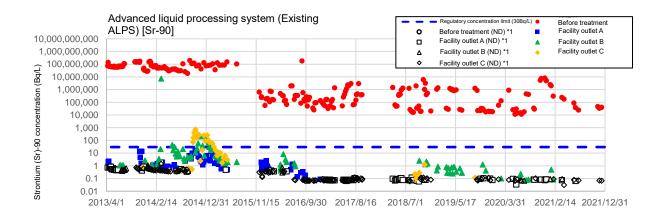
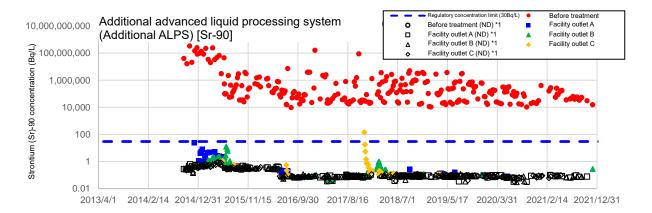


Figure II-5-2 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Cs-134)





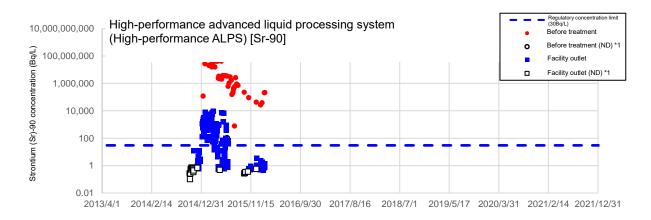
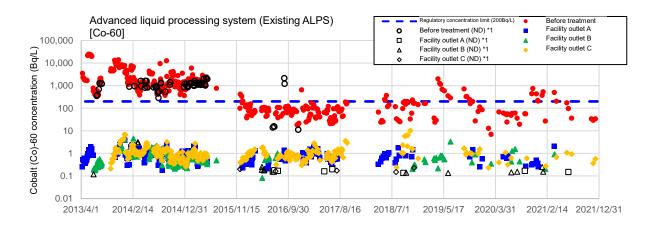
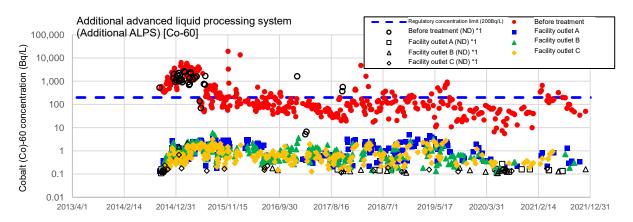


Figure II-5-3 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Sr-90)





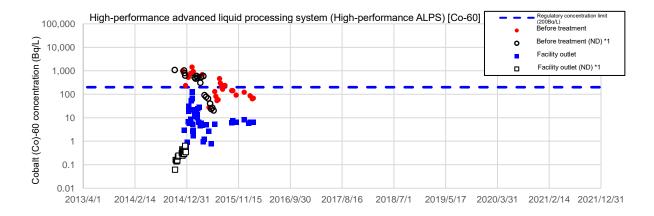
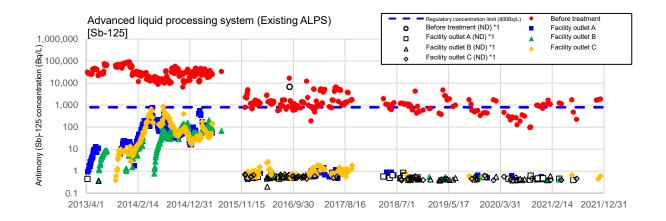
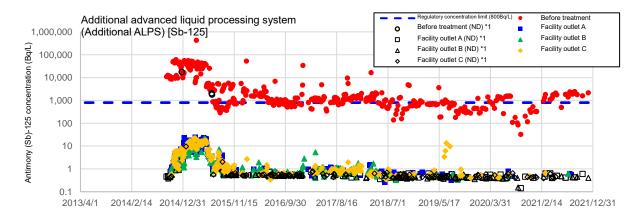


Figure II-5-4 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Co-60)





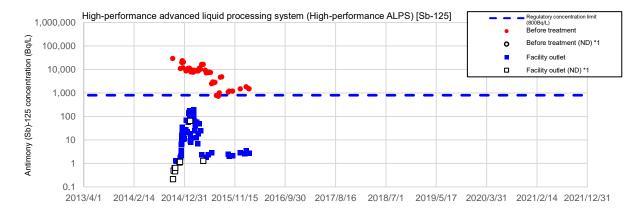
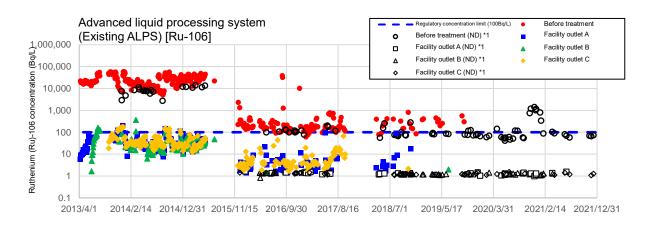
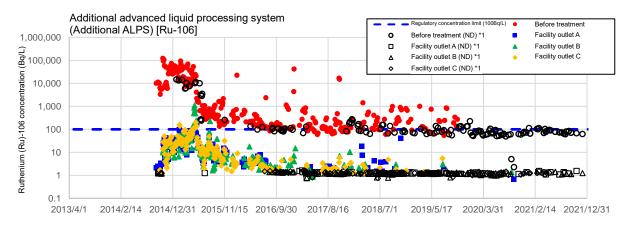


Figure II-5-5 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Sb-125)





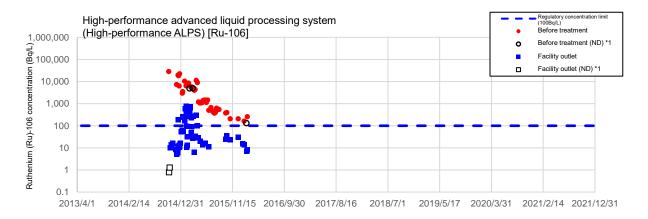
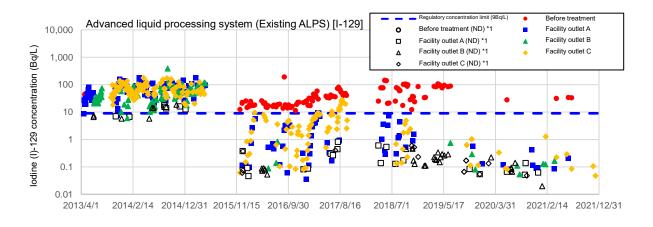
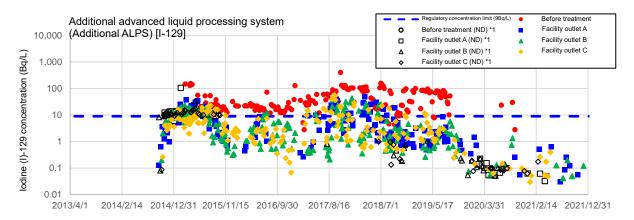


Figure II-5-6 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Ru-106)





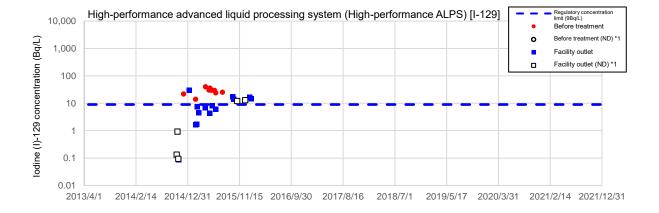
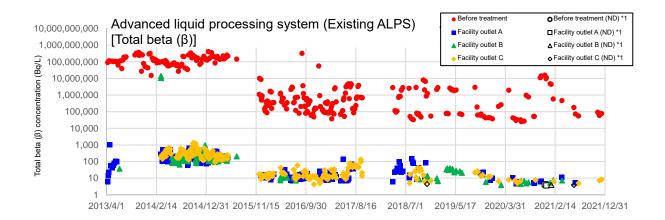
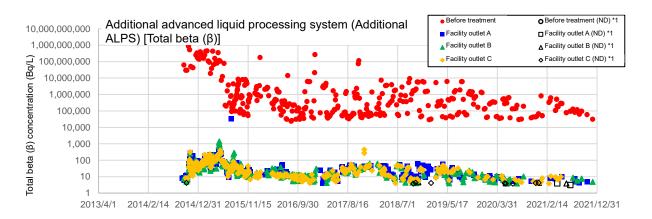


Figure II-5-7 Radioactive concentration in the inlet and outlet of each advanced liquid processing system I-129)





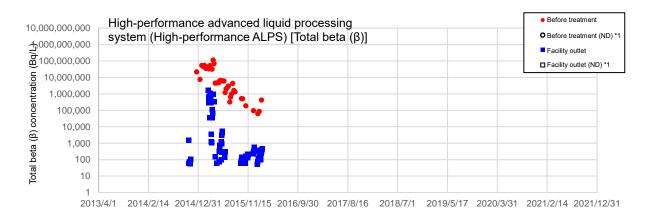


Figure II-5-8 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Total beta nuclide)

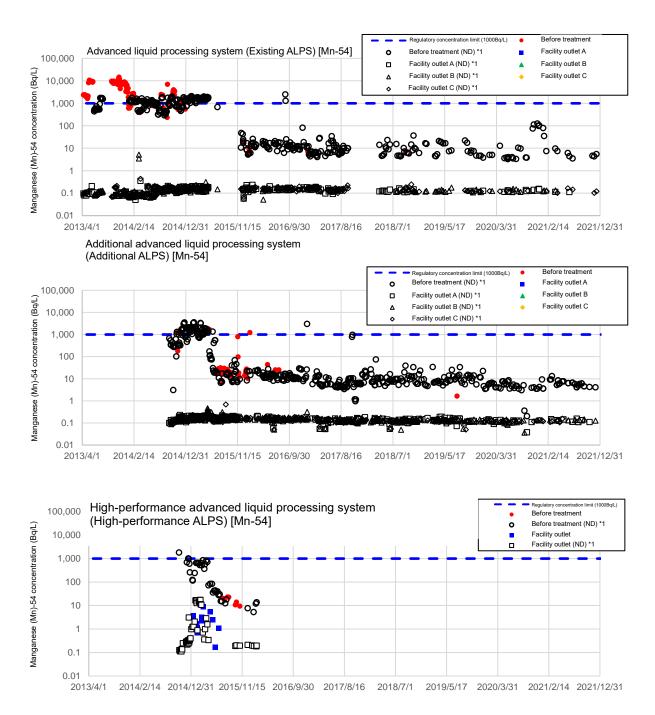
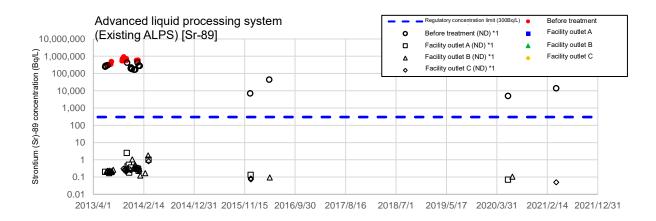
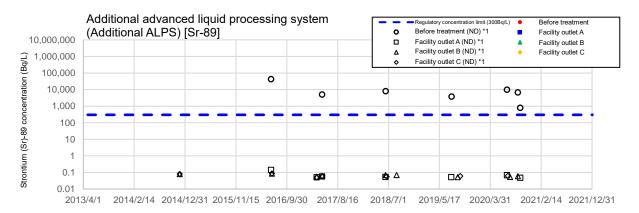


Figure II-5-9 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Mn-54)





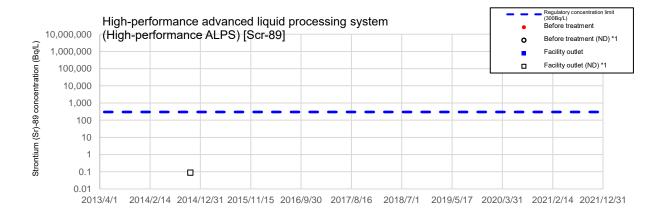


Figure II-5-10 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Sr-89)

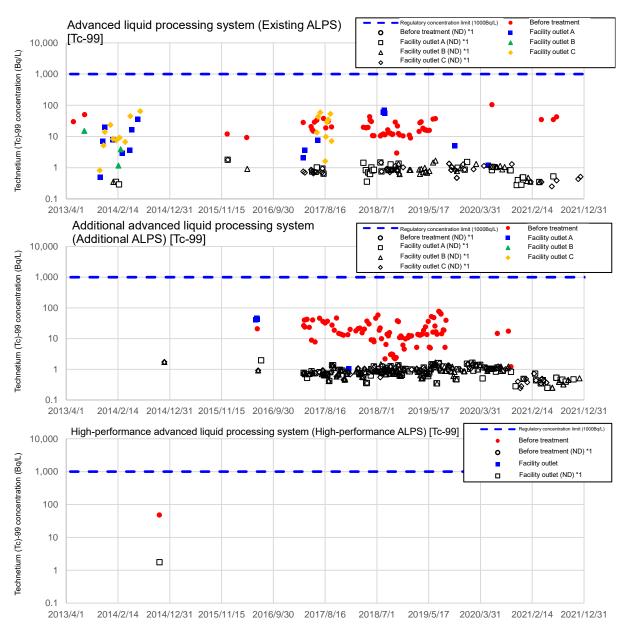


Figure II-5-11 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Tc-99)

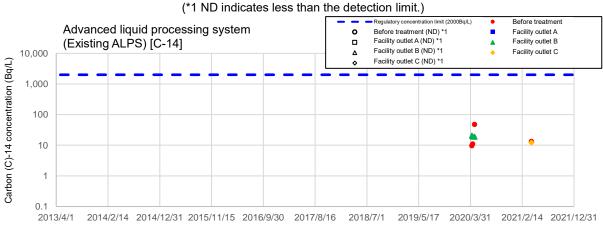
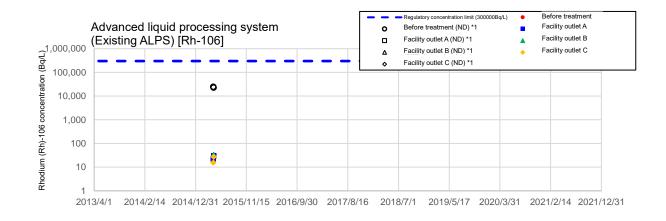
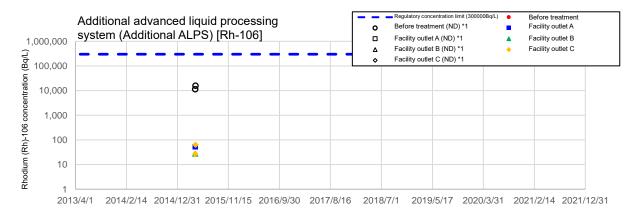


Figure II-5-12 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (C-14)





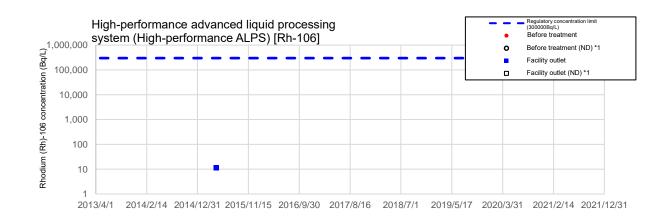
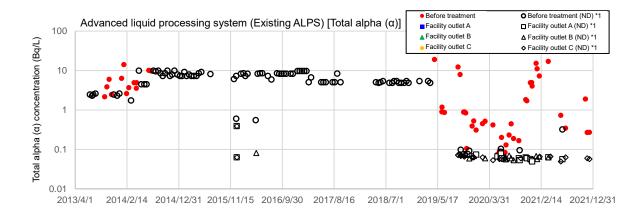
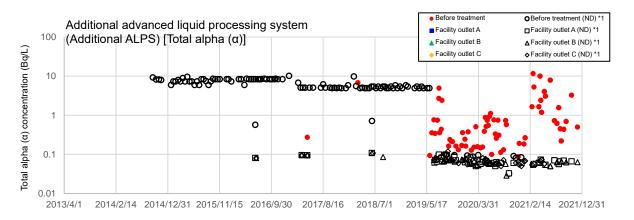


Figure II-5-13 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Rh-106)





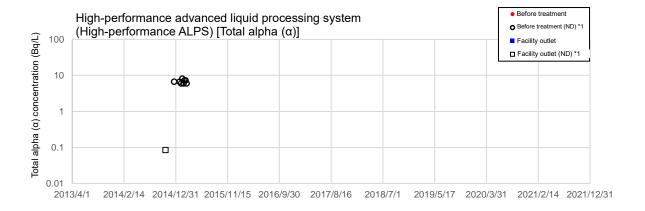


Figure II-5-14 Radioactive concentration in the inlet and outlet of each advanced liquid processing system (Total alpha nuclide)

II-4. Secondary treatment performance of ALPS for treated water to be purified

II-4-1 Background of the secondary performance test

As of now, approx. 70% of the water stored in the FDNPS is water of which sum of the ratios to regulatory concentrations limits is assessed to be 1 or more (so-called "treated water to be purified") due to the various reasons shown in II-7. As described in the section about the discharge method in the main text, the secondary treatment of this treated water to be purified is surely performed before discharge to verify that sum of the ratios to regulatory concentrations limits other than tritium before dilution is less than 1.

ALPS is designed to be able to treat strontium treated water with a high radioactive material concentration, etc., and its capability to remove radioactive materials has been proven in actual operation, but there was an opinion that the secondary treatment of ALPS was very important and it should be proven immediately with measured values that radioactive materials other than tritium can be removed by secondary treatment up to the sum of the ratios to regulatory concentration limits of less than 1⁴.

In response to this opinion, we decided to perform the secondary treatment test of treated water to be purified of a high concentration (sum of the ratios to regulatory concentrations limits of 100 or more) in ALPS, and started the secondary treatment performance test using the additional ALPS in September 2020 and completed it by December of the same year.

II-4-2 Overview of the secondary performance test

In this secondary treatment performance test, two tank groups (J1-C tank group as the high concentration side (sum of the ratios to regulatory concentrations limits: approx. 2,400) and J1-G tank group as the low concentration side (sum of the ratios to regulatory concentrations limits: approx. 390)) were selected from the tank groups of the sum of the ratios to regulatory concentrations limits of 100 or higher, and 1,000m³ was treated from each of the tanks. For the piping used for the transfer, water replacement operation already included in the system was performed before the test.

Afterward, the treated water was sampled and the concentrations of the 62 nuclides subject to removal by ALPS, C-14, and tritium were measured to verify that the sum of the ratios to regulatory concentrations limits of the 63 nuclides except tritium became less than 1 by secondary treatment, and the procedure and process of the nuclide analysis were performed.

II-4-3 Result of the secondary performance test

Table II-3 and 4 show the results. It was verified that the sum of the ratios to regulatory concentrations limits of any treated water to be purified became less than 1 by secondary treatment.

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⁴ Minutes of the 17th Subcommittee on Handling of the ALPS treated water p.11

Table II-3 Secondary treatment performance test result by ALPS (J1-C tank group)

	ory ation		dary treatment ⁵	After seconda	ary treatment ⁶	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
H-3 (About 12 years)	6.0E+04	8.51E+05	1.4E+01	8.22E+05	1.4E+01	Dilute to less than 1,500Bq/L before discharge
C-14 (About 5700 years)	2.0E+03	1.53E+01	7.6E-03	1.76E+01	8.8E-03	
Mn-54 (About 310 days)	1.0E+03	< 3.62E-01	3.6E-04	< 3.83E-02	3.8E-05	
Fe-59 (About 44 days)	4.0E+02	< 6.41E-01	1.6E-03	< 8.66E-02	2.2E-04	
Co-58 (About 71 days)	1.0E+03	< 3.44E-01	3.4E-04	< 4.11E-02	4.1E-05	
Co-60 (About 5.3 years)	2.0E+02	3.63E+01	1.8E-01	3.33E-01	1.7E-03	
Ni-63 (About 100 days)	6.0E+03	5.19E+01	8.6E-03	< 8.45E+00	1.4E-03	
Zn-65 (About 240 days)	2.0E+02	< 7.19E-01	3.6E-03	< 9.41E-02	4.7E-04	
Rb-86 (About 19 days)	3.0E+02	< 4.11E+00	1.4E-02	< 4.97E-01	1.7E-03	
Sr-89 (About 51 days)	3.0E+02	< 6.72E+03	2.2E+01	< 5.37E-02	1.8E-04	

-

If the result falls below the lower limit of detection, describe the lower limit of detection following "<"

Composite (mixing/stirring) was performed for the samples collected between September 19 and 21, 2020, and then analysis was performed.

Samples were collected from the middle layer in the sample tank installed latter part of the additional ALPS outlet on September 27, 2020, and then analysis was performed.

⁸ If the analysis result is less than the lower limit of detection, the lower limit of detection is used for the calculation.

	rtion	Before second	dary treatment ⁵	After seconda	ary treatment ⁶	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Sr-90 (About 29 years)	3.0E+01	6.46E+04	2.2E+03	3.57E-02	1.2E-03	
Y-90 (About 64 hours)	3.0E+02	6.46E+04	2.2E+02	3.57E-02	1.2E-04	Radioactive equilibrium with Sr-90
Y-91 (About 59 days)	3.0E+02	< 8.45E+01	2.8E-01	< 1.65E+01	5.5E-02	
Nb-95 (About 35 days)	1.0E+03	< 3.50E-01	3.5E-04	< 4.96E-02	5.0E-05	
Tc-99 (About 210 thousand years)	1.0E+03	1.74E+01	1.7E-02	< 1.23E+00	1.2E-03	
Ru-103 (About 39 days)	1.0E+03	< 7.21E-01	7.2E-04	< 5.27E-02	5.3E-05	
Ru-106 (About 370 days)	1.0E+02	< 5.00E+00	5.0E-02	< 1.43E+00	1.4E-02	
Rh-103m (About 56 minutes)	2.0E+05	< 7.21E-01	3.6E-06	< 5.27E-02	2.6E-07	Radioactive equilibrium with Ru-103
Rh-106 (About 30 seconds)	3.0E+05	< 5.00E+00	1.7E-05	< 1.43E+00	4.8E-06	Radioactive equilibrium with Ru-106
Ag-110m (About 250 days)	3.0E+02	< 5.41E-01	1.8E-03	< 4.26E-02	1.4E-04	
Cd-113m (About 14 years)	4.0E+01	< 2.05E+01	5.1E-01	< 8.52E-02	2.1E-03	
Cd-115m (45 days)	3.0E+02	< 2.26E+01	7.5E-02	< 2.70E+00	9.0E-03	
Sn-119m (About 290 days)	2.0E+03	< 3.90E+02	1.9E-01	< 4.24E+01	2.1E-02	Assessed from the radioactive concentration of Sn-123
Sn-123 (About 130 days)	4.0E+02	< 6.06E+01	1.5E-01	< 6.59E+00	1.6E-02	
Sn-126 (About 230 thousand years)	2.0E+02	< 2.88E+00	1.4E-02	< 2.92E-01	1.5E-03	
Sb-124 (About 60 days)	3.0E+02	< 2.79E-01	9.3E-04	< 9.67E-02	3.2E-04	
Sb-125 (About 2.8 years)	8.0E+02	8.30E+01	1.0E-01	2.26E-01	2.8E-04	
Te-123m (About 120 days)	6.0E+02	< 8.32E-01	1.4E-03	< 9.19E-02	1.5E-04	

	ory	Before second	dary treatment ⁵	After seconda	ary treatment ⁶	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Te-125m (About 57 days)	9.0E+02	8.30E+01	9.2E-02	2.26E-01	2.5E-04	Radioactive equilibrium with Sb-125
Te-127 (About 9.4 hours)	5.0E+03	< 7.25E+01	1.5E-02	< 4.69E+00	9.4E-04	
Te-127m (About 110 days)	3.0E+02	< 7.53E+01	2.5E-01	< 4.87E+00	1.6E-02	Assessed from the radioactive concentration of Te-127
Te-129 (About 70 minutes)	1.0E+04	< 1.27E+01	1.3E-03	< 6.15E-01	6.1E-05	
Te-129m (About 34 days)	3.0E+02	< 1.31E+01	4.4E-02	< 1.37E+00	4.6E-03	
I-129 (About 16 million years)	9.0E+00	2.99E+01	3.3E+00	1.16E+00	1.3E-01	
Cs-134 (About 2.1 years)	6.0E+01	< 2.93E+01	4.9E-01	< 7.60E-02	1.3E-03	
Cs-135 (About 2.3 million years)	6.0E+02	3.81E-03	6.4E-06	< 1.18E-06	2.0E-09	Assessed from the radioactive concentration of Cs-137
Cs-136 (About 13 days)	3.0E+02	< 3.77E-01	1.3E-03	< 4.68E-02	1.6E-04	
Cs-137 (About 30 years)	9.0E+01	< 5.99E+02	6.7E+00	< 1.85E-01	2.1E-03	
Ba-137m (About 2.6 minutes)	8.0E+05	5.99E+02	7.5E-04	< 1.85E-01	2.3E-07	Radioactive equilibrium with Cs-137
Ba-140 (About 13 days)	3.0E+02	< 2.40E+00	8.0E-03	< 2.02E-01	6.7E-04	
Ce-141 (About 33 days)	1.0E+03	< 1.51E+00	1.5E-03	< 2.62E-01	2.6E-04	
Ce-144 (About 280 days)	2.0E+02	< 6.84E+00	3.4E-02	< 5.69E-01	2.8E-03	
Pr-144 (About 17 minutes)	2.0E+04	< 6.84E+00	3.4E-04	< 5.69E-01	2.8E-05	Radioactive equilibrium with Ce-144
Pr-144m (About 7.2 minutes)	4.0E+04	< 6.84E+00	1.7E-04	< 5.69E-01	1.4E-05	Radioactive equilibrium with Ce-144
Pm-146 (About 5.5 years)	9.0E+02	< 1.23E+00	1.4E-03	< 6.66E-02	7.4E-05	
Pm-147 (About 2.6 years)	3.0E+03	< 4.08E+00	1.4E-03	< 8.04E-01	2.7E-04	Assessed from the radioactive concentration of Eu-154

	> G	Refore second	dary treatment ⁵	After second:	ary treatment ⁶	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Pm-148 (About 5.4 days)	3.0E+02	< 6.49E-01	2.2E-03	< 2.33E-01	7.8E-04	
Pm-148m (About 41 days)	5.0E+02	< 6.34E-01	1.3E-03	< 4.84E-02	9.7E-05	
Sm-151 (About 90 years)	8.0E+03	< 5.77E-02	7.2E-06	< 1.14E-02	1.4E-06	Assessed from the radioactive concentration of Eu-154
Eu-152 (About 14 years)	6.0E+02	< 2.70E+00	4.5E-03	< 2.84E-01	4.7E-04	
Eu-154 (About 8.6 years)	4.0E+02	< 5.77E-01	1.4E-03	< 1.14E-01	2.8E-04	
Eu-155 (About 4.8 years)	3.0E+03	< 3.43E+00	1.1E-03	< 3.36E-01	1.1E-04	
Gd-153 (About 240 days)	3.0E+03	< 3.17E+00	1.1E-03	< 2.64E-01	8.8E-05	
Tb-160 (About 72 days)	5.0E+02	< 1.66E+00	3.3E-03	< 1.43E-01	2.9E-04	
Pu-238 (About 88 years)	4.0E+00	< 5.70E-01	1.4E-01	< 3.25E-02	8.1E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-239 (About 24000 years)	4.0E+00	< 5.70E-01	1.4E-01	< 3.25E-02	8.1E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-240 (About 6600 years)	4.0E+00	< 5.70E-01	1.4E-01	< 3.25E-02	8.1E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-241 (About 14 years)	2.0E+02	< 2.07E+01	1.0E-01	< 1.18E+00	5.9E-03	Assessed from the radioactive concentration of Pu-238
Am-241 (About 430 years)	5.0E+00	< 5.70E-01	1.1E-01	< 3.25E-02	6.5E-03	Assessed as included in the measurement value of the total α radioactivity
Am-242m (About 140 years)	5.0E+00	< 1.03E-02	2.1E-03	< 5.87E-04	1.2E-04	Assessed from the radioactive concentration of Am-241
Am-243 (About 7400 years)	5.0E+00	< 5.70E-01	1.1E-01	< 3.25E-02	6.5E-03	Assessed as included in the measurement value of the total α radioactivity
Cm-242 (About 160 days)	6.0E+01	< 5.70E-01	9.5E-03	< 3.25E-02	5.4E-04	Assessed as included in the measurement value of the total α radioactivity
Cm-243 (About 29 years)	6.0E+00	< 5.70E-01	9.5E-02	< 3.25E-02	5.4E-03	Assessed as included in the measurement value of the total α radioactivity
Cm-244 (About 18 years)	7.0E+00	< 5.70E-01	8.1E-02	< 3.25E-02	4.6E-03	Assessed as included in the measurement value of the total α radioactivity
Sum of the ratios to regulatory concentrations limits of nuclides other than tritium		-	2.4E+03	-	3.5E-01	

Table II-4 Secondary treatment performance test result by ALPS (.11-G tank group)

Table II-4	Secon	idary treatm	ent perform	ance test re	sult by ALP	S (J1-G tank group)
	ory ation		dary treatment ⁹	After seconda	ry treatment10	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
H-3 (About 12 years)	6.0E+04	2.73E+05	4.6E+00	2.72E+05	4.5E+00	Dilute to less than 1,500Bq/L before discharge
C-14 (About 5700 years)	2.0E+03	1.26E+01	6.3E-03	1.56E+01	7.8E-03	
Mn-54 (About 310 days)	1.0E+03	< 2.02E-01	2.0E-04	< 3.79E-02	3.8E-05	
Fe-59 (About 44 days)	4.0E+02	< 3.51E-01	8.8E-04	< 7.17E-02	1.8E-04	
Co-58 (About 71 days)	1.0E+03	< 2.11E-01	2.1E-04	< 3.74E-02	3.7E-05	
Co-60 (About 5.3 years)	2.0E+02	1.31E+01	6.5E-02	2.33E-01	1.2E-03	
Ni-63 (About 100 days)	6.0E+03	< 1.84E+01	3.1E-03	< 8.84E+00	1.5E-03	
Zn-65 (About 240 days)	2.0E+02	< 4.35E-01	2.2E-03	< 7.97E-02	4.0E-04	
Rb-86 (About 19 days)	3.0E+02	< 2.56E+00	8.5E-03	< 4.67E-01	1.6E-03	
Sr-89 (About 51 days)	3.0E+02	< 7.87E+02	2.6E+00	< 4.52E-02	1.5E-04	
Sr-90 (About 29 years)	3.0E+01	1.04E+04	3.5E+02	< 3.18E-02	1.1E-03	
Y-90 (About 64 hours)	3.0E+02	1.04E+04	3.5E+01	< 3.18E-02	1.1E-04	Radioactive equilibrium with Sr-90
Y-91 (About 59 days)	3.0E+02	< 4.82E+01	1.6E-01	< 1.18E+01	3.9E-02	
Nb-95 (About 35 days)	1.0E+03	< 2.56E-01	2.6E-04	< 4.70E-02	4.7E-05	
Tc-99 (About 210 thousand years)	1.0E+03	1.20E+00	1.2E-03	< 1.29E+00	1.3E-03	
Ru-103 (About 39 days)	1.0E+03	< 3.39E-01	3.4E-04	< 5.06E-02	5.1E-05	

Composite (mixing/stirring) was performed for the samples collected between October 5 and 7, 2020, and then analysis was performed.

Samples were collected from the middle layer in the sample tank installed latter part of the additional ALPS outlet on

October 13, 2020, and then analysis was performed.

	y on	Before second	dary treatment ⁹	After seconda	ry treatment ¹⁰	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Ru-106 (About 370 days)	1.0E+02	< 2.27E+00	2.3E-02	4.83E-01	4.8E-03	
Rh-103m (About 56 minutes)	2.0E+05	< 3.39E-01	1.7E-06	< 5.06E-02	2.5E-07	Radioactive equilibrium with Ru-103
Rh-106 (About 30 seconds)	3.0E+05	< 2.27E+00	7.6E-06	4.83E-01	1.6E-06	Radioactive equilibrium with Ru-106
Ag-110m (About 250 days)	3.0E+02	< 2.92E-01	9.7E-04	< 4.00E-02	1.3E-04	
Cd-113m (About 14 years)	4.0E+01	< 2.04E+01	5.1E-01	< 8.55E-02	2.1E-03	
Cd-115m (45 days)	3.0E+02	< 1.16E+01	3.9E-02	< 2.29E+00	7.6E-03	
Sn-119m (About 290 days)	2.0E+03	< 2.13E+02	1.1E-01	< 4.03E+01	2.0E-02	Assessed from the radioactive concentration of Sn-123
Sn-123 (About 130 days)	4.0E+02	< 3.31E+01	8.3E-02	< 6.26E+00	1.6E-02	
Sn-126 (About 230 thousand years)	2.0E+02	< 1.16E+00	5.8E-03	< 1.47E-01	7.3E-04	
Sb-124 (About 60 days)	3.0E+02	< 2.20E-01	7.3E-04	< 8.42E-02	2.8E-04	
Sb-125 (About 2.8 years)	8.0E+02	3.23E+01	4.0E-02	1.37E-01	1.7E-04	
Te-123m (About 120 days)	6.0E+02	< 3.83E-01	6.4E-04	< 6.67E-02	1.1E-04	
Te-125m (About 57 days)	9.0E+02	3.23E+01	3.6E-02	1.37E-01	1.5E-04	Radioactive equilibrium with Sb-125
Te-127 (About 9.4 hours)	5.0E+03	< 3.53E+01	7.1E-03	< 4.33E+00	8.7E-04	
Te-127m (About 110 days)	3.0E+02	< 3.67E+01	1.2E-01	< 4.50E+00	1.5E-02	Assessed from the radioactive concentration of Te-127
Te-129 (About 70 minutes)	1.0E+04	< 4.71E+00	4.7E-04	< 5.94E-01	5.9E-05	
Te-129m (About 34 days)	3.0E+02	< 6.61E+00	2.2E-02	< 1.21E+00	4.0E-03	
I-129 (About 16 million years)	9.0E+00	2.79E+00	3.1E-01	3.28E-01	3.6E-02	
Cs-134 (About 2.1 years)	6.0E+01	5.94E+00	9.9E-02	< 6.65E-02	1.1E-03	

	y ion	Before second	dary treatment ⁹	After seconda	iry treatment ¹⁰	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Cs-135 (About 2.3 million years)	6.0E+02	7.51E-04	1.3E-06	2.10E-06	3.5E-09	Assessed from the radioactive concentration of Cs-137
Cs-136 (About 13 days)	3.0E+02	< 1.96E-01	6.5E-04	< 3.63E-02	1.2E-04	
Cs-137 (About 30 years)	9.0E+01	1.18E+02	1.3E+00	3.29E-01	3.7E-03	
Ba-137m (About 2.6 minutes)	8.0E+05	1.18E+02	1.5E-04	3.29E-01	4.1E-07	Radioactive equilibrium with Cs-137
Ba-140 (About 13 days)	3.0E+02	< 1.22E+00	4.1E-03	< 1.73E-01	5.8E-04	
Ce-141 (About 33 days)	1.0E+03	< 9.39E-01	9.4E-04	< 1.19E-01	1.2E-04	
Ce-144 (About 280 days)	2.0E+02	< 3.02E+00	1.5E-02	< 5.53E-01	2.8E-03	
Pr-144 (About 17 minutes)	2.0E+04	< 3.02E+00	1.5E-04	< 5.53E-01	2.8E-05	Radioactive equilibrium with Ce-144
Pr-144m (About 7.2 minutes)	4.0E+04	< 3.02E+00	7.6E-05	< 5.53E-01	1.4E-05	Radioactive equilibrium with Ce-144
Pm-146 (About 5.5 years)	9.0E+02	< 5.26E-01	5.8E-04	< 6.30E-02	7.0E-05	
Pm-147 (About 2.6 years)	3.0E+03	< 2.53E+00	8.4E-04	< 7.20E-01	2.4E-04	Assessed from the radioactive concentration of Eu-154
Pm-148 (About 5.4 days)	3.0E+02	< 5.19E-01	1.7E-03	< 4.52E-01	1.5E-03	
Pm-148m (About 41 days)	5.0E+02	< 2.76E-01	5.5E-04	< 4.09E-02	8.2E-05	
Sm-151 (About 90 years)	8.0E+03	< 3.57E-02	4.5E-06	< 1.02E-02	1.3E-06	Assessed from the radioactive concentration of Eu-154
Eu-152 (About 14 years)	6.0E+02	< 1.21E+00	2.0E-03	< 1.90E-01	3.2E-04	
Eu-154 (About 8.6 years)	4.0E+02	< 3.57E-01	8.9E-04	< 1.02E-01	2.5E-04	
Eu-155 (About 4.8 years)	3.0E+03	< 1.38E+00	4.6E-04	< 1.75E-01	5.8E-05	
Gd-153 (About 240 days)	3.0E+03	< 1.21E+00	4.0E-04	< 1.85E-01	6.2E-05	
Tb-160 (About 72 days)	5.0E+02	< 6.88E-01	1.4E-03	< 1.35E-01	2.7E-04	

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	ory atio	Before second	dary treatment ⁹	After seconda	ry treatment •	
Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Analysis result ⁷ [Bq/L]	Ratio to regulatory limit ⁸	Remarks
Pu-238 (About 88 years)	4.0E+00	< 3.19E-02	8.0E-03	< 2.80E-02	7.0E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-239 (About 24000 years)	4.0E+00	< 3.19E-02	8.0E-03	< 2.80E-02	7.0E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-240 (About 6600 years)	4.0E+00	< 3.19E-02	8.0E-03	< 2.80E-02	7.0E-03	Assessed as included in the measurement value of the total α radioactivity
Pu-241 (About 14 years)	2.0E+02	< 1.16E+00	5.8E-03	< 1.02E+00	5.1E-03	Assessed from the radioactive concentration of Pu-238
Am-241 (About 430 years)	5.0E+00	< 3.19E-02	6.4E-03	< 2.80E-02	5.6E-03	Assessed as included in the measurement value of the total α radioactivity
Am-242m (About 140 years)	5.0E+00	< 5.77E-04	1.2E-04	< 5.05E-04	1.0E-04	Assessed from the radioactive concentration of Am-241
Am-243 (About 7400 years)	5.0E+00	< 3.19E-02	6.4E-03	< 2.80E-02	5.6E-03	Assessed as included in the measurement value of the total α radioactivity
Cm-242 (About 160 days)	6.0E+01	< 3.19E-02	5.3E-04	< 2.80E-02	4.7E-04	Assessed as included in the measurement value of the total α radioactivity
Cm-243 (About 29 years)	6.0E+00	< 3.19E-02	5.3E-03	< 2.80E-02	4.7E-03	Assessed as included in the measurement value of the total α radioactivity
Cm-244 (About 18 years)	7.0E+00	< 3.19E-02	4.6E-03	< 2.80E-02	4.0E-03	Assessed as included in the measurement value of the total α radioactivity
Sum of the ratios to regulatory concentrations limits of nuclides other than tritium		-	3.9E+02	-	2.2E-01	

II-5. Analysis of the radioactive materials in the stored ALPS treated water, etc.

As shown in II-3. "Performance of ALPS", in measured point (7) of the ALPS outlet, mainly the seven nuclides detected significantly in the process of treatment among those subject to removal by ALPS (Cs-134, Cs-137, Co-60, Sb-125, Ru-106, Sr-90, and I-129) were measured. The result is shown on our web site.

Our web site:

https://www.tepco.co.jp/decommission/progress/watertreatment/images/exit.pdf (ja) https://www.tepco.co.jp/en/decommission/progress/watertreatment/images/exit_en.pdf (en) The judgment of whether stored water is regarded as "ALPS treated water" and "treated water to be purified" shall be performed according to the following procedure based on this measurement result

In other words, when the transfer destination tank group (8 to 10 tanks connected at the time of water reception) becomes full, water of which ratios to regulatory concentrations limits of nuclides other than tritium were estimated to be less than 1 using the following formula is judged as ALPS treated water and the other water as treated water to be purified, based on the measurement result of the sample (water) collected in the ALPS outlet (measured point (7)) during reception of water in the corresponding tanks group from ALPS.

$$C_{All} = C_{M7} + C_{C-14} + C_0 < 1$$

where

C_{All}: Sum of the ratios to regulatory concentrations limits of nuclides other than tritium

 C_{M7} : Sum of the ratios to regulatory concentrations limits calculated from the measurement results of the seven major nuclides

C_{C-14}: Ratio to the regulatory concentrations limit of C-14 (conservatively set to the ratio to the regulatory concentrations limit of 0.11 calculated from the maximum concentration (215Bq/L) measured in the past)

C₀: Estimated value of the sum of the ratios to regulatory concentrations limits of the nuclides not included in the 7 nuclides among the nuclides other than tritium (The estimated value based on the past measurement results is set to 0.3)

Based on the result of the measurement, nuclides deemed to be less than the detection limit (ND) are assumed to be included at the concentration of the lower limit of detection and the lower limit of detection is used for the assessment of the above formula. The following table shows examples of measurement results and values in the calculation of the sum of the ratios to regulatory concentration limits.

Table II-5 Relationship between the analysis results of the seven major nuclides and the sum of the ratios to regulatory concentration limits of the seven major nuclides

	in or the ratios to regulatory concentration innite or the covern major nacinate							
Nuclide	Cs-137	Cs-134	Co-60	Sb-125	Ru-106	Sr-90	I-129	
Measured concentration	ND (<1.26E- 01)	ND (<1.66E-01)	2.35E-01	ND (<4.57E-01)	ND (<1.15E00)	ND (<3.90E-01)	2.02E-01	
Calculated concentration	1.26E-01	1.66E-01	2.35E-01	4.57E-01	1.15E+00	3.90E-01	2.02E-01	
Regulatory concentration limit	9.00E+01	6.00E+01	2.00E+02	8.00E+02	1.00E+02	3.00E+01	9.00E+00	
Ratio to regulatory concentration limit	1.40E-03	2.76E-03	1.18E-03	5.71E-04	1.15E-02	1.30E-02	2.24E-02	
Sum of the regulatory ratios of the 7 nuclides (C _{M7})		γ 0.05 (5.28E-02)						
Sum of the regulatory ratios of the 63 nuclides (CAII)			0.05 (=C _{M7}	·)+0.11(= <i>C_{C-14}</i>)+0.	3(= <i>C</i> ₅₅)=0.46			

Figure II-5 shows the concentration distribution of the seven major nuclides arranged from the analysis result of the tank group of which sum of the ratios to regulatory concentrations limits other than tritium is estimated to be less than 1.

- Measured value of the radioactive concentration of each tank group (excluding reused tanks) (as of March 31, 2021)
- Secondary treatment test water
 https://www.tepco.co.jp/decommission/information/newsrelease/reference/pdf/2020/2h/rf_
 20201224_1.pdf

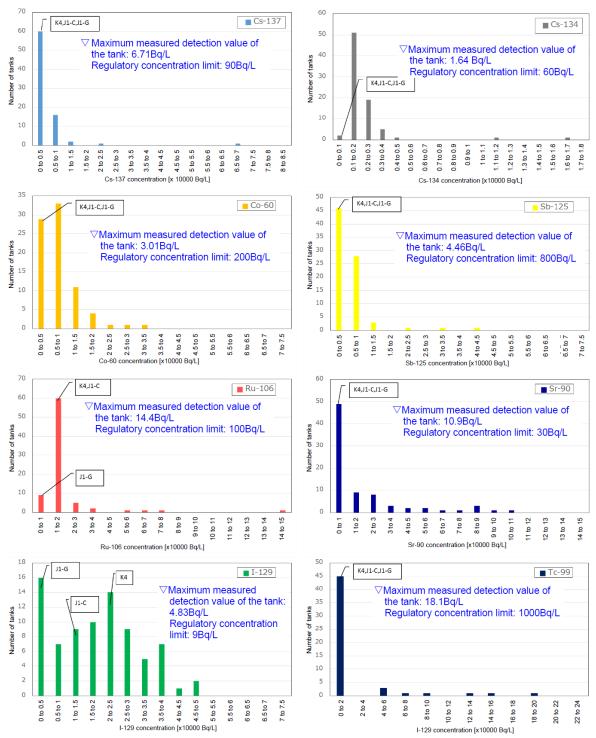


Figure II-5 Concentration distribution of the seven major nuclides in the analysis result of ALPS treated water (as of the end of March 2021)

- * The analysis results in which sum of the ratios to regulatory concentrations limits of the 7 major nuclides is less than 0.59 (for 80 tanks) (excluding secondary treatment test water)
- * The vertical axis indicates the number of tanks (counted as the lower detection limit if not detected)
- * Some maximum values are the detection limit values because they were created using the detection limit value in the case of non-detection.
- * Values are measured values at the times and no half-life correction is considered.

Figure II-6 shows the analysis result concentration distribution created by extracting the analysis results of the analyzed tanks for tritium and C-14, which are not subject to removal by ALPS.

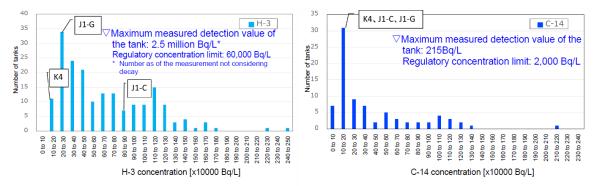


Figure II-6 Concentration distribution of tritium and C-14 in the analysis result of ALPS treated water, etc. (as of the end of March 2021)

- * The analysis results of the tank group (189 tanks for tritium and 81 tanks for C-14) are plotted (excluding secondary treatment test water)
- * The vertical axis indicates the number of tanks (counted as the lower detection limit if not detected)
- * Values are measured values at the times and no half-life correction is considered.

As a result of the above-mentioned estimation, approx. 70% of the water currently stored in the tanks is judged to be "treated water to be purified," which does not satisfy the above formula: in other words, the sum of the ratios to regulatory concentrations limits (C_{All}) of nuclides other than tritium is greater than 1. "Treated water to be purified" is discharged only after secondary treatment is conducted immediately before future discharge into the sea, and after it is confirmed that the regulatory concentration limit is less than 1 with the facility for measurement and confirmation.

In addition, this sample is not representative because each tank group does not have a necessary stirring device to guarantee the homogeneity. Therefore, for the actual judgment of whether the discharge is possible, the correct regulatory concentration limit obtained from the result of the measurement and assessment in the facility for measurement and confirmation is used.

All data of the past measurement and estimation results of the above-mentioned method are published on our web site. Our treatment water portal shows the measurement results of each tank group. The latest data is available in the following links.

Our web site (Japanese only):

https://www.tepco.co.jp/decommission/data/daily_analysis/tank/index-j.html

Treated water portal:

https://www.tepco.co.jp/decommission/progress/watertreatment/ (ja) https://www.tepco.co.jp/en/decommission/progress/watertreatment/images/tankarea en.pdf (en) For the K4 tank group of which sum of the ratios to regulatory concentrations limits becomes less than 1 after treated by ALPS once, the 64 nuclides included in the collected sample are measured and assessed according to the measurement and assessment method shown in Table II-6 (however, the representativeness of the sample is not secured). The K4 tank group is the receiving tank group in the operation considering the sum of the ratios to regulatory concentrations limits of less than 1 in ALPS in FY 2016. For analysis, samples were collected from 24 locations, which are upper, middle, and lower layer of each 8 out of 35 tanks, the water samples were mixed (composite sample), and 62 nuclides were analyzed. For C-14, the average value of the results of analyses of samples taken from middle layer of five tanks after verification of the presence is shown. Table II-7 shows the results.

Table II-6 Measurement and assessment methods of each nuclide

	o-II alda I	modour	ement and assessment methods of each nuclide
No.	Nuclide	Radiation type	Measurement or assessment method
1	Mn-54	Υ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
2	Fe-59	Υ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
3	Co-58	Υ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
4	Co-60	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
5	Ni-63	β	Isolated by resin, mixed with a scintillator, and counted by a low back liquid scintillation counter.
6	Zn-65	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
7	Rb-86	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
8	Sr-89	β	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish
9	Sr-90	β	Isolated with resin, precipitated and recovered, mounted, and counted with the β nuclide analyzer in stainless steel dish
10	Y-90	β	Concentration assessment as Sr -90 and radioactive equilibrium
11	Y-91	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
12	Nb-95	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
13	Tc-99	β	Samples are diluted with dilute nitric acid and counted with the inductively coupled plasma mass spectrometry (ICP-MS).
14	Ru-103	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
15	Ru-106	β	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
16	Rh-103m	βγ	Concentration assessment as radioactive equilibrium with Ru-103
17	Rh-106	Υ	Concentration assessment as radioactive equilibrium with Ru-106
18	Ag-110m	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
19	Cd-113m	γ	Isolated by ion exchange, mixed with a scintillator, and counted by a low back liquid scintillation counter.
20	Cd-115m	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
21	Sn-119m	γ	Assessed from the measured value of the radioactive concentration of Sn-123 and the calculated nuclide abundance ratio
22	Sn-123	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.

No.	Nuclide	Radiation type	Measurement or assessment method
23	Sn-126	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
24	Sb-124	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
25	Sb-125	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
26	Te-123m	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
27	Te-125m	γ	Concentration assessment as radioactive equilibrium with Sb-125
28	Te-127	βγ	Homogenized samples are collected in a Marinelli container, counted with a Ge semiconductor detector, and assessed using the half-life of the parent nuclide (Te-127m).
29	Te-127m	βγ	Assessed from the measured value of the radioactive concentration of Te-127 and the calculated nuclide abundance ratio
30	Te-129	βγ	Homogenized samples are collected in a Marinelli container, counted with a Ge semiconductor detector, and assessed using the half-life of the parent nuclide (Te-129m).
31	Te-129m	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
32	I-129	βγ	Samples were counted with the inductively coupled plasma mass spectrometry (ICP-MS) after adjusting to iodate ion by the addition of reagents.
33	Cs-134	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
34	Cs-135	β	Assessed from the measured value of the radioactive concentration of Cs-137 and the calculated nuclide abundance ratio
35	Cs-136	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
36	Cs-137	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
37	Ba-137m	γ	Concentration assessment as radioactive equilibrium with Cs-137
38	Ba-140	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
39	Ce-141	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
40	Ce-144	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
41	Pr-144	βγ	Concentration assessment as radioactive equilibrium with Ce-144, using half-life of parent nuclide (Pr-144m)
42	Pr-144m	Υ	Concentration assessment as radioactive equilibrium with Ce-144
43	Pm-146	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
44	Pm-147	βγ	Assessed from the measured value of the radioactive concentration of Eu-154 and the calculated nuclide abundance ratio
45	Pm-148	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
46	Pm-148m	γ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
47	Sm-151	βγ	Assessed from the measured value of the radioactive concentration of Eu-154 and the calculated nuclide abundance ratio
48	Eu-152	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
49	Eu-154	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
50	Eu-155	βγ	Homogenized samples are collected in a Marinelli container and

No.	Nuclide	Radiation type	Measurement or assessment method
			counted with a Ge semiconductor detector.
51	Gd-153	Υ	Homogenized samples are collected in a Marinelli container and
<u> </u>	04 100	ı	counted with a Ge semiconductor detector.
52	Tb-160	βγ	Homogenized samples are collected in a Marinelli container and counted with a Ge semiconductor detector.
			After iron is removed by iron coprecipitation, the sample is
53	Pu-238	α	evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
54	Pu-239	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnSα automatic measuring device is used as it is without proportionate division with other nuclides
55	Pu-240	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
56	Pu-241	β	Assessed from the total α discrete value and the isotopic ratio of Pu-238 $$
57	Am-241	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
58	Am-242m	α	Assessed from the isotopic ratio of Am-241
59	Am-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
60	Cm-242	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
61	Cm-243	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
62	Cm-244	α	After iron is removed by iron coprecipitation, the sample is evaporated to dryness in a stainless steel dish and the total α measured value counted with the ZnS α automatic measuring device is used as it is without proportionate division with other nuclides
-	H-3(FWT)	β	Isolated by distillation, mixed with a scintillator, and counted by a low back liquid scintillation counter.
-	C-14	β	Converted to CO ₂ , collected and isolated on absorbent, mixed with a scintillator, and counted by a low back liquid scintillation counter.

Table II-7 Analysis result of the K4 tank group

	Table II-7	Analysis resu	<u>ilt of the K4 tan</u>	ik group
Nuclide (Half-life)	Regulatory concentration limit	Analysis result	Ratio to regulatory limit	Remarks
H-3	[Bq/L] 6.0E+04	[Bq/L] 1.9E+05	3.2E+00	Dilute to less than 1,500Bq/L
(About 12 years) C-14 (About 5700	2.0E+03	1.5E+01	7.5E-03	before discharge
years) Mn-54				
(About 310 days) Fe-59	1.0E+03 4.0E+02	< 6.7E-03	6.7E-06 4.3E-05	
(About 44 days) Co-58	1.0E+03	< 8.0E-03	8.0E-06	
(About 71 days)	2.0E+02	4.4E-01	2.2E-03	
(About 5.3 years) Ni-63	6.0E+03	2.2E+00	3.7E-04	
(About 100 days) Zn-65 (About 240 days)	2.0E+02	< 1.5E-02	7.5E-05	
Rb-86 (About 19 days)	3.0E+02	< 1.9E-01	6.3E-04	
Sr-89 (About 51 days)	3.0E+02	< 1.0E-01	3.3E-04	
Sr-90 (About 29 years)	3.0E+01	2.2E-01	7.3E-03	
Y-90 (About 64 hours)	3.0E+02	2.2E-01	7.3E-04	Radioactive equilibrium with Sr-90
Y-91 (About 59 days)	3.0E+02	< 2.2E+00	7.3E-03	
Nb-95 (About 35 days)	1.0E+03	< 1.0E-02	1.0E-05	
Tc-99 (About 210 thousand years)	1.0E+03	7.0E-01	7.0E-04	
Ru-103 (About 39 days)	1.0E+03	< 1.0E-02	1.0E-05	
Ru-106 (About 370 days)	1.0E+02	1.6E+00	1.6E-02	
Rh-103m (About 56 minutes)	2.0E+05	< 1.0E-02	5.0E-08	Radioactive equilibrium with Ru- 103
Rh-106 (About 30 seconds)	3.0E+05	1.6E+00	5.3E-06	Radioactive equilibrium with Ru- 106
Ag-110m (About 250 days)	3.0E+02	< 5.6E-03	1.9E-05	
Cd-113m (About 14 years)	4.0E+01	< 1.8E-02	4.5E-04	
Cd-115m (45 days)	3.0E+02	< 6.4E-01	2.1E-03	
Sn-119m (About 290 days)	2.0E+03	< 1.7E-01	8.5E-05	Assessed from the radioactive concentration of Sn-123
Sn-123 (About 130 days) Sn-126	4.0E+02	< 1.2E+00	3.0E-03	
(About 230 thousand years)	2.0E+02	< 2.7E-02	1.4E-04	

Nuclide (Half-life)	Regulatory concentration limit	Analysis result	Ratio to regulatory limit	Remarks
	[Bq/L]	[Bq/L]		
Sb-124 (About 60 days)	3.0E+02	< 9.5E-03	3.2E-05	
Sb-125 (About 2.8 years)	8.0E+02	3.3E-01	4.1E-04	
Te-123m (About 120 days)	6.0E+02	< 9.2E-03	1.5E-05	
Te-125m (About 57 days)	9.0E+02	3.3E-01	3.7E-04	Radioactive equilibrium with Sb-125
Te-127 (About 9.4 hours)	5.0E+03	< 3.2E-01	6.4E-05	
Te-127m (About 110 days)	3.0E+02	< 3.2E-01	1.1E-03	Assessed from the radioactive concentration of Te-127
Te-129 (About 70 minutes)	1.0E+04	< 8.1E-02	8.1E-06	
Te-129m (About 34 days)	3.0E+02	< 3.2E-01	1.1E-03	
I-129 (About 16 million years)	9.0E+00	2.1E+00	2.3E-01	
Cs-134 (About 2.1 years)	6.0E+01	4.5E-02	7.5E-04	
Cs-135 (About 2.3 million years)	6.0E+02	2.5E-06	4.2E-09	Assessed from the radioactive concentration of Cs-137
Cs-136 (About 13 days)	3.0E+02	< 3.0E-02	1.0E-04	
Cs-137 (About 30 years)	9.0E+01	4.2E-01	4.7E-03	
Ba-137m (About 2.6 minutes)	8.0E+05	4.2E-01	5.3E-07	Radioactive equilibrium with Cs-137
Ba-140 (About 13 days)	3.0E+02	< 9.5E-02	3.2E-04	
Ce-141 (About 33 days)	1.0E+03	< 2.5E-02	2.5E-05	
Ce-144 (About 280 days)	2.0E+02	< 6.3E-02	3.2E-04	
Pr-144 (About 17 minutes)	2.0E+04	< 6.3E-02	3.2E-06	Radioactive equilibrium with Ce-144
Pr-144m (About 7.2 minutes)	4.0E+04	< 6.3E-02	1.6E-06	Radioactive equilibrium with Ce- 144
Pm-146 (About 5.5 years)	9.0E+02	< 9.8E-02	1.1E-04	
Pm-147 (About 2.6 years)	3.0E+03	< 1.9E-01	6.3E-05	Assessed from the radioactive concentration of Eu-154
Pm-148 (About 5.4 days)	3.0E+02	< 5.0E-01	1.7E-03	
Pm-148m (About 41 days)	5.0E+02	< 8.4E-03	1.7E-05	
Sm-151 (About 90 years)	8.0E+03	< 9.0E-04	1.1E-07	Assessed from the radioactive concentration of Eu-154

Nuclide (Half-life)	Regulatory concentration limit [Bq/L]	Analysis result	Ratio to regulatory limit	Remarks
Eu-152 (About 14 years)	6.0E+02	< 2.8E-02	4.7E-05	
Eu-154 (About 8.6 years)	4.0E+02	< 1.2E-02	3.0E-05	
Eu-155 (About 4.8 years)	3.0E+03	< 3.3E-02	1.1E-05	
Gd-153 (About 240 days)	3.0E+03	< 3.2E-02	1.1E-05	
Tb-160 (About 72 days)	5.0E+02	< 2.8E-02	5.6E-05	
Pu-238 (About 88 years)	4.0E+00	< 6.3E-04	1.6E-04	Assessed as included in the measurement value of the total α radioactivity
Pu-239 (About 24000 years)	4.0E+00	< 6.3E-04	1.6E-04	Assessed as included in the measurement value of the total α radioactivity
Pu-240 (About 6600 years)	4.0E+00	< 6.3E-04	1.6E-04	Assessed as included in the measurement value of the total α radioactivity
Pu-241 (About 14 years)	2.0E+02	< 2.8E-02	1.4E-04	Assessed from the radioactive concentration of Pu-238
Am-241 (About 430 years)	5.0E+00	< 6.3E-04	1.3E-04	Assessed as included in the measurement value of the total α radioactivity
Am-242m (About 140 years)	5.0E+00	< 3.9E-05	7.8E-06	Assessed from the radioactive concentration of Am-241
Am-243 (About 7400 years)	5.0E+00	< 6.3E-04	1.3E-04	Assessed as included in the measurement value of the total α radioactivity
Cm-242 (About 160 days)	6.0E+01	< 6.3E-04	1.1E-05	Assessed as included in the measurement value of the total α radioactivity
Cm-243 (About 29 years)	6.0E+00	< 6.3E-04	1.1E-04	Assessed as included in the measurement value of the total α radioactivity
Cm-244 (About 18 years)	7.0E+00	< 6.3E-04	9.0E-05	Assessed as included in the measurement value of the total α radioactivity
	regulatory concen clides other than trit	trations limits of 63 ium	2.9E-01	

^{*}The analysis result of C-14 is the average value of measurement results of samples from middle layer of five tanks (K4-A1, B1, C5, D1, E1) taken between on May 21 and June 2, 2020, the analysis result of H-3 is the average value of measurement results of samples from three tanks (K4-A6, B6, E5; average value of measurement results of samples from upper, middle, lower layer respectively) taken between on October 26 and 31, 2017 and samples from five tanks, (K4-A1, B1, C5, D1, E1; measurement results of samples from middle layer) taken between on May 21 an Jun2, 2020. The analysis results of the other nuclides are the results of composite sample of total of 24 sampling locations of upper, middle, and lower layer in each eight tanks (K4-A1, A6, B1, B6, C5, D1, E1, E5) taken between on October 26 and 31, 2017.

II-6. Water quality other than radioactive materials

As mentioned above, ALPS is equipped with coprecipitation, adsorption, and physical filters, etc., all of which are used to remove the 62 nuclides subject to removal regardless of their chemical forms. Judging from the past analysis results, not only radioactive materials but also materials that may affect the water quality are removed when passing through the filters.

Table II-8 shows the tank group from which samples were collected and the timing of receiving water stored in the tanks¹¹. Table II-9-1 and 2 show the results of the 46 measurement items based on our "general wastewater treatment management guideline." It was verified that all of them met the standards set by the laws in Japan and ordinances of Fukushima prefecture. It should be noted that since no facility to secure the representativeness of samples is installed in the tank group, in this analysis, one tank is randomly selected from the tank group and samples collected from the middle layer of the tank are analyzed without stirring or circulation, so the representativeness is not necessarily secured.

Table II-8 Tank group of which chemical substances were analyzed based on the general wastewater standard, and timing of receiving water

Area	Groups	Time of receiving ALPS treated water, etc.
G3	А	FY 2013
J4	В	FY 2014
H1	Е	FY 2015
K3	Α	FY 2016
K4	А	FY 2016
H2	С	FY 2017
G1S	Α	FY 2018

Table II-9-1 Results of analyses of chemical substances, etc., in tanks containing ALPS treated water, etc. (Part 1)

			Area and tank group				
Item	Guideline or permissible limit	Unit	G3	J4	H1	K3	
	P • · · · · · · · · · · · · · · · · · ·		Α	В	E	Α	
Hydrogen ion	5.0< /<9.0	рН	8.8	8.3	7.8	8.3	
Mass of suspended solids (SS)	Permissible limit 200 (Daily average 150)	mg/L	<1	<1	<1	<1	
Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	2.4	2.8	3.9	3.9	

December 28, 2018, "Analysis of chemical substance in tanks containing ALPS treated water etc." https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/012 04 01.pdf

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			Area and tank group			
Item	Guideline or	Unit	G3	J4	H1	K3
	permissible limit		Α	В	Е	А
Boron (mg/L)	Permissible limit 230 (Sea area)	mg/L	3.5	4.4	2.3	0.9
Soluble iron	Permissible limit 10	mg/L	<1	<1	<1	<1
Copper	Permissible limit 3	mg/L	<0.1	<0.1	<0.1	<0.1
Nickel	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1
Chromium	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1
Zinc	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	<0.1
Biochemical oxygen demand (BOD)	Permissible limit 160 (Daily average 120)	mg/L	<1	<1	<1	<1
Coliform count	Permissible limit Daily average 3000	Pieces/cm ³	0	0	0	0
Cadmium	Permissible limit 0.03	mg/L	<0.01	<0.01	<0.01	<0.01
Cyan	Permissible limit 1	mg/L	<0.05	<0.05	<0.05	<0.05
Organic phosphorus	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	<0.1
Lead	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01
Hexavalent chromium	Permissible limit 0.5	mg/L	<0.05	<0.05	<0.05	<0.05
Arsenic	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01
Mercury	Permissible limit 0.005	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Alkyl mercury	It should not be detected	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Polychlorinated biphenyls	Permissible limit 0.003	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Trichloroethylene	Permissible limit 0.1	mg/L	<0.03	<0.03	<0.03	<0.03
Tetrachloroethylene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01
Dichloromethane	Permissible limit 0.2	mg/L	<0.02	<0.02	<0.02	<0.02
Carbon tetrachloride	Permissible limit 0.02	mg/L	<0.002	<0.002	<0.002	<0.002
1,2-dichloroethane	Permissible limit 0.04	mg/L	<0.004	<0.004	<0.004	<0.004
1,1-dichloroethane	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	<0.1
Cis-1, 2- dichloroethylene	Permissible limit 0.4	mg/L	<0.04	<0.04	<0.04	<0.04
1,1,1-trichloroethane	Permissible limit 3	mg/L	<0.3	<0.3	<0.3	<0.3
1,1,2-trichloroethane	Permissible limit 0.06	mg/L	<0.006	<0.006	<0.006	<0.006
1,3-dichloropropene	Permissible limit 0.02	mg/L	<0.002	<0.002	<0.002	<0.002
Thiuram	Permissible limit 0.06	mg/L	<0.006	<0.006	<0.006	<0.006
Simazine	Permissible limit 0.03	mg/L	<0.003	<0.003	<0.003	<0.003
Thiobencarb	Permissible limit 0.2	mg/L	<0.02	<0.02	<0.02	<0.02
Benzene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01

			Area and tank group			
Item	Guideline or permissible limit	Unit	G3	J4	H1	K3
	permissione iiiiii		А	В	E	А
Selenium	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	<0.01
Fenitrothion	Permissible limit 0.03	mg/L	<0.003	<0.003	<0.003	<0.003
Phenols	Permissible limit 5	mg/L	<0.1	<0.1	<0.1	<0.1
Fluorine	Permissible element 15 (Sea area)	mg/L	<0.5	<0.5	<0.5	<0.5
Soluble manganese	Permissible limit 10	mg/L	<1	<1	<1	<1
Ammonia, ammonium compounds		mg/L	<1	<1	<1	<1
Nitrous acid compound and nitrous acid compound	Permissible limit 100	mg/L	2	2	<1	11
1,4-dioxane	Permissible limit 0.5	mg/L	<0.05	<0.05	<0.05	<0.05
n-Hexane Extract (Mineral oil)	Permissible limit 5	mg/L	<0.5	<0.5	<0.5	<0.5
n-Hexane Extract (Animal and vegetable oil)	Permissible limit 30	mg/L	<1	<1	<1	<1
Nitrogen	Permissible limit 120 (Daily average 60)	mg/L	2	2.3	0.7	11.1
Phosphate	Permissible limit 16 (Daily average 8)	mg/L	<0.05	<0.05	<0.05	<0.05

Table II-9-2 Results of analyses of chemical substances, etc. in tanks containing ALPS treated water, etc. (Part 2)

1			Area and tank group		
Item	Guideline or permissible limit	Unit	K4	H2	G1S
	permissible illilit		А	С	А
Hydrogen ion	5.0< /<9.0	рН	8.3	8.5	8.3
Mass of suspended solids (SS)	Permissible limit 200 mg/L (Daily average 150)		<1	<1	<1
Chemical oxygen demand (COD)	Permissible limit 160 (Daily average 120)	mg/L	0.9	1.8	1.5
Boron (mg/L)	Permissible limit 230 mg/L (Sea area)		0.4	1.1	1.1
Soluble iron	Permissible limit 10	mg/L	<1	<1	<1
Copper	Permissible limit 3	mg/L	<0.1	<0.1	<0.1
Nickel	Permissible limit 2	mg/L	<0.1	<0.1	<0.1
Chromium	Permissible limit 2	mg/L	<0.1	<0.1	<0.1

			Area and tank group			
Item	Guideline or	Unit	K4	H2	G1S	
	permissible limit		Α	С	А	
Zinc	Permissible limit 2	mg/L	<0.1	<0.1	<0.1	
Biochemical oxygen demand (BOD)	Permissible limit 160 (Daily average 120)	mg/L	2	<1	<1	
Coliform count	Permissible limit Daily average 3000	Pieces/cm ³	0	0	0	
Cadmium	Permissible limit 0.03	mg/L	<0.01	<0.01	<0.01	
Cyan	Permissible limit 1	mg/L	<0.05	<0.05	<0.05	
Organic phosphorus	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	
Lead	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	
Hexavalent chromium	Permissible limit 0.5	mg/L	<0.05	<0.05	<0.05	
Arsenic	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	
Mercury	Permissible limit 0.005	mg/L	<0.0005	<0.0005	<0.0005	
Alkyl mercury	It should not be detected	mg/L	<0.0005	<0.0005	<0.0005	
Polychlorinated biphenyls	Permissible limit 0.003	mg/L	<0.0005	<0.0005	<0.0005	
Trichloroethylene	Permissible limit 0.1	mg/L	<0.03	<0.03	<0.03	
Tetrachloroethylene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	
Dichloromethane	Permissible limit 0.2	mg/L	<0.02	<0.02	<0.02	
Carbon tetrachloride	Permissible limit 0.02	mg/L	<0.002	<0.002	<0.002	
1,2-dichloroethane	Permissible limit 0.04	mg/L	<0.004	<0.004	<0.004	
1,1-dichloroethane	Permissible limit 1	mg/L	<0.1	<0.1	<0.1	
Cis-1, 2- dichloroethylene	Permissible limit 0.4	mg/L	<0.04	<0.04	<0.04	
1,1,1-trichloroethane	Permissible limit 3	mg/L	<0.3	<0.3	<0.3	
1,1,2-trichloroethane	Permissible limit 0.06	mg/L	<0.006	<0.006	<0.006	
1,3-dichloropropene	Permissible limit 0.02	mg/L	<0.002	<0.002	<0.002	
Thiuram	Permissible limit 0.06	mg/L	<0.006	<0.006	<0.006	
Simazine	Permissible limit 0.03	mg/L	<0.003	<0.003	<0.003	
Thiobencarb	Permissible limit 0.2	mg/L	<0.02	<0.02	<0.02	
Benzene	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	
Selenium	Permissible limit 0.1	mg/L	<0.01	<0.01	<0.01	
Fenitrothion	Permissible limit 0.03	mg/L	<0.003	<0.003	<0.003	
Phenols	Permissible limit 5	mg/L	<0.1	<0.1	<0.1	
Fluorine	Permissible element 15 (Sea area)	mg/L	<0.5	<0.5	<0.5	
Soluble manganese	Permissible limit 10	mg/L	<1	<1	<1	

			Area and tank group			
Item	Guideline or permissible limit	Unit	K4	H2	G1S	
	permissible innit		А	С	А	
Ammonia, ammonium compounds		mg/L	<1	<1	<1	
Nitrous acid compound and nitrous acid compound	Permissible limit 100	mg/L	25	7	10	
1,4-dioxane	Permissible limit 0.5	mg/L	<0.05	<0.05	<0.05	
n-Hexane Extract (Mineral oil)	Permissible limit 5	mg/L	<0.5	<0.5	<0.5	
n-Hexane Extract (Animal and vegetable oil)	Permissible limit 30	mg/L	<1	<1	<1	
Nitrogen	Permissible limit 120 (Daily average 60)	mg/L	24.6	7.5	10	
Phosphate	Permissible limit 16 (Daily average 8)	mg/L	<0.05	<0.05	<0.05	

II-7. Reason for generation of treated water to be purified

ALPS can remove the 62 nuclides subject to removal from contaminated water and make the sum of the ratios to regulatory concentrations limits of nuclides other than tritium less than 1 by performing treatment once, but as a result of estimation by the above-mentioned method, "treated water to be purified" of which contained radioactive material concentration is equivalent to or higher than the sum of the ratios to regulatory concentrations limits of 1 and which is to be subject to secondary treatment accounts for 70% of all water stored in the tank (about 67% as of February 2022). The following shows the reason depending on the timing of each treatment.

a. FY 2013 to 2015

of 1mSv/year at the site boundary.

Highly contaminated water with only cesium removed was stored in tanks at the site prior to the start of the operation of ALPS. Due to the direct radiation and skyshine rays from the highly contaminated water, the radiation dose at the boundary of the site was very large and assessed to be 9.76mSv/year at the site boundary, which greatly exceeded the standard set by the government, "The effective dose at the site boundary is less than 1mSv/year." In response to this situation, we continued the operation while accepting the outlet concentration of each adsorption vessel slightly exceeding the replacement standard and treated highly contaminated water raising the operating rate, aiming at early achievement of the effective dose

As a result, the effective dose of 1mSv/year at the site boundary was achieved at the end of FY 2015, but naturally, treated water to be purified of which radioactive material concentration is equivalent to or higher than the sum of the ratios to regulatory concentrations limits of 1 was stored in the tanks.

It was immediately after the start of the operation of ALPS, so excessive concentrations also occurred due to facility trouble. Treated water to be purified of which sum of the ratios to regulatory concentrations limits exceeds 10 thousand was caused by the facility trouble, but the cause of the facility trouble has been removed and the event has not reoccurred.

b. FY 2016

In this period, the treatment capacity exceeded the speed of tank construction due to the advancement of treatment of highly concentrated water up to the preceding fiscal year, so tanks for storage of treated water were lacking, but treatment was performed to make the sum of the ratios to regulatory concentrations limits less than 1 by accelerating construction of tanks for storage of treated water and making use of the performance of ALPS.

Like this, the original performance of ALPS was used more appropriately than before, which reduced the frequency of treated water to be treated of which sum of the ratios to regulatory concentrations limits is 1 or more.

c. FY 2017 to 2018

Immediately after the accident, we hastened to collect tanks from all over Japan and used them for storage of contaminated water, etc. However, among these flange tanks, leak events occurred one after another, and the storage of strontium treated water (water from which most of the cesium and strontium has been removed before the treatment by ALPS) became an issue during this period.

Therefore, we decided to perform early treatment of the stored strontium treated water (water before treatment by ALPS) by ALPS to solve the issue of storage in flange tanks aiming at completion by the end of FY 2018, and raised the operating ratio while accepting slightly excessive concentrations at the outlet of each adsorption vessel again.

As a result, the treatment of all strontium treated water in the flange tanks was completed in November 2018, but compared to FY2016, the frequency of exceeding the regulatory concentration limit was higher.

All ALPS treated water, etc., stored in flange tanks have been transferred to weld tanks by March 2019.

Attachment III Impact of the organically bound tritium in the exposure assessment of tritium

ALPS treated water contains a lot of tritium water (HTO). If ingested, tritium water is converted to free water tritium (FWT), which behaves as normal water (H₂O) keeping the form of tritium water to organically bound tritium (OBT), a part of which is ingested into the tissue. OBT remains in the body longer and has greater exposure effects than FWT, so ICRP sets its effective dose factor of ingestion of OBT separately from tritium water. FWT is a name representing behavior in the body, but it is the same as tritium water, so it is written as HTO in this document.

III-1. Disposition of tritium

effective dose factors for tritium as follows.

According to the model of ICRP Publication 56[III-1], about 3% of tritiated water (HTO) taken into the body changes into OBT and remains in the body longer than HTO. The half-life of HTO in the body is about 10 days, while that of OBT is about 40 days. (Figure III-1) On the other hand, when tritium is taken into the body as OBT, 50% is assumed to be immediately converted to HTO in the blood. With the half-life mentioned above, each of OBT and HTO is eventually excreted from the blood as HTO. (Figure III-2) Based on such a pharmacokinetic model in the body, ICRP Publication 72 [III-2] sets the

Tritiated water (HTO)
 Organically bound tritium (OBT)
 1.8E-11 Sv/Bq
 4.2E-11 Sv/Bq

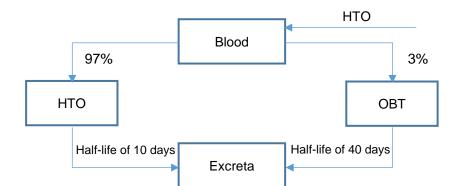


Figure III-1ICRP model for ingestion of tritiated water (HTO)

(Source: Annex C [III-3] of UNSCEAR2016)

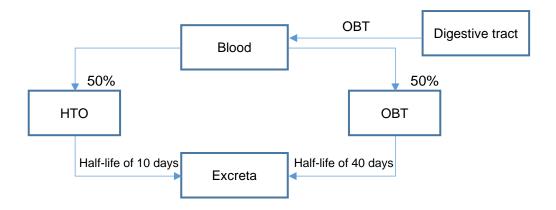


Figure III-2 ICRP model for ingestion of OBT

(Source: Annex C of UNSCEAR2016)

The ICRP Publication 134 [III-4] provides a new pharmacokinetic model that incorporates OBT with a biological half-life of about 40 days and OBT with a biological half-life of about 1 year, which remains in the body for a more extended period. (Figures III-3 and III-4) The effective dose factors based on this model are higher than those presented in ICRP Publication 72, as shown below. Even so, calculating exposures using those factors does not significantly affect the exposure assessment results.

Tritiated water (HTO)

1.9E-11 Sv/Bq

Organically bound tritium (OBT)

5.1E-11 Sv/Bq

The model predicts that about 6% of total tritium in the body will be OBT if HTO is ingested continuously.

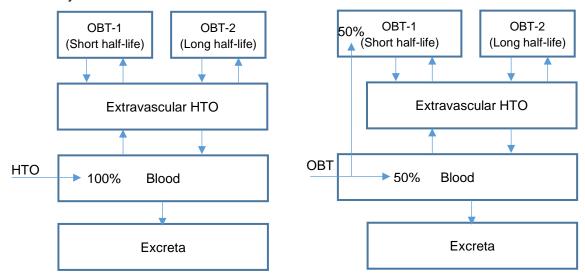


Figure III-3 New ICRP model for ingestion of HTO Figure III-4 New ICRP model for ingestion of OBT

(Source: Annex C of UNSCEAR2016)

(Source: Annex C of UNSCEAR2016)

III-2. Impact of ingestion of OBT on the exposure assessment

ALPS is equipped with coprecipitation, adsorption, and physical filters, etc., which are used to eliminate the 62 nuclides subject to removal regardless of their chemical forms. None of the past analysis results shows the inclusion of a lot of organic matters (See Attachment II "Water quality of ALPS treated water, etc."). Therefore, all tritium contained in ALPS treated water was assumed to be HTO in the assessment of internal exposure by drinking and ingestion of seawater spray without considering OBT.

On the other hand, a part of HTO is converted to OBT in animals and vegetables in the environment, so a part of the tritium ingested as seafood is considered to be OBT. However, since no concentration in the environment that changes the isotopic ratio between tritium and hydrogen is seen, and water accounts for about 70 to 90% of seafood, it is considered that OBT does not change the tritium concentration in seafood significantly.

The effective dose factor DC_{correction} can be represented by the following formula where the effective dose factor of ingestion of HTO is DC_{FWT}, that of ingestion of OBT is DC_{OBT}, and the ratio of OBT to the ingested tritium is X%.

$$DC_{correction} = (1-X/100) \cdot DC_{FWT} + X/100 \cdot DC_{OBT}$$
 (III-1)

Table III-1 shows the effective dose factor corrected by the formula (III-1). In this report, the calculation was made with the percentage of OBT as 10% in the assessment of internal exposure from ingestion of seafood.

Table III-1 Effective dose factor corrected by the percentage of OBT in tritium

ingested from seafood

Percentage of	Effective dose factor (mSv/Bq)			Remarks
OBT of seafood (%)	Adult	Children under school age	Infants	
0	1.8E-08	3.1E-08	6.4E-08	
10	2.0E-08	3.5E-08	7.0E-08	Used for the assessment
20	2.3E-08	3.9E-08	7.5E-08	
100	4.2E-08	7.3E-08	1.2E-07	

III-3. OBT of marine plants and animals

For the isotopic ratio between HTO and OBT in the environment, the result of monitoring performed around the La Hague reprocessing plant in France is shown (Figure III-5) [III-5]. The isotopic ratio is the same in any species including fish and seaweed, so no trend of concentration has been observed.

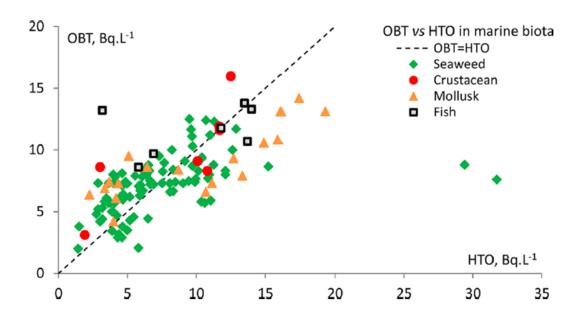


Figure III-5 Investigation result of the OBT and HTO concentrations in marine plants and animals performed in the sea area around the La Hague reprocessing plant

In our monitoring of fish continued since 2014 around the Fukushima Daiichi Nuclear Power Station, OBT has never been observed in the 83 samples measured so far.

References

- [III-1] ICRP Publication 56 "Age-dependent Doses to Members of the Public from Intake of Radionuclides Part1",1989
- [III-2] ICRP Publication 72 " Age-dependent Doses to the Members of the Public from Intake of Radionuclides - Part 5 Compilation of Ingestion and Inhalation Coefficients",1995
- [III-3] UNSCEAR 2016 Report "SOURCES, EFFECTS AND RISKS OF IONIZING RADIATION UNSCEAR 2016 Report ANNEX C BIOLOGICAL EFFECTS OF SELECTED INTERNAL EMITTERS TRITIUM",2017
- [III-4] ICRP Publication 134 "Occupational Intakes of Radionuclides: Part 2",2016
- [III-5] Bruno Fiévet, Julien Pommier, Claire Voiseux, Pascal Bailly du Bois, Philippe Laguionie, Catherine Cossonnet, and Luc Solier "Transfer of Tritium Released into the Marine Environment by French Nuclear Facilities Bordering the English Channel",2013

Attachment IV Analysis on the period of discharge of ALPS treated water

At the FDNPS, it is planned to secure the site necessary for decommissioning based on the "Mid- and Long-term Roadmap toward Decommissioning of the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc." and the "Reduction Target Map of Mid-term Risks of TEPCO Fukushima Daiichi NPS" by installing facilities for dilution and discharge of ALPS treated water and related facilities to discharge ALPS treated water stored in the tanks.

The following shows that the site necessary for decommissioning can be secured by discharging ALPS treated water and reducing the tanks according to the plan, using the ALPS treated water discharge simulation.

IV-1. Prerequisites for ALPS treated water discharge simulation

The following describes the simulation period, the specifications of the dilution and discharge facilities, and the conditions regarding the ALPS treated water to be discharged as the prerequisites of ALPS treated water discharge simulation.

The unit of the simulation period shall be one year from FY 2021¹; discharge is to be started in FY 2023 and discharge is to be completed in FY 2051².

As the specifications of the dilution and discharge facilities, the flow rate of ALPS treated water is assumed to be up to 500m³/day and the annual operating rate 80% (292 days of discharge). The seawater flow rate is assumed to be 170 to 510 thousand m³/day with 1 to 3 seawater pumps assumed to be in operation.

As conditions regarding ALPS treated water to be discharged, the upper limit of the annual discharge amount of tritium is assumed to be 22 TBq. The tank capacity in each fiscal year shall be a constraint condition because the purpose of discharge of ALPS treated water into the sea is to secure the site necessary for decommissioning. In addition, tritium is a radioactive material of which half-life is about 12 years, so the annual reduction amount is assumed to be about 5.5%. It is planned to discharge a small amount in the early stage of discharge so the annual discharge amount of tritium of FY 2023 is set to half of that of FY 2024.

In addition, the ALPS treated water to be discharged in the future includes "(A) ALPS treated water to be generated daily" and "(B) ALPS treated water, etc., stored in the tanks." As the discharge order of the water, it is assumed that about 30 thousand m³ of "ALPS treated water stored in the tank" in the K4 tanks used as facilities for measurement and confirmation will be discharged and then "ALPS treated water to be generated daily" and "ALPS treated water

¹ The business year in Japan starts on April 1st and ends on March 31st of the following year.

² In the Mid- and Long-term Roadmap, the goal is set to the completion of decommissioning 30 to 40 years after December 2011, in which the discharge of radioactive materials was managed and the radiation dose was greatly inhibited.

stored in the tank" will be discharged in ascending order of the tritium concentration. Discharge of "ALPS treated water to be generated daily" is to be continued as long as it is generated until the total amount of tritium in the building becomes 0. In doing so, the generation amount of contaminated water is assumed to decrease 10m³/day every year step by step so that the daily generation amount of "ALPS treated water to be generated daily" will become 100m³/day after 2025.

Table IV-1 Prerequisites for ALPS treated water discharge simulation

Table 19-1 Prefequisites for ALFO treated water discharge simulation					
Annual release of tritium (Less than 22 TBq/year)	Set the total amount of discharge so that discharge into the sea will be completed in FY 2051 to the extent that it will not affect the site utilization plan				
Simulation assessment start date	April 1, 2021 (simulation by year)				
Discharge start date	April 1, 2023				
ALPS treated water flow rate	Up to 500 m³/day				
Seawater flow rate for dilution	170 thousand m³/day (1 seawater pump) to 510 thousand m³/day (3 seawater pumps)				
ALPS treated water discharge order	About 30 thousand m ³ of water in the K4 tank used as facilities for measurement and confirmation will be discharged in ascending order of the tritium concentration After that, the water in the other tanks and the newly generated ALPS treated water will also be discharged in ascending order of the tritium concentration				
Tritium decay	The half-life is considered to be about 12 years (decrease by about 5.5% in 1 year) and decay is considered for newly generation one as well				
ALPS treated water generation amount	The generation amount of contaminated water is assumed to decrease 10m³/day every year step by step so that it will become 100m³/day after FY 2025				
Number of days of discharge	292 days (Operating rate: 80%)				

"ALPS treated water to be generated daily" will be generated in the future and is highly uncertain, so the assessment was performed in two cases: cases with the largest and smallest total amounts of tritium, respectively. In the case with the largest total amount of tritium, it is assumed that the concentration of newly generated tritium is the largest value, 448 thousand Bq/L, between January and June 2021 and the total amount of tritium in the building is about 1150 TBq assuming that the whole of 3400 TBq remain in the building or tanks at the time of the accident. In the case with the smallest total amount of tritium, it is assumed that the concentration of newly generated tritium is the smallest value, 215 thousand Bq/L, between January and June 2021 and the total amount of tritium in the building estimated from the stagnant water storage amount and concentration in the building is about 81 TBq.

Table IV-2 Assessment case of ALPS treated water discharge simulation

Case	Case with the largest total amount of tritium Case with the smallest total amount of tritium		
Concentration of newly generated tritium	448 thousand Bq/L (January 5, 2021, Largest in 2021)	215 thousand Bq/L (June 1, 2021, Smallest in 2021)	
Total amount of tritium in the building (As of April 1, 2021)	About 1150 TBq (At the time of the accident, the whole of 3400 TBq remained in the building and tanks)	About 81 TBq (Estimated from the stagnant water storage amount and concentration in the building)	

Based on these prerequisites, we assessed the minimum value of the annual tritium discharge amount of every year, the water storage amount of ALPS treated water, etc., the average flow rate of ALPS treated water, and the average tritium concentration before and after seawater dilution.

IV-2. ALPS treated water discharge simulation result

For each case, we changed the annual total tritium charge amount not to affect the site usage plan and assessed the total discharge amount, with which discharge into the sea will be assessed in FY 2051. As a result, it was verified that the maximum and minimum annual tritium discharge amounts of the case with the largest and smallest total tritium amount are up to 22 and 16 TBq, respectively, and discharge will be completed by FY 2051 with the annual amount below 22 TBq in both cases.

The annual tritium discharge amount of each fiscal year was 11 TBq/year in FY 2023, 22 TBq/year between FY 2024 and FY 2029, 18 TBq/year between FY 2030 and FY 2032, and 16 TBq/year in and after FY 2033 in the case with the largest total tritium amount. On the other hand, it was 8 TBq/year in FY 2023, 16 TBq/year between FY 2024 and FY 2028, and 11 TBq/year in and after FY 2029 in the case with the smallest total tritium amount.

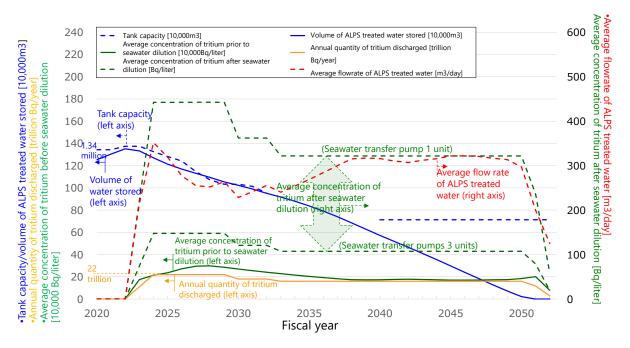


Figure IV-1 Case with the largest total amount of tritium

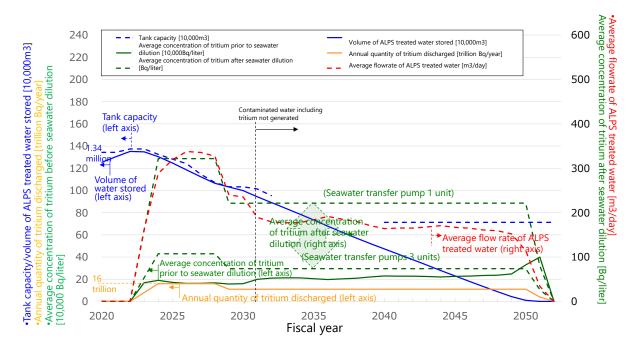


Figure IV-2 Case with the smallest total amount of tritium

Attachment V Impacts of intake and discharge of diluted water on outside For discharge of ALPS treated water, the concentration of tritium, which is difficult to remove, is diluted with seawater 100 or more times until it becomes less than 1,500Bq/L, which is much lower than that specified in laws and regulations, before discharge. The seawater for diluting the ALPS treated water is planned to be taken from the unit 5 intake. However, regarding the seawater concentration within the port, the concentration of radioactive materials is slightly higher than that of the seawater in the surrounding sea area. Considering this point, as well as the impact of the seabed soil within the port, the seawater will be drawn from the north side of the unit 5/6 discharge outlet in the plan.

V-1. State of the concentration in seawater in the port

The current state of Cs-137 concentration in the port is shown in Figure V-1. The concentration near the water intake of units 1 to 4 is high, and it becomes lower as measurement points are away from the water intake of units 1 to 4 toward the port outlet or units 5/6.

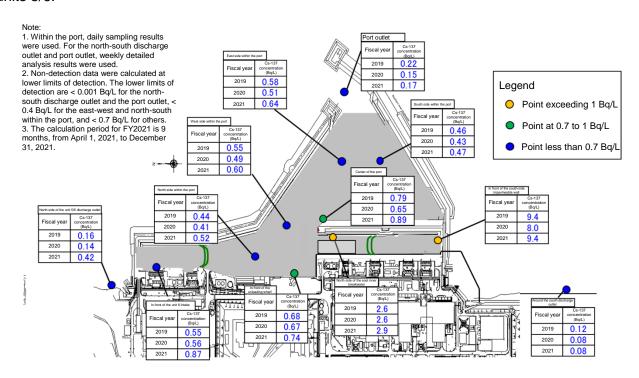


Figure V-1 State of the Cs-137 concentration in the port

V-2. Assumed impacts of intake and discharge of seawater for dilution on outside and countermeasures

As shown in V-1., the radioactive material concentration in seawater in the port tends to be high near units 1 - 4 intake. Seawater for dilution is planned to be taken from near the unit 5 intake and seawater with high concentration may be drawn from the unit 1 - 4 intake open-channel to the unit 5/6 side.

As a countermeasure in the installation of intake facilities, a unit 5/6 intake open-channel will be separated with a partition weir (riprap sloping weir + sheet) for prevention of inflow of seawater from the units 1 - 4 side, and instead a part of the north breakwater permeation prevention work will be remodeled so that the seawater for dilution is taken in from outside the port. (Figure V-2)

As a result, the concentration of radioactive materials in seawater in the unit 5/6 intake openchannel may decrease. In contrast, the concentration around the unloading wharf, where diffusion to the unit 5/6 intake channel will be restricted, may slightly increase, but the impact of intake and discharge of seawater for dilution on outside is considered to be inhibited.

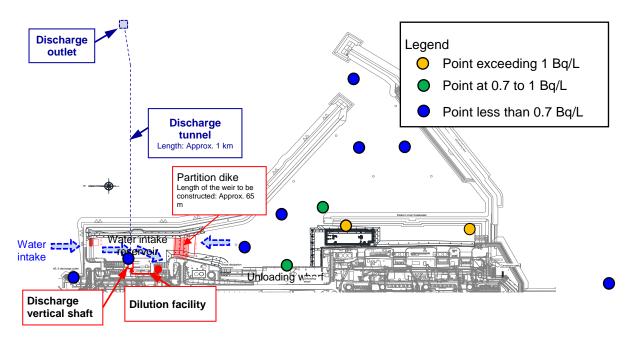


Figure V-2 Intake and discharge plan and state of the Cs-137 concentration in the port

- V-3. Assessment of the impacts of intake and discharge of seawater for dilution on outside To verify the effect of the countermeasure, external effects were compared and assessed in cases where seawater inside the port (area on the side of units 1 to 4) is taken in and where seawater outside the port (north side of the unit 5/6 discharge outlet) is taken in. The assessment was performed by adding the movement amount of the radioactive materials that move to outside the port with seawater for dilution to the source term in the human exposure assessment of discharge of ALPS treated water.
- (1) Setting of the movement amount of the radioactive materials added to the source term Concentrations of seawater for dilution used for comparison and assessment are set based on the monitoring results (for about 3 years from FY 2019). The water taken from the outside of the port was on the north of the unit 5/6 discharge outlet, and the water taken within the port was north side within the port. (Figure V-3)

The target nuclides are Cs-137, Sr-90, and tritium whose presence in the seawater in the port was verified and which are subject to monitoring (For Cs-137 and Sr-90, the progeny nuclides, Ba-137 and Y-90, are assumed to be contained at the same concentration in the equilibrium state).

The minimum detection limits differ between the port and outside the port (it is higher within the port). Based on this, there is a possibility that the Cs-137 and tritium on the north side within the port are overestimated, but it is clear that the concentrations on the north side of the unit 5/6 discharge outlet are lower.

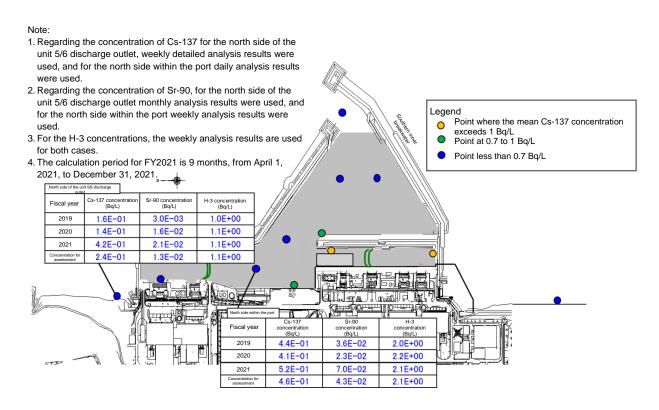


Figure V-3 Radioactive material concentration of seawater for dilution used for comparison and assessment

The movement amount M(i) of nuclide i, which is a radioactive material included in seawater for dilution (if three seawater pumps for dilution are in operation) and moving to outside the port, was calculated from the concentration in seawater for diluted water, $C_D(i)$, set above by the following equation:

M(i) [Bq/year] = $C_D(i)$ [Bq/L] × 510,000 [m³/day] × 1000 [L/m³] × 365 [day/year] × 0.8 (availability rate)

Two types of source terms were used for the assessment: "measured values of the K4 tank group" and "measured values of the J1-G tank group" used for radiological impact assessment. The amount of added radioactivity transferred is shown in Table V-1.

Table V-1 Annual amount of radioactivity transferred by nuclide of seawater for dilution

		outside the port unit 5/6 discharge let)	Water intake inside the port (North side within the port)		
	Concentration	Volume to be	Concentration	Volume to be	
	for assessment	transferred	for assessment	transferred	
Nuclide	(Bq/L)	(Bq/year)	(Bq/L)	(Bq/year)	
Cs-137	2.4E-01	3.6E+10	4.6E-01	6.9E+10	
Sr-90	1.3E-02	1.9E+09	4.3E-02	6.4E+09	
H-3	1.1E+00	1.6E+11	2.1E+00	3.1E+11	

(2) Study results

The results of the exposure assessment are shown in Tables V-2 and V-3. Water intake outside the port has fewer impacts on the external exposures.

However, the results in both assessments are more minor compared with the dose limit of 1 mSv/year and the target dose for domestic nuclear power plant of 0.05 mSv/year, which is corresponding to the dose constraint. Even if seawater inside the port is taken in for dilution, the impact of radiation exposure is more minor.

Table V-2 Comparison of the exposure assessment results of representative persons (Large amount of ingestion of seafood)

		Source term of the K4 tank group based on measured values		Source term of the J1-G tank group based on measured values				
Assess	ed case	Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Remarks
	Sea surface	7.6E-10	6.8E-08	1.3E-07	4.8E-10	6.8E-08	1.3E-07	
External	Hull	7.2E-10	5.4E-08	1.0E-07	4.6E-10	5.4E-08	1.0E-07	
exposure	During swimming	5.2E-10	4.7E-08	9.0E-08	3.2E-10	4.7E-08	9.0E-08	
(mSv/year)	Beach sand	9.1E-07	8.7E-05	1.7E-04	5.6E-07	8.6E-05	1.7E-04	
	Fishing net	1.8E-07	1.6E-05	3.0E-05	1.1E-07	1.5E-05	3.0E-05	
Internal	Ingestion of water	3.3E-07	7.3E-07	1.2E-06	3.1E-07	7.2E-07	1.2E-06	Value of an adult
exposure	Inhalation of spray	9.1E-08	4.1E-07	7.8E-07	3.8E-07	7.0E-07	1.1E-06	
(mSv/year)	Ingestion of seafood	2.0E-05	3.1E-05	4.2E-05	9.0E-06	2.0E-05	3.0E-05	
To	otal	2E-05	1E-04	2E-04	1E-05	1E-04	2E-04	

Table V-3 Results of internal exposures assessment by age (Large amount of ingestion of seafood)

Assessed case		Source term of the K4 tank group based on measured values			Source term of the J1-G tank group based on measured values			
		Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Exposure assessment under normal conditions	Water intake outside the port (North side of the unit 5/6 discharge outlet)	Water intake inside the port (North side within the port)	Remarks
Internal exposure from ingestion of water (mSv/year)	Adult	3.3E-07	7.3E-07	1.2E-06	3.1E-07	7.2E-07	1.2E-06	
	Child under school year	5.7E-07	9.2E-07	1.4E-06	5.4E-07	8.7E-07	1.3E-06	
	Infant	1	_	_	_	_	_	
Internal exposure from inhalation of spray (mSv/year)	Adult	9.1E-08	4.1E-07	7.8E-07	3.8E-07	7.0E-07	1.1E-06	
	Child under school year	6.0E-08	2.8E-07	5.4E-07	2.1E-07	4.3E-07	6.8E-07	
	Infant	3.9E-08	1.5E-07	2.8E-07	1.1E-07	2.2E-07	3.6E-07	
Internal exposure from ingestion of seafood (mSv/year)	Adult	2.0E-05	3.1E-05	4.2E-05	9.0E-06	2.0E-05	3.0E-05	
	Child under school year	2.0E-05	2.4E-05	2.8E-05	9.9E-06	1.4E-05	1.8E-05	
	Infant	1.2E-05	1.6E-05	2.0E-05	1.1E-05	1.5E-05	1.8E-05	

Attachment VI Transfer pathways and exposure pathways other than the assessment targets

The Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (design stage) (November 2021, hereinafter called "the first report") refers to "Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities" approved by the former Nuclear Safety Commission, which had been formulating the domestic safety guidelines, (hereinafter called "Dose Assessment of Light Water Reactor") and the Application for the Designation of Reprocessing Business of Rokkasho Plant, (hereinafter called "Rokkasho Application") which is a precedent case, in the selection of the migration and exposure pathways, as well as using IAEA GSG-10 as a reference. In "Dose Assessment of Light Water Reactor," case studies of potentially important exposure pathways are performed as the examination of the basic concept of the dose assessment to the public in the safety review of reactor facilities for power generation, and the following pathways are simulated as the dose assessment with the radioactive materials in liquid waste.

- (1) External exposure during work at sea
- (2) External exposure during swimming
- (3) External exposure during work at a beach
- (4) External exposure during fishing operation
- (5) Internal exposure from ingestion of seafood

As a result of the simulation, internal exposure from ingestion of seafood is considered to be the most important form of exposure from intake of liquid waste.

On the other hand, the following exposure pathways were assessed and reviewed in the Rokkasho Application.

- (1) External exposure from sea surface
- (2) External exposure from hulls
- (3) External exposure during underwater work
- (4) External exposure from fishing nets
- (5) Internal exposure from ingestion of seafood

External exposure during work at a beach was not selected because there is no beach in the vicinity. In the original report, migration and exposure pathways were first selected based on these documents.

On the other hand, IAEA GSG-10 shows pathways to be considered for transfer and exposure pathways. The Radiological Impact Assessment Report Regarding the Discharge of ALPS Treated Water into the Sea (Design stage / Revised version) (April 2022, hereinafter referred to as the "Revised Report") These transfer pathways and exposure pathways were examined again from the viewpoint of the comprehensiveness of the pathways, and after the simulation of the exposure dose, the additional pathways were examined from the viewpoint of the scale and comprehensiveness of exposure.

Specifically, the transfer and exposure pathways described in the IAEA-TECDOC-1759 [VI-1] (radiological assessment procedures for determining the suitability of materials for sea dumping) were assessed using the assessment method shown in this document and compared with the exposure assessment results in the first report, and studied on needs of immigration and addition of exposure pathway. The exposure pathway of drinking water while swimming and inhalation of water spray at the beach were added.

In this revision, since the nuclides to be measured and assessed in ALPS treated water were selected, we compared the results of the assessment in the main text using the re-selected source terms with the assessment using the TECDOC-1759 methodology.

VI-1. Comparative assessment by the method of TECDOC -1759

VI-1-1. Source term

Since nuclides with large exposure impacts differ depending on the exposure assessment method and pathway, the source term based on the measured values including all the 31 nuclides was used.

VI-1-2. Modeling of diffusion and transfer in the environment

The following migration pathways were selected in accordance with the pathways shown by IAEA in GSG-10.

(1) Direct radiation

The radioactive materials handled in the disposal of ALPS treated water is limited to ALPS treated water or diluted ALPS treated water. ALPS treated water is water purified in advance until the sum of the ratios to regulatory concentrations limits of the radioactive materials other than tritium becomes less than 1. Therefore, it was not selected as a migration pathway in the original report considering that there is almost no impact of exposure from ALPS treated water and the direct radiation from the facility.

Not selected in this assessment either.

- (2) Diffusion in air, and deposition from the atmosphere onto the ground surface and subsequent resuspension
 - Since ALPS treated water is diluted with seawater and discharged into the sea as liquid and further diluted in the sea before migration to air, it was not selected as a migration pathway in the original report considering that there is almost no impact of exposure from the radioactive materials diffused into the air.

Not selected in this assessment either.

(3) Advection and diffusion in seawater

Since ALPS treated water is discharged into the sea as liquid, advection and diffusion in seawater were selected in the original report.

Selected in this assessment as well.

(4) Migration from seawater to hulls

Radioactive materials diffused in seawater may migrate to the hulls of ships continuously operating in the surrounding sea area, so it was selected as a migration pathway in the original report.

In TECDOC-1759, no example of a pathway or calculation method is exemplified, so it is not subject to simulation in this assessment.

(5) Migration from seawater to coastal sediment

Since radioactive materials advected and diffused in seawater may migrate to coastal sediment, it was selected as a migration pathway in the original report. In TECDOC-1759, examples of a pathway and a calculation method are also exemplified, so it was also selected in this assessment.

(6) Migration from seawater to suspended particles and seabed sediment Radioactive materials advected and diffused in seawater are partly adsorbed by suspended particles and seabed sediment, and the concentration in seawater decreases due to the migration. On the other hand, radioactive materials accumulate in seabed sediment, and the concentration in seawater and the concentration in seabed sediment will reach equilibrium in the long term. In the original report, it was not conservatively considered in the stage of advection or diffusion and it was considered that the equilibrium state was achieved with the distribution factor with seabed sediment in the exposure assessment of marine plants and animals.

In TECDOC-1759, an example of a calculation method was exemplified with a model of discharged radioactive materials migrating from seawater to suspended particles and seabed sediment, so it was also selected in this assessment.

(7) Migration from seawater to fishing nets

Radioactive materials advected and diffused in seawater may migrate to fishing nets used in seawater. Since it was assessed in the domestic precedent case, it was selected in the original report.

In TECDOC-1759, no example of a pathway or calculation method is shown, so it was not selected in this assessment.

(8) Migration from seawater to the atmosphere

Since ALPS treated water was diluted with seawater as liquid before being discharged into the sea and diluted in the sea before migration to air, it was not selected as a migration pathway in the first report considering that there is almost no impact of exposure from the radioactive materials diffused from seawater to air. In TECDOC-1759, examples of a transfer pathway as spray from seawater and a calculation method are exemplified, so it was selected as a pathway.

As a result of this review, it was added as a transition/exposure pathway in the revised report.

(9) Migration from coastal sediment to air

Since only a small amount of coastal sediment migrates to the air, and it remains on the seashore for only a short time, so the exposure impact was negligible and it was not selected as a transfer pathway in the first report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was selected as a pathway.

As a result of this review, it was added as a transition/exposure pathway in the revised report.

(10) Migration from seawater to seafood

Migration (concentration) from seawater to seafood is widely known and has been assessed in domestic precedent cases including light water reactors, so it was selected in the first report.

In TECDOC-1759, examples of a pathway and a calculation method are exemplified, so it was also selected as a pathway.

Though the diffusion simulation uses the same calculation result as that of the first report, in TECDOC-1759, the dissolved concentration $C_{\text{DW}}(j)$ is calculated considering the suspended particle concentration and migration to seabed sediment from the equilibrium concentration $C_{\text{BOX}}(j)$ of nuclide j calculated from the annual discharge amount of the nuclides discharged into the calculation area and the amount of seawater which passes through the calculation area by the following equation:

$$C_{\text{DW}}(j) = \frac{C_{\text{BOX}}(j)}{1 + K_{\text{d}}(j)(S + \frac{L_{\text{B}}\rho_{\text{B}}}{D})}$$
(VI-1)

where

Kd(j) is the sediment partition factor of radionuclide j (m³/kg)

- S is the suspended sediment concentration (kg/m³), 3E-03 kg/m³ is used
- L_B is the thickness of the sediment boundary layer (m), 1E-02 m is used
- ρ_B is the density of the sediment boundary layer (kg/m³), 1500 kg/m³ is used
- D is the water depth of the model (m), A water depth of 12 m, the depth of the discharge point, is used

The mass density $C_p(j)$ (Bq/kg) of the suspended particles was obtained by the following equation:

$$C_{P}(j)=K_{d}(j)C_{DW}(j) \tag{VI-2}$$

The total concentration in seawater $C_w(j)$ of dissolved and suspended particles was obtained by the following equation:

$$C_W(j)=(1+K_d(j)S) C_{DW}(j)$$
 (VI-3)

VI-1-3. Identification of exposure pathways

The following exposure pathways were simulated from the pathways and calculation methods shown in TECDOC-1759.

- · External exposure from beach sand
- · Internal exposure from accidental ingestion of coastal sediment
- Internal exposure from accidental ingestion of seawater
- · Internal exposure from accidental inhalation of dispersed coastal sediment
- Internal exposure from inhalation of seawater spray
- · Internal exposure from ingestion of seafood
- Exposure due to skin contamination

The calculation method is as follows:

(1) External exposure from beach sand

The external exposure from nuclide migrated to beaches $E_{\text{ext,shore,public}}(Sv)$ is calculated by the following equation:

$$\mathsf{E}_{\mathsf{ext},\mathsf{shore},\mathsf{public}} = \mathsf{t}_{\mathsf{public}} \sum_{\mathbf{j}} \mathsf{C}_{\mathsf{S}}(\mathbf{j}) \mathsf{D} \mathsf{C}_{\mathsf{gr}}(\mathbf{j}) \tag{VI-4}$$

$$Cs(j) = \frac{C_P(j)\rho_S d_S}{10}$$
 (VI-5)

where

t_{public} is the time spent at the beach (h)

- DC_{gr}(j) is the dose conversion factor for ground contamination of radionuclide j ((Sv/h)/(Bq/m²)); Dose conversion factors for ground surface contamination specified in the latest FGR 15[VI-2] prepared by the United States Environmental Protection Agency were used (See in Table VI -1).
- $C_s(j)$ is the surface contamination density of radionuclide j in the shore sediments (in Bq/m^2)
- ρ_s is the density of coastal sediment (kg/m³), 1.5 E + 03 kg/m³ is used

- d_s is the effective thickness of coastal sediment (m), 0.1 m is used The activity concentration radionuclide j in suspended particles $C_p(j)$ (Bq/kg-dry weight) is calculated by equation (VI-2).
- (2) Internal exposure from accidental ingestion of coastal sediment

 The internal exposure from accidental ingestion of coastal sediment E_{ing, shore, public} (Sv) is
 calculated by the following equation:

$$\mathsf{E}_{\mathsf{ing},\mathsf{shore},\mathsf{public}} \mathsf{H}_{\mathsf{shore}} \sum_{j} \frac{\mathsf{C}_{\mathsf{S}}(\mathsf{j})}{\mathsf{o}_{\mathsf{s}} \mathsf{L}_{\mathsf{B}}} \mathsf{DC}_{\mathsf{ing}}(\mathsf{j}) \tag{VI-6}$$

where

t_{public} is the time spent at the beach (h)

H_{shore} is the hourly ingestion rate of beach sediment (kg/h), 5.0E-06kg/h, the recommended value of TECDOC-1759, is used

 $C_s(j)$ is the surface contamination density of radionuclide j in the shore sediments (Bq/m²)

 ρ_s is the density of coastal sediment (kg/m³), 1.5 E + 03 kg/m³ is used

d_s is the effective thickness of coastal sediment (m), 0.1 m is used

DC_{ing}(j) is the effective dose (Sv/Bq) [VI-3] per unit intake by ingestion of radionuclide j (See Table VI -2).

(3) Internal exposure from ingestion of seawater

The internal exposure from accidental drinking of seawater during swimming on the seashore E_{drink,public} (Sv) is calculated by the following equation:

$$\mathsf{E}_{\mathsf{drink},\mathsf{public}} = \mathsf{t}_{\mathsf{public}} \mathsf{H}_{\mathsf{swim}} \sum_{j} \mathsf{C}_{\mathsf{w}}(\mathsf{j}) \, \mathsf{DC}_{\mathsf{ing}}(\mathsf{j}) \tag{VI-7}$$

where

t_{public} is the time spent while swimming (h)

H_{swim} is the intake rate of seawater during swimming (L/h); conservatively, 0.2L/h is used.

C_w(j) is the concentration of nuclide j in the seawater calculated by equation (VI-3) (Bq/m³);

DC_{ing}(j) is the effective dose (Sv/Bq) [VI-3] per unit intake by ingestion of radionuclide j (See Table VI -2).

(4) Internal exposure from accidental inhalation of dispersed coastal sediment The internal exposure from inhalation of dispersed coastal sediment on the shore E_{inh,shore,public} (Sv) is calculated by the following equation:

$$\mathsf{E}_{\mathsf{inh},\mathsf{shore},\mathsf{public}} = \mathsf{t}_{\mathsf{public}} \mathsf{R}_{\mathsf{inh},\mathsf{public}} \mathsf{DL}_{\mathsf{shore}} \sum_{i} \mathsf{C}_{\mathsf{n}}(j) \mathsf{DC}_{\mathsf{inh}}(j) \tag{VI-8}$$

where

t_{public} is the time spent at the beach (h)

R_{inh, public}is the inhalation rate of a member of the public in m³/h, the recommended value of TECDOC-1759 (0.92m³/h for adults) is used

DL_{shore} is the load factor (kg/m³) for dust from coastal sediment, 2.5E-09 kg/m³, the recommended value of TECDOC-1759, is used

DC_{inh}(j) is the effective dose (Sv/Bq) per unit intake by inhalation of radionuclide j (See in Table VI -3).

The concentration of radionuclides in sediment $C_p(j)$ (Bq/kg) can be calculated by equation (VI-2).

(5) Internal exposure from inhalation of seawater spray The internal exposure from seawater spray caused by wave, etc., on the shore E_{inh.spray.public} (Sv) is calculated by the following equation:

$$\mathsf{E}_{\mathsf{inh},\mathsf{spray},\mathsf{public}} = \mathsf{t}_{\mathsf{public}} \cdot \mathsf{R}_{\mathsf{inh},\mathsf{public}} \frac{\mathsf{c}_{\mathsf{spray}}}{\rho_{\mathsf{w}}} \sum_{j} \mathsf{C}_{\mathsf{w}}(\mathsf{j}) \mathsf{D} \mathsf{C}_{\mathsf{inh}}(\mathsf{j}) \tag{VI-9}$$

where

t_{public} is the time spent at the beach (h)

 $R_{inh,\;public}$ is the inhalation rate of a member of the public (m³/h), the recommended value (0.92 m³/h for adults) is used

C_{spray} is the concentration of seawater spray in the air (kg/m³), 1.0E-02kg/m³, the recommended value of TECDOC-1759, is used

 ρ_w is the density of seawater (kg/m³), 1E+03 kg/m³ is used

C_w(j) is the concentration of radionuclide j in the seawater (Bq/m³)

DC_{inh}(j) is the effective dose per unit intake by inhalation (Sv/Bq) (See Table VI - 3).

(6) Internal exposure from ingestion of seafood

The internal exposure from ingestion of seafood $E_{ing,food,public}$ (Sv) is calculated by the following equation:

$$\mathsf{E}_{\mathsf{ing},\mathsf{food},\mathsf{public}} = \sum_{k} \mathsf{H}_{\mathsf{B}}(\mathsf{k}) \sum_{\mathsf{j}} \mathsf{C}_{\mathsf{EB}}(\mathsf{j},\mathsf{k}) \mathsf{D} \mathsf{C}_{\mathsf{ing}}(\mathsf{j}) \tag{VI-10}$$

where

 $H_B(k)$ is the annual ingestion of seafood k (kg)

DC_{ing}(j) is the effective dose per unit intake by ingestion of radionuclide j (Sv/Bq) (See Table VI -2).

C_{EB}(j,k) is the concentration of nuclide j in the edible part of seafood k and calculated by the following equation:

$$C_{EB}(j,k) = CF(j,k)C_{DW}(j) \cdot 1E-03 \tag{VI-11}$$

where

CF(j,k) is the concentration factor for nuclide j of seafood k ((Bq/kg)/(Bq/L)).

C_{DW}(j) is the dissolved concentration of radionuclide j in the seawater (Bq/m³) and is calculated by equation (VI-1). 1E-03 is unit conversion (m³/L)

(7) Exposure of the skin from sea seabed sediment settled on the skin Exposure from sea seabed sediment that is adhered to fishing nets during fishing operation and settled on the skin was simulated and the skin effective dose E_{skin}(Sv) is calculated by the following equation:

$$\mathsf{E}_{\mathsf{skin}} = 0.01 \mathsf{t}_{\mathsf{public}} \sum_{\mathbf{j}} \mathsf{S}_d \; \mathsf{DC}_{\mathsf{skin}}(\mathbf{j}) / 8760 \tag{VI-12}$$

where

0.01 is the skin tissue loading factor.

t_{public} is the duration of exposure (h).

DC_{skin}(j) is the dose conversion factor for the skin ((Sv/y)/(Bq/cm²)) specified in IAEA SRS44[VI-4] (beta and gamma-ray emitting nuclides) (See Table VI - 4).

8760 is the unit conversion factor (h/y)

S_d is the surface contamination density (Bq/cm²) calculated by the following equation:

$$S_{d}=K_{d}(j)C_{DW}(j)\rho_{d} \qquad (VI-13)$$

where

- K_d(j) is the distribution factor of the nuclide j between seawater and sea seabed sediment ((Bq/kg)/(Bq/L))
- C_{DW}(j) is the concentration of nuclide j in seawater (Bq/L)
- ρ is the density of sea seabed sediment (kg/cm³), 1.5 E-03 kg/cm³ is used.
- d is the thickness of the sea seabed sediment settled on the skin (cm), 0.01 cm is used.
- VI-1-4. Setting of the representative person subject to the exposure assessment The features of representative persons subject to the exposure assessment were the same as 6-1-2.(4).
 - Engage in fishing 120 days (2,880 hours) a year, of which 80 days (1,920 hours) are spent near fishing nets.
 - Stay at the beach 500 hours a year and swim for 96 hours.
 - The ingestion of seafood is the intake of persons who consume a large amount of seafood. (Table VI-5)

Table VI-1 Dose conversion factor for the effective dose from radiation from beach sand (Source: U.S. EPA FGR15)

	beach sand (oodiec	<u>, </u>
Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m²))	Remarks
H-3	6.7E-22	
C-14	6.1E-19	
Mn-54	5.3E-16	
Co-60	1.5E-15	
Ni-63	8.0E-20	
Se-79	6.8E-19	
Sr-90	6.5E-18	
Y-90	1.5E-16	
Tc-99	2.0E-18	
Ru-106	1.7E-20	
Cd-113m	6.3E-18	
Sb-125	2.7E-16	
Te-125m	4.1E-18	
I-129	4.4E-18	
Cs-134	1.0E-15	
Cs-137	7.9E-18	
Ce-144	1.1E-17	
Pm-147	9.4E-19	
Sm-151	1.1E-19	
Eu-154	7.9E-16	
Eu-155	3.1E-17	
U-234	1.2E-15	
U-238	1.4E-15	
Np-237	1.8E-15	
Pu-238	2.1E-20	
Pu-239	4.2E-20	
Pu-240	2.2E-20	
Pu-241	1.7E-21	
Am-241	9.9E-18	
Cm-243	7.1E-17	
Cm-244	3.1E-20	

Table VI-2 Committed effective dose per unit intake for ingestion (Source: IAEA GSR-Part3)

(Source: IAEA GSR-Faits)						
	Effectiv	e dose factor ((Sv/Bq)			
Target Nuclide	Adult	Child under school age	Infant	Remarks		
H-3 (HTO)	1.8E-11	3.1E-11	6.4E-11	Used for the assessment of ingestion of water		
H-3 (considering				Used for the assessment of		
OBT)	2.0E-11	3.5E-11	7.0E-11	ingestion of seafood assuming that		
,				10% of tritium to be ingested is OBT		
C-14	5.8E-10	9.9E-10	1.4E-09			
Mn-54	7.1E-10	1.9E-09	5.4E-09			
Co-60	3.4E-09	1.7E-08	5.4E-08			
Ni-63	1.5E-10	4.6E-10	1.6E-09			
Se-79	2.9E-09	1.9E-08	4.1E-08			
Sr-90	2.8E-08	4.7E-08	2.3E-07	Including the impact of the progeny nuclide		
Y-90	2.7E-09	1.0E-08	3.1E-08			
Tc-99	6.4E-10	2.3E-09	1.0E-08			
Ru-106	7.0E-09	2.5E-08	8.4E-08			
Cd-113m	2.3E-08	3.9E-08	1.2E-07	Including the impact of the progeny nuclide		
Sb-125	1.1E-09	3.4E-09	1.1E-08			
Te-125m	8.7E-10	3.3E-09	1.3E-08			
I-129	1.1E-07	1.7E-07	1.8E-07			
Cs-134	1.9E-08	1.3E-08	2.6E-08			
Cs-137	1.3E-08	9.6E-09	2.1E-08	Including the impact of the progeny nuclide		
Ce-144	5.2E-09	1.9E-08	6.6E-08	Including the impact of the progeny nuclide		
Pm-147	2.6E-10	9.6E-10	3.6E-09			
Sm-151	9.8E-11	3.3E-10	1.5E-09	Independent intake is not considered because the half-life is short enough (about 30 seconds).		
Eu-154	2.0E-09	6.5E-09	2.5E-08			
Eu-155	3.2E-10	1.1E-09	4.3E-09			
U-234	4.9E-08	8.8E-08	3.7E-07			
U-238	4.5E-08	8.0E-08	3.4E-07			
Np-237	1.1E-07	1.4E-07	2.0E-06			
Pu-238	2.3E-07	3.1E-07	4.0E-06			
Pu-239	2.5E-07	3.3E-07	4.2E-06			
Pu-240	2.5E-07	3.3E-07	4.2E-06			
Pu-241	4.8E-09	5.5E-09	5.6E-08			
Am-241	2.0E-07	2.7E-07	3.7E-06			
Cm-243	1.5E-07	2.2E-07	3.2E-06			

	Effective dose factor (Sv/Bq)			
Target Nuclide	Adult	Child under school age	Infant	Remarks
Cm-244	1.2E-07	1.9E-07	2.9E-06	

Table VI-3 Committed effective dose per unit intake from inhalation (Source: IAEA GSR-Part3)

	Effectiv	e dose factor	(Sv/Bq)	
Target Nuclide	Adult	Child under school age	Infant	Remarks
H-3	1.8E-11	3.1E-11	6.4E-11	The conversion factor of tritium vapor is used
C-14	5.8E-09	1.1E-08	1.9E-08	
Mn-54	1.5E-09	3.8E-09	7.5E-09	
Co-60	3.1E-08	5.9E-08	9.2E-08	
Ni-63	1.3E-09	2.7E-09	4.8E-09	
Se-79	6.8E-09	1.3E-08	2.3E-08	
Sr-90	1.6E-07	2.7E-07	4.2E-07	Including the impact of the progeny nuclide
Y-90	1.5E-09	4.2E-09	1.3E-08	
Tc-99	1.3E-08	2.4E-08	4.1E-08	
Ru-106	6.6E-08	1.4E-07	2.6E-07	Including the impact of the progeny nuclide
Cd-113m	1.1E-07	1.8E-07	3.0E-07	
Sb-125	1.2E-08	2.4E-08	4.2E-08	
Te-123m	5.1E-09	9.8E-09	2.0E-08	
Te-125m	4.2E-09	7.8E-09	1.7E-08	
I-129	3.6E-08	6.1E-08	7.2E-08	
Cs-134	2.0E-08	4.1E-08	7.0E-08	
Cs-137	3.9E-08	7.0E-08	1.1E-07	Including the impact of the progeny nuclide
Ce-144	5.3E-08	1.4E-07	3.6E-07	Including the impact of the progeny nuclide
Pm-147	5.0E-09	1.1E-08	2.1E-08	
Sm-151	4.0E-09	6.7E-09	1.1E-08	
Eu-154	5.3E-08	9.7E-08	1.6E-07	
Eu-155	6.9E-09	1.4E-08	2.6E-08	
U-234	9.4E-06	1.9E-05	3.3E-05	
U-238	8.0E-06	1.6E-05	2.9E-05	
Np-237	5.0E-05	6.0E-05	9.8E-05	
Pu-238	1.1E-04	1.4E-04	2.0E-04	
Pu-239	1.2E-04	1.5E-04	2.1E-04	
Pu-240	1.2E-04	1.5E-04	2.1E-04	

	Effective dose factor (Sv/Bq)			
Target Nuclide	Adult	Child under school age	Infant	Remarks
Pu-241	2.3E-06	2.6E-06	2.8E-06	
Am-241	9.6E-05	1.2E-04	1.8E-04	
Cm-243	6.9E-05	9.5E-05	1.6E-04	
Cm-244	5.7E-05	8.3E-05	1.5E-04	

Table VI-4 Skin equivalent dose conversion factors (β and γ emitting nuclides)

Nuclide	Skin equivalent dose conversion factors ((Sv/year)/(Bq/cm²))	Remarks
H-3	0.0E+00	
C-14	7.9E-03	
Mn-54	5.3E-04	
Co-60	1.7E-02	
Ni-63	1.6E-04	
Se-79	1.0E-02	
Sr-90	4.5E-02	
Y-90	2.4E-02	
Tc-99	1.4E-02	
Ru-106	2.5E-02	
Cd-113m	2.0E-02	
Sb-125	1.8E-02	
Te-123m	2.0E-02	
Te-125m	2.6E-02	
Te-129m	3.7E-02	
I-129	5.8E-03	
Cs-134	1.7E-02	
Cs-137	2.2E-02	
Ce-144	3.9E-02	
Pm-147	1.1E-02	
Sm-151	2.5E-04	
Eu-154	3.1E-02	
Eu-155	7.6E-03	
U-234	3.7E-02	
U-238	3.7E-02	

Nuclide	Skin equivalent dose conversion factors ((Sv/year)/(Bq/cm²))	Remarks
Np-237	3.1E-02	
Pu-238	9.5E-04	
Pu-239	1.3E-05	
Pu-240	9.1E-07	
Pu-241	1.4E-08	
Am-241	6.3E-04	
Cm-243	1.7E-02	
Cm-244	1.9E-05	

Table VI-5 Intake of persons who consume a large amount of seafood (g/day)

	Fish	Invertebrate	Seaweeds
Adult	190	62	52
Children under school	97	31	26
Infants	39	12	10

VI-2. Exposure assessment result

The source terms of the following three cases were assessed by the assessment method of TECDOC-1759 and compared with the results in the body of the report.

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

The results of the comparison are shown in Table VI-6(1) to (3).

Regardless of the source term, none of the assessment results exceeded the exposure from the ingestion of seafood, fishing nets, and beach sand in the body of the report. However, because the exposure from ingestion of seawater and inhalation of seawater spray are larger than the exposure from sea surface, etc. described in the original report, it was decided to select them as additional pathways for this report as well.

Table VI-6(1) Comparison of the exposure assessment results by the source term of the K4 tank group

			Г	
Asse	ssed case	The body of the report	TECDOC-1759	Remarks
	Exposure from sea surface	7.6E-10	Not to be assessed	
	Exposure from hulls	7.2E-10	Not to be assessed	
External exposure	Exposure during swimming	5.2E-10	Not to be assessed	
(mSv/year)	Exposure from beach sand	9.1E-07	1.3E-07	In the assessment of the body of the report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.
	Exposure from fishing nets	1.8E-07	Not to be assessed	
	Ingestion of coastal sediment	Not to be assessed	6.2E-10	
Internal	Ingestion of seawater	3.3E-07	3.3E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium and the result is not changed
exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	4.5E-12	
	Inhalation of seawater spray	9.1E-08	7.7E-08	
	Ingestion of seafood	2.0E-05	1.6E-05	In the assessment of the original report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.
Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	1.6E-10	
	Total Sv/year)	2E-05	2E-05	

Table VI-6(2) Comparison of the exposure assessment results by the source term of the J1-C tank group

by the source term of the 51-6 tank group						
Assessed case		The body of the report	TECDOC-1759	Remarks		
	Exposure from sea surface	2.3E-10	Not to be assessed			
	Exposure from hulls	2.2E-10	Not to be assessed			
External	Exposure during swimming	1.6E-10	Not to be assessed			
exposure (mSv/year)	Exposure from beach sand	2.7E-07	3.1E-07	In the assessment of of the body of the oreport, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.		
	Exposure from fishing nets	5.3E-08	Not to be assessed			
	Ingestion of coastal sediment	Not to be assessed	3.3E-10			
Internal	Ingestion of seawater	3.1E-07	3.1E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium and the result is not changed		
exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	3.7E-11			
	Inhalation of seawater spray	1.9E-07	8.1E-08			
	Ingestion of seafood	4.5E-06	2.7E-06	In the assessment of the body of the report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.		
Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	2.3E-10			
	Total Sv/year)	5E-06	3E-06			

Table VI-6(3) Comparison of the exposure assessment results by the source term of the J1-G tank group

the 31-3 talk group						
Asse	ssed case	The body of the report	TECDOC-1759	Remarks		
	Exposure from sea surface	4.8E-10	Not to be assessed			
	Exposure from hulls	4.6E-10	Not to be assessed			
External exposure	Exposure during Swimming	3.2E-10	Not to be assessed			
(mSv/year)	Exposure from beach sand	5.6E-07	7.0E-0.8	In the assessment of the body of the report, conservative dose conversion factors were used for external exposures, and therefore the results are considered to be conservative.		
	Exposure from fishing nets	1.1E-07	Not to be assessed			
	Ingestion of coastal sediment	Not to be assessed	7.3E-10			
Internal	Ingestion of seawater	3.1E-07	3.1E-07	Since the tritium in the ALPS treated water before dilution, of which concentration exceed the regulatory concentration limit, has higher concentration than the other nuclides after discharge into the sea as well, the exposure through accidently ingestion of seawater is mainly caused by tritium and the result is not changed.		
exposure (mSv/year) (Adult)	Inhalation of dispersed coastal sediment	Not to be assessed	9.5E-11			
	Inhalation of seawater spray	3.8E-07	9.4E-08			
	Ingestion of seafood	9.0E-06	4.1E-06	In the assessment of the body of the report, the concentration in seafood was assessed using conservative concentrations in seawater rather than taking into account adhesion to suspended particles and sea seabed sediment. Therefore, the assessment result is considered to be conservative.		
Exposure of the skin (mSv/year)	When seabed sediment settles on the skin	Not to be assessed	6.3E-10			
	Total Sv/year)	1E-05	5E-06			

References

- [VI-1] IAEA, TECDOC-1759" Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure",2015
- [VI-2] EPA, FEDERAL GUIDANCE REPORT NO.15 "EXTERNAL EXPOSURE TO RADIONUCLIDES IN AIR, WATER AND SOIL",2019
- [VI-3] IAEA, General Safety Requirements Part 3" Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards",2014
- [VI-4] IAEA, Safety Report Series No. 44" Derivation of Activity Concentration Values for Exclusion, Exemption and Clearance",2005

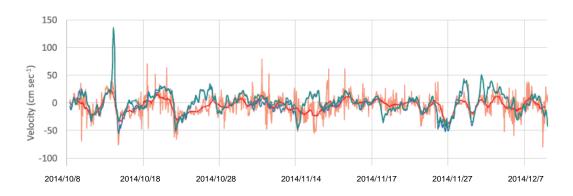
Attachment VII Validity of the diffusion simulation

In the chapter 6-1-2.(2) "Modeling of diffusion and transfer after discharge", the simulation model used to calculate the advection and diffusion of tritium is the model for the reproduction calculation of the diffusion of cesium leaked into the sea area due to the Accident at the Fukushima Daiichi Nuclear Power Station.

The following describes the validity of the diffusion simulation from various viewpoints.

VII-1. Reproducibility of the flow rate

As described in the chapter 6-1-2.(2) "Modeling of diffusion and transfer after discharge", this simulation used actual meteorological and oceanographic data for the reproduction calculation of cesium leaked from the Fukushima Daiichi Nuclear Power Station, and confirmed the reproducibility by comparing it with actual sea area monitoring data. Figure VII-1 shows a comparison of the north and south components of the flow rate measured with the acoustic doppler current profiler (ADCP; 600 kHz, RDI) in the locations about 5 km to the south of the Fukushima Daiichi nuclear power station and about 2.8 km offshore (37°22.6' N, 141°3.7'E) and the flow rate reproduced by simulation between October 8 and December 10, 2014 and between April 22 and June 25, 2015 [VII-1]. The match rate between the simulation and measured value is high no matter whether the river flow rate is considered.



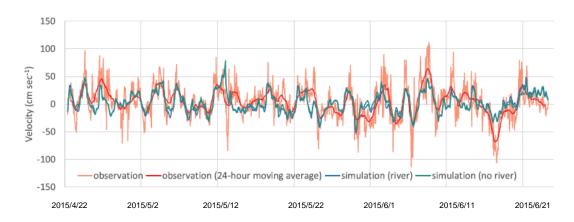


Figure VII-1 Comparison between the flow rate measured near the Fukushima Daiichi Nuclear Power Station and the reproduction calculation by simulation

VII-2. Reproducibility of the cesium concentration

Figure VII-2 shows the result of comparison between the annual average value of the cesium 137 concentration [VII-2] of surface seawater obtained by coastal seawater monitoring in Fukushima by TEPCO and the annual average concentration distribution of the surface reproduced by simulation between 2013 and 2016. "O" shows the monitoring points, the colors show the measured Cs-137 concentrations, and the contour figure shows the calculation result of simulation. Similarly, Figure VII-3 shows a comparison with the annual average value of the cesium 137 concentration [VII-2] of surface seawater obtained by seawater monitoring in the offshore sea area by the Secretariat of the Nuclear Regulation Authority. The high concentration in the coastal area around the power station and the general concentration trend are reproduced well.

Moreover, Figure VII-4 shows the data in the scatter diagram. The measured values are almost similar to the simulated ones in the upper right region, where the concentration is high (blue dashed line).

On the other hand, in the lower-left region where the concentration is low (red dashed line), the measured values tend to be higher than the simulated results. Measured values are higher in the low concentration region probably because the simulation results do not adequately reflect some sources, such as the supply of cesium from rivers and inflow of cesium due to recirculation by currents in the North Pacific Ocean. Thus, this does not raise issues regarding the reproducibility of simulation results in this assessment conducted to evaluate the impact of the discharge of the ALPS treated water.

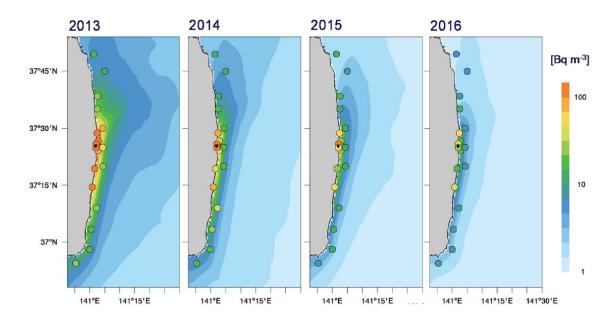


Figure VII-2 Comparison between the measured value and simulation of the Cs-137 concentration in the coastal area around the Fukushima Daiichi Nuclear Power Station

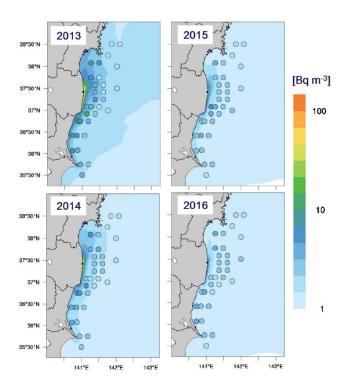


Figure VII-3 Comparison between the measured value and simulation of the Cs-137 concentration offshore in the sea area around the Fukushima Daiichi Nuclear Power Station

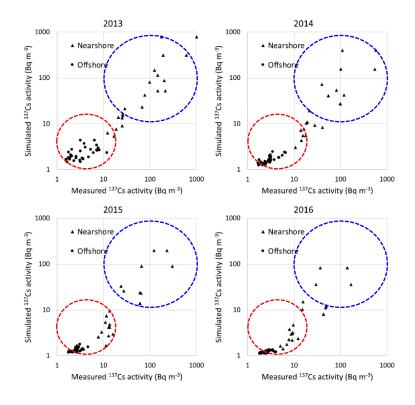


Figure VII-4 Comparison between the measured value and simulation of the Cs-137 concentration in the sea area around the Fukushima Daiichi Nuclear Power Station (Blue and red mainly show coast and offshore, respectively.)

VII-3. Concentration distribution around the discharge outlet

The tritium simulation model used in 6-1-2.(2) "Modeling of diffusion and transfer after discharge" is a model to simulate migration and diffusion in vast areas and did not simulate the physical flow around the discharge outlet. Therefore, despite the upward discharge of water, the concentration near the seabed around the discharge outlet is higher than in the surrounding areas. Still, the result is that the concentration just above the discharge outlet does not show an increase much.

On the other hand, during the actual discharge, it will entrain surrounding seawater, facilitating the mixing and dilution. In addition, since the ALPS treated water to be discharged has already been diluted more than 100 times with seawater, the salinity and specific gravity of the water will be almost the same as those of the surrounding seawater. Therefore, although there is a slight difference in the concentration distribution around the discharge outlet, the diffusion in areas away from the outlet will not be expected to differ significantly to the simulated results.

Attachment VIII "Difference in the diffusion area by discharge location" of the report compares the simulated tritium diffusion when the discharge point is 1 km off the coast with the result when a discharge point is a unit 5/6 discharge outlet.

Although the concentration distribution around the discharge outlet is different, as shown in Figures VII-5 and VII-6, there is no notable difference in the diffusion in the surrounding sea area.

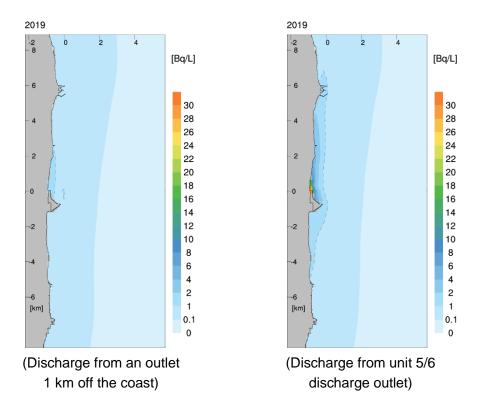


Figure VII-5 Comparison of the distribution of annual mean tritium concentration in the sea between different discharge locations (sea surface)

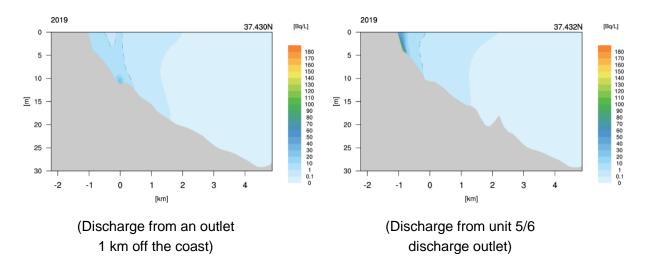


Figure VII-6 Comparison of the distribution of annual mean tritium concentration in the sea between different discharge locations (cross-sectional view)

In addition, even when the upward flow is not considered, the mean concentration in the $10 \text{ km} \times 10 \text{ km}$ area calculated in the simulation is higher in the upper layer than the concentration around the discharge outlet, because as shown in Figures VII-7 to 10, the water depth in the surrounding sea gradually becomes deeper, and the concentration on the bottom offshore is much lower than in the surface layer.

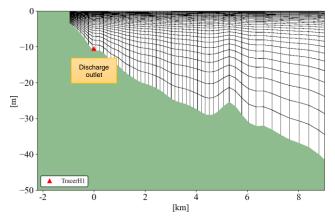


Figure VII-7 Cross-sectional view of the seabed up to about 10 km offshore

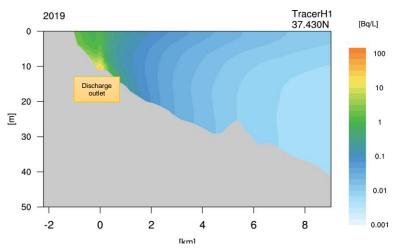


Figure VII-8 Cross-sectional view of distribution of annual mean tritium concentration up to 10 km offshore

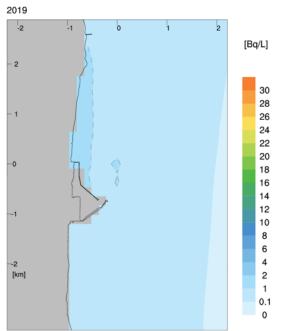


Figure VII-9 Distribution of annual mean tritium concentration on the sea surface up to 3 km offshore

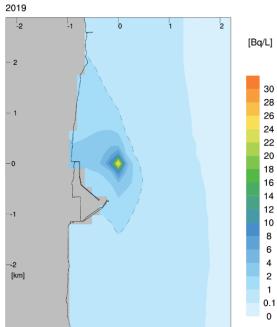


Figure VII-10 Distribution of annual mean tritium concentration on the sea bottom up to 3 km offshore

VII-4. Calculation period

As shown in 6-1-3, a simulation calculation of 7 years was performed in order to verify the fluctuation caused by the fluctuation in annual meteorological and oceanographic data. The result shows that the fluctuation in the annual average concentration of all layers within the range of 10 km × 10 km was small. Figure VII-11 shows the change in the daily average concentration in the same calculation. The concentration fluctuates significantly and no accumulation trend was observed in each calculation period (one year). No significant difference is expected to occur between the result of the calculations performed each year and the result of calculations performed for multiple consecutive years. Therefore, the result of the calculations for each year will be used because there is considered to be no problem in evaluating the impact over a long period of discharge with the assessment based on the result of one-year's calculations.

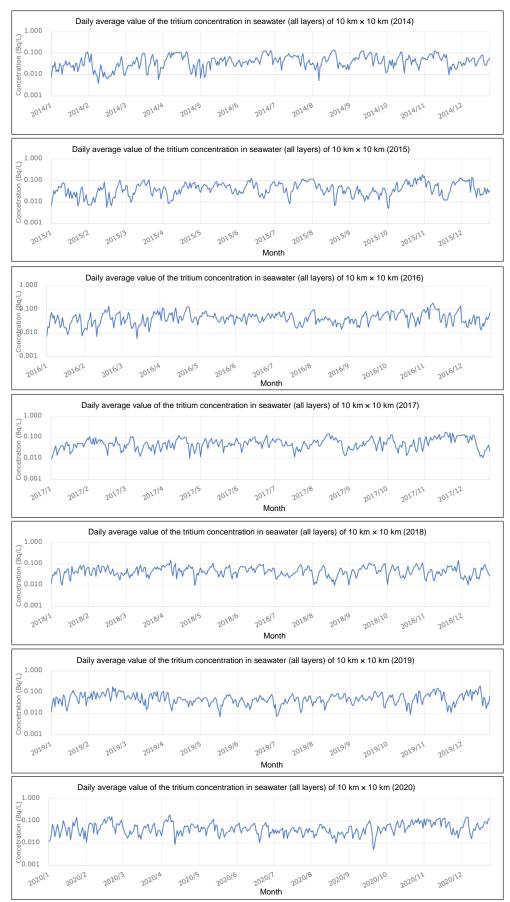


Figure VII-11 Calculation result of the daily average concentration within the range of 10 km × 10 km of each year

VII-5. Validity of the calculation area

The calculation area of the simulation used in the report is approximately 490 km north-south and 270 km east-west. Table VII-1 shows the maximum value and position of the area boundary from the annual average concentration calculated from meteorological and oceanographic data for the years 2014 to 2020. Table VII-2 shows the annual maximum value, position, and date of occurrence of the area boundary based on the daily average concentration. The annual average concentration distribution diagram of tritium concentration of the entire area (result shown diagrammatically down to the lower limit of 1E-05Bq/L) is shown in Figure VII-12.

The maximum value of the annual average concentration range on the boundary of the calculation area is from 1.1E-04 to 2.6E-04Bq/L and maximum daily average concentration range is from 5.3E-03 to 1.4E-02Bq/L, all in the east side, but compared to the tritium concentration in sea water in sea area around Japan (about 1.0E-1Bq/L) [VII-3], which is sufficiently low.

In addition, the exposure assessment result calculated from the annual average concentration of 10 km \times 10 km area around the power station is much lower than the dose limit for the general public of 1mSv/year, as well as the dose constraint of 0.05mSv/year, and it is not necessary to assess the impact of radioactivity outside of the calculation area.

Table VII-1 Maximum value and position of the annual average concentration on the model boundary (north, south, and east) of each year

	_	Coordinate				
Year	Concentration (Bq/L)	East - West (0: West boundary, 460: East boundary)	North - South (0: South boundary, 658: North boundary)	Depth (0: Bottom layer, 29: Top layer)		
2014	1.1E-04	460 (East boundary)	80	23		
2015	2.6E-04	460 (East boundary)	145	29		
2016	1.4E-04	460 (East boundary)	318	25		
2017	2.4E-04	460 (East boundary)	224	23		
2018	1.9E-04	460 (East boundary)	150	29		
2019	1.6E-04	460 (East boundary)	181	28		
2020	1.9E-04	460 (East boundary)	232	28		

Table VII-2 Maximum value, position, and date occurred of the daily average concentration on the model boundary (north, south, and east) of each year

_		Coordinate				
Date Concentration (Bq/L)	Concentration (Bq/L)	East - West (0: West boundary, 460: East boundary)	North - South (0: South boundary, 658: North boundary)	Depth (0: Bottom layer, 29: Top layer)		
2014/9/21	6.7E-03	460 (East boundary)	198	19		
2015/8/2	7.2E-03	460 (East boundary)	158	25		
2016/8/6	1.4E-02	460 (East boundary)	341	28		
2017/7/28	6.5E-03	460 (East boundary)	252	29		
2018/8/15	5.3E-03	460 (East boundary)	215	21		
2019/8/1	1.0E-02	460 (East boundary)	177	27		
2020/5/30	1.1E-02	460 (East boundary)	234	28		

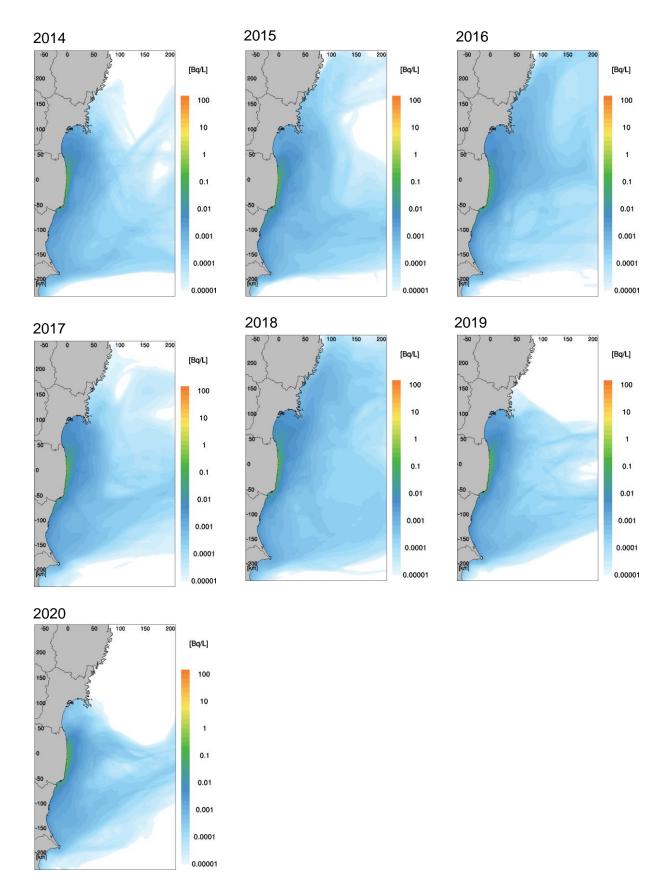


Figure VII-12 Annual average concentration distribution diagram of the tritium concentration (result shown diagrammatically up to 1E-05Bq/L as the lowest limit)

References

- [VII-1] D.Tsumune, T.Tsubono, K.Misumi, Y.Tateda, Y.Toyoda, Y.Onda, and M.Aoyama, "Impacts of direct release and river discharge on oceanic 137Cs derived from the Fukushima Dai-ichi Nuclear Power Plant accident", 2020
- [VII-2] https://radioactivity.nsr.go.jp/ja/list/428/list-1.html
- [VII-3] Marine Ecology Research Institute "FY2020 Commissioned Project Survey Report such as Disaster Prevention Measures, etc. for Nuclear Facilities (Investigation of radioactivity and comprehensive assessment in marine environment)" March 2021

Attachment VIII Difference in the diffusion area by discharge location

In the consideration of the discharge method of ALPS treated water, initially a plan of discharging from the unit 5/6 discharge outlet was considered as with the normal operation of units 5 and 6. Figure VIII-1 shows the water discharge position under consideration in this plan and the position of the unit 5/6 discharge outlet.

Figures VIII-2 to 4 show a comparison of diffusion simulation results among different discharge positions. Though no significant difference is observed in the concentration range of 0.1Bq/L, the concentration around the power station is lower in discharge from 1 km offshore.

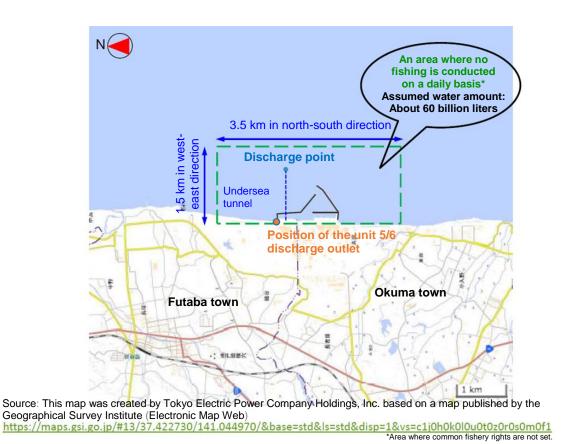
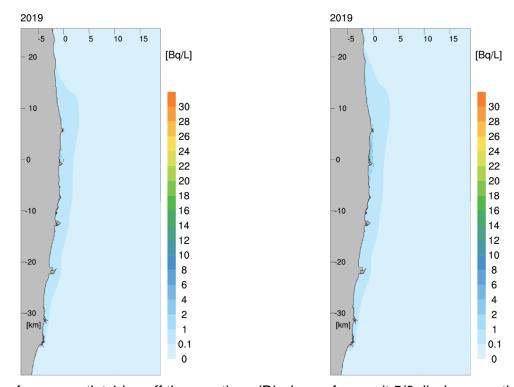


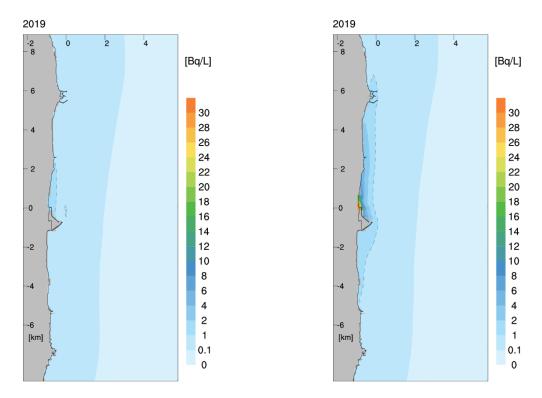
Figure VIII-1 Discharge position and position of the unit 5/6 discharge outlet in the current plan



(Discharge from an outlet 1 km off the coast) (Discharge from unit 5/6 discharge outlet)

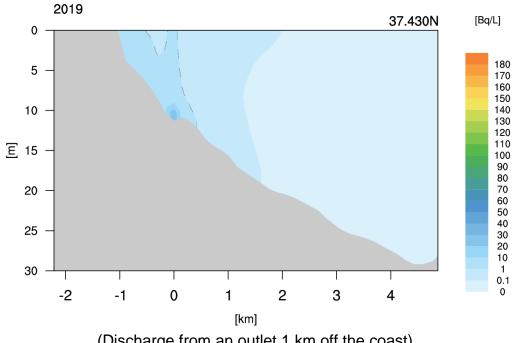
Figure VIII-2 Comparison of the distribution of annual mean concentration of the sea

surface between different discharge locations (wide area)

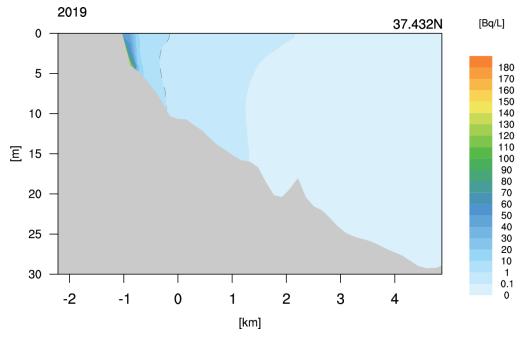


(Discharge from an outlet 1 km off the coast) (Discharge from unit 5/6 discharge outlet)

Figure VIII-3 Comparison of the distribution of annual mean concentration of the sea surface between different discharge locations (enlarged diagram)



(Discharge from an outlet 1 km off the coast)



(Discharge from unit 5/6 discharge outlet)

Comparison of the distribution of annual mean concentration between Figure VIII-4 different discharge locations (cross-sectional view)

Attachment IX Contribution to the undetected nuclides in the source term based on the measured value

The 31 nuclides subject to this assessment include many undetected nuclides which have never been detected in the past analysis assessments. As shown in 6-1-2.(1) "Source term (annual discharge amount of each nuclide)" annual discharge amount is conservatively assumed to include nuclides below the detection limit in the source term based on actual measurement. However, it is estimated that the actual concentrations of many of the nuclides which have never been detected are much lower than the detection limit considering their half-lives, etc.

In order to verify the contribution from undeteted nuclides in the result of the exposure assessment, the exposure assessment result of each nucle is aggregated separating detected nuclides from undetected nuclides

Tables IX-1 to 4 show the result.

In both cases, the contribution from undetected nuclides was significant before selecting nuclides to be measured and assessed, but the contribution from undetected nuclides is decreased.

Table IX-1(1) Contributions of detected and undetected nuclides (human exposure, 64 nuclides)

Assessed case	Source term	Source term based on measured values						
		i. K4 tank group		ii. J1-C tank group		iii. J1-G tank group		
	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
Exposure* (mSv/year)	Detected nuclide	5.7E-06	2.0E-05	1.4E-06	4.0E-06	2.1E-06	6.4E-06	
	Undetected nuclide	1.9E-05	5.1E-05	5.2E-05	1.3E-04	1.5E-04	3.6E-04	
	Total	2.5E-05	7.1E-05	5.4E-05	1.3E-04	1.5E-04	3.7E-04	
Percentage of undetected nuclides in total		77%	71%	97%	97%	99%	98%	

^{*} Exposure is the total of external exposure and internal exposure

Table IX-1(2) Contributions of detected and undetected nuclides (human exposure, 31 nuclides)

Assessed case	Source term	Source term based on measured values					
		i. K4 tank group		ii. J1-C tank group		iii. J1-G tank group	
	Ingestion of seafood	Average	Large	Average	Large	Average	Large
Exposure* (mSv/year)	Detected nuclide	5.7E-06	2.0E-05	1.3E-06	3.9E-06	2.1E-06	6.3E-06
	Undetected nuclide	4.6E-07	1.6E-06	5.3E-07	1.4E-06	1.3E-06	4.0E-06
	Total	6.2E-06	2.2E-05	1.9E-06	5.4E-06	3.5E-06	1.0E-05
Percentage of undetected nuclides in total		7%	7%	28%	27%	39%	39%

Exposure is the total of external exposure and internal exposure

Table IX-2(1) Contributions of detected and undetected nuclides (environmental protection and K4 tank group, 64 nuclides)

Assessed case		K4 tank group			
		Flatfish	Crab	Brown seaweed	
	Detected nuclide	7.5E-07	7.6E-07	8.3E-07	
Exposure (mGy/day)	Undetected nuclide	1.7E-05	1.7E-05	1.8E-05	
	Total	1.7E-05	1.7E-05	1.9E-05	
Percentage of undetected nuclides in total		96%	96%	96%	

Table IX-2(2) Contributions of detected and undetected nuclides (environmental protection and K4 tank group, 31 nuclides)

Assessed case		K4 tank group			
		Flatfish	Crab	Brown seaweed	
	Detected nuclide	7.5E-07	7.6E-07	8.3E-07	
Exposure (mGy/day)	Undetected nuclide	1.7E-07	1.4E-07	1.7E-07	
	Total	9.3E-07	9.0E-07	1.0E-06	
Percentage of undetected nuclides in total		19%	16%	17%	

Table IX-3(1) Contributions of detected and undetected nuclides (environmental protection and J1-C tank group, 64 nuclides)

Assessed case		J1-C tank group				
		Flatfish	Crab	Brown seaweed		
Detected nuclide		1.4E-07	1.4E-07	1.5E-07		
Exposure (mGy/day)	Undetected nuclide	2.2E-05	2.2E-05	2.3E-05		
	Total	2.2E-05	2.2E-05	2.3E-05		
Percentage of undetected nuclides in total		99%	99%	99%		

Table IX-3(2) Contributions of detected and undetected nuclides (environmental protection and J1-C tank group, 31 nuclides)

	A		J1-C tank group				
Assessed case		Flatfish	Crab	Brown seaweed			
Detected nuclide		1.4E-07	1.4E-07	1.5E-07			
Exposure (mGy/day)	Undetected nuclide	3.5E-07	2.9E-07	3.6E-07			
Total		4.9E-05	4.3E-07	5.1E-07			
Percentage of undetected nuclides in total		71%	68%	71%			

Table IX-4(1) Contributions of detected and undetected nuclides (environmental protection and J1-G tank group, 64 nuclides)

Assessed case		J1-G tank group				
		Flatfish	Crab	Brown seaweed		
	Detected nuclide		2.8E-07	3.0E-07		
Exposure (mGy/day)	Undetected nuclide	5.6E-05	5.5E-05	5.8E-05		
Total		5.6E-05	5.5E-05	5.9E-05		
Percentage of undetected nuclides in total		99%	99%	99%		

Table IX-4(2) Contributions of detected and undetected nuclides (environmental protection and J1-G tank group, 31 nuclides)

Assessed case		J1-G tank group				
		Flatfish	Crab	Brown seaweed		
	Detected nuclide		2.8E-07	3.0E-07		
Exposure (mGy/day)	Undetected nuclide	9.8E-07	8.0E-07	1.0E-06		
	Total	1.3E-06	1.1E-06	1.3E-06		
Percentage of undetected nuclides in total		77%	74%	77%		

Attachment X Breakdown of the exposure assessment result by nuclide

X-1. Internal exposures assessment of human

For the following exposure assessments shown in 6-1. "Exposure assessment under normal conditions", Tables X-1-1 to 4, X-2-1 to 4, and X-3-1 to 4 show the internal exposure assessment result of each nuclide.

Source term based on measured values of 31 nuclides

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

Table X-1-1 Internal exposure assessment result from ingestion of seawater (Source term based on measured values (K4 tank group))

- (Oddice	term baset	i On measu	eu values	K4 tank group))
	Exposure as	sessment resu		
Nuclide	Adult	Children under school age	Infants	Remarks
H-3	3.0E-07	5.2E-07	Exempted	
I-129	2.1E-08	3.2E-08	Exempted	
Ru-106	1.0E-09	3.6E-09	Exempted	
C-14	7.7E-10	1.3E-09	Exempted	
Sr-90	5.5E-10	9.2E-10	Exempted	
Cs-137	4.9E-10	3.6E-10	Exempted	
Se-79	3.9E-10	2.5E-09	Exempted	
Co-60	1.3E-10	6.7E-10	Exempted	
Cs-134	7.6E-11	5.2E-11	Exempted	
Y-90	5.3E-11	2.0E-10	Exempted	
Tc-99	4.0E-11	1.4E-10	Exempted	
Cd-113m	3.7E-11	6.2E-11	Exempted	
Sb-125	3.2E-11	1.0E-10	Exempted	
Ni-63	2.9E-11	9.0E-11	Exempted	
Ce-144	2.9E-11	1.1E-10	Exempted	
Te-125m	2.6E-11	9.7E-11	Exempted	
Pu-239	1.4E-11	1.8E-11	Exempted	
Pu-240	1.4E-11	1.8E-11	Exempted	
Pu-238	1.3E-11	1.7E-11	Exempted	
Pu-241	1.2E-11	1.4E-11	Exempted	
Am-241	1.1E-11	1.5E-11	Exempted	
Cm-243	8.4E-12	1.2E-11	Exempted	

	Exposure as	sessment resu		
Nuclide	Adult	Children under school age	Infants	Remarks
Cm-244	6.7E-12	1.1E-11	Exempted	
Np-237	6.2E-12	7.8E-12	Exempted	
Pm-147	4.4E-12	1.6E-11	Exempted	
U-234	2.7E-12	4.9E-12	Exempted	
U-238	2.5E-12	4.5E-12	Exempted	
Eu-154	2.1E-12	6.9E-12	Exempted	
Eu-155	9.4E-13	3.2E-12	Exempted	
Mn-54	4.2E-13	1.1E-12	Exempted	
Sm-151	7.8E-15	2.6E-14	Exempted	
Total	3.3E-07	5.7E-07	Exempted	

Table X-1-2 Assessment result of internal exposure from inhalation of seawater spray (Source term based on measured values (K4 tank group))

Exposure assessment result (mSv/year) Children Nuclide Remarks Adult under Infants school age H-3 7.3E-08 3.4E-08 5.0E-08 Ru-106 2.3E-09 1.9E-09 1.1E-09 C-14 1.9E-09 1.4E-09 7.9E-10 I-129 1.6E-09 1.1E-09 4.2E-10 Pu-239 1.6E-09 7.9E-10 3.6E-10 Pu-240 1.6E-09 7.9E-10 3.6E-10 Pu-238 1.5E-09 7.4E-10 3.5E-10 Pu-241 1.4E-09 6.1E-10 2.2E-10 Am-241 1.3E-09 6.4E-10 3.1E-10 Cm-243 9.3E-10 5.0E-10 2.8E-10 Cm-244 7.7E-10 4.4E-10 2.6E-10 Sr-90 7.5E-10 5.0E-10 2.5E-10 Np-237 6.7E-10 3.2E-10 1.7E-10 Cs-137 3.5E-10 2.5E-10 1.3E-10 2.9E-10 1.1E-10 Co-60 2.2E-10 Se-79 2.2E-10 1.6E-10 9.5E-11 Tc-99 1.9E-10 1.4E-10 7.9E-11 U-234 1.3E-10 1.0E-10 5.7E-11 U-238 1.1E-10 8.5E-11 5.0E-11 Sb-125 8.5E-11 6.7E-11 3.8E-11 Ce-144 7.2E-11 7.4E-11 6.3E-11 Ni-63 6.1E-11 5.0E-11 2.9E-11

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Cd-113m	4.2E-11	2.7E-11	1.5E-11	
Te-125m	3.0E-11	2.2E-11	1.5E-11	
Pm-147	2.0E-11	1.8E-11	1.1E-11	
Cs-134	1.9E-11	1.6E-11	8.7E-12	
Eu-154	1.4E-11	9.8E-12	5.3E-12	
Y-90	7.1E-12	7.8E-12	7.9E-12	
Eu-155	4.9E-12	3.9E-12	2.4E-12	
Mn-54	2.2E-13	2.1E-13	1.4E-13	
Sm-151	7.7E-14	5.1E-14	2.7E-14	
Total	9.1E-08	6.0E-08	3.9E-08	

Table X-1-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), Average ingestion)

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
I-129	2.7E-06	2.0E-06	8.6E-07	
C-14	1.4E-06	1.2E-06	6.8E-07	
Se-79	3.2E-07	1.1E-06	9.4E-07	
Cd-113m	5.8E-08	5.0E-08	6.1E-08	
Co-60	4.9E-08	1.2E-07	1.6E-07	
Ru-106	3.3E-08	5.7E-08	7.6E-08	
H-3	3.2E-08	2.8E-08	2.3E-08	
Tc-99	1.6E-08	2.8E-08	4.9E-08	
Cs-137	4.1E-09	1.5E-09	1.4E-09	
Ni-63	3.6E-09	5.4E-09	7.6E-09	
Ce-144	2.7E-09	4.9E-09	6.8E-09	
Sb-125	1.5E-09	2.3E-09	3.1E-09	
Am-241	1.4E-09	9.2E-10	5.0E-09	
Pu-239	1.4E-09	8.8E-10	4.4E-09	
Pu-240	1.4E-09	8.8E-10	4.4E-09	
Pu-238	1.2E-09	8.3E-10	4.2E-09	
Te-125m	1.2E-09	2.2E-09	3.6E-09	
Pu-241	1.2E-09	6.5E-10	2.6E-09	
Cm-243	7.2E-10	5.1E-10	3.0E-09	
Pm-147	6.4E-10	1.2E-09	1.8E-09	
Cs-134	6.4E-10	2.2E-10	1.8E-10	
Cm-244	5.8E-10	4.4E-10	2.7E-09	

	Exposure as	sessment resu		
Nuclide	Adult	Children under school age	Infants	Remarks
Mn-54	3.2E-10	4.3E-10	4.8E-10	
Eu-154	3.1E-10	5.1E-10	7.7E-10	
Sr-90	2.5E-10	2.1E-10	4.2E-10	
Eu-155	1.4E-10	2.4E-10	3.6E-10	
Np-237	3.4E-11	2.2E-11	1.2E-10	
Y-90	2.5E-11	4.5E-11	5.6E-11	
U-234	4.8E-12	4.2E-12	7.1E-12	
U-238	4.4E-12	3.9E-12	6.5E-12	
Sm-151	1.1E-12	1.9E-12	3.5E-12	
Total	4.7E-06	4.6E-06	2.9E-06	

Table X-1-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (K4 tank group), More ingestion)

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
I-129	1.3E-05	1.0E-05	4.1E-06	
C-14	5.2E-06	4.5E-06	2.5E-06	
Se-79	1.2E-06	4.0E-06	3.4E-06	
Cd-113m	3.1E-07	2.6E-07	3.1E-07	
Co-60	2.7E-07	6.8E-07	8.4E-07	
Ru-106	1.6E-07	2.9E-07	3.8E-07	
H-3	1.2E-07	1.1E-07	8.7E-08	
Tc-99	7.7E-08	1.4E-07	2.3E-07	
Cs-137	1.5E-08	5.6E-09	4.9E-09	
Ni-63	1.5E-08	2.3E-08	3.1E-08	
Ce-144	1.4E-08	2.5E-08	3.4E-08	
Pu-239	7.0E-09	4.6E-09	2.3E-08	
Pu-240	7.0E-09	4.6E-09	2.3E-08	
Am-241	6.7E-09	4.6E-09	2.4E-08	
Pu-238	6.4E-09	4.3E-09	2.2E-08	
Pu-241	6.0E-09	3.4E-09	1.3E-08	
Sb-125	5.2E-09	8.2E-09	1.1E-08	
Te-125m	4.1E-09	8.0E-09	1.3E-08	
Cm-243	3.5E-09	2.5E-09	1.4E-08	
Pm-147	3.4E-09	6.4E-09	9.2E-09	
Cm-244	2.8E-09	2.2E-09	1.3E-08	
Cs-134	2.3E-09	8.1E-10	6.4E-10	

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
Mn-54	1.8E-09	2.5E-09	2.7E-09	
Eu-154	1.7E-09	2.7E-09	4.1E-09	
Sr-90	1.1E-09	9.6E-10	1.8E-09	
Eu-155	7.4E-10	1.3E-09	1.9E-09	
Np-237	2.1E-10	1.3E-10	7.2E-10	
Y-90	1.1E-10	2.0E-10	2.5E-10	
U-234	2.4E-11	2.2E-11	3.5E-11	
U-238	2.2E-11	2.0E-11	3.2E-11	
Sm-151	6.1E-12	1.0E-11	1.8E-11	
Total	2.0E-05	2.0E-05	1.2E-05	

Table X-2-1 Internal exposure assessment result from ingestion of seawater (Source term based on measured values (J1-C tank group))

`	Evnosure as	sessment resu	It (mSy/year)	9 a.p,,
Nuclide	Adult	Children under school age	Infants	Remarks
H-3	3.0E-07	5.2E-07	Exempted	
I-129	2.7E-09	4.2E-09	Exempted	
C-14	2.2E-10	3.7E-10	Exempted	
Ru-106	2.0E-10	7.2E-10	Exempted	
Pu-239	1.7E-10	2.2E-10	Exempted	
Pu-240	1.7E-10	2.2E-10	Exempted	
Pu-238	1.6E-10	2.1E-10	Exempted	
Am-241	1.4E-10	1.8E-10	Exempted	
Pu-241	1.2E-10	1.4E-10	Exempted	
Cm-243	1.0E-10	1.5E-10	Exempted	
Se-79	9.0E-11	5.9E-10	Exempted	
Cm-244	8.2E-11	1.3E-10	Exempted	
Np-237	7.5E-11	9.5E-11	Exempted	
Ce-144	6.1E-11	2.2E-10	Exempted	
Cs-137	5.1E-11	3.8E-11	Exempted	
Cd-113m	4.0E-11	6.8E-11	Exempted	
U-234	3.3E-11	6.0E-11	Exempted	
U-238	3.1E-11	5.4E-11	Exempted	
Cs-134	3.0E-11	2.0E-11	Exempted	
Ni-63	2.6E-11	8.1E-11	Exempted	
Co-60	2.3E-11	1.2E-10	Exempted	
Sr-90	2.1E-11	3.5E-11	Exempted	

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Tc-99	1.6E-11	5.7E-11	Exempted	
Sb-125	5.2E-12	1.6E-11	Exempted	
Eu-154	4.5E-12	1.5E-11	Exempted	
Pm-147	4.3E-12	1.6E-11	Exempted	
Te-125m	4.1E-12	1.6E-11	Exempted	
Eu-155	2.2E-12	7.7E-12	Exempted	
Y-90	2.0E-12	7.4E-12	Exempted	
Mn-54	5.6E-13	1.5E-12	Exempted	
Sm-151	2.2E-14	7.5E-14	Exempted	
Total	3.1E-07	5.3E-07	Exempted	

Table X-2-2 Assessment result of internal exposure from inhalation of seawater spray (Source term based on measured values (J1-C tank group))

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
H-3	7.3E-08	5.0E-08	3.4E-08	
Pu-239	2.0E-08	9.6E-09	4.4E-09	
Pu-240	2.0E-08	9.6E-09	4.4E-09	
Pu-238	1.8E-08	9.0E-09	4.2E-09	
Am-241	1.6E-08	7.7E-09	3.8E-09	
Pu-241	1.4E-08	6.1E-09	2.1E-09	
Cm-243	1.1E-08	6.1E-09	3.4E-09	
Cm-244	9.3E-09	5.3E-09	3.2E-09	
Np-237	8.2E-09	3.9E-09	2.1E-09	
U-234	1.5E-09	1.2E-09	7.0E-10	
U-238	1.3E-09	1.0E-09	6.1E-10	
C-14	5.2E-10	3.9E-10	2.2E-10	
Ru-106	4.6E-10	3.8E-10	2.3E-10	
I-129	2.1E-10	1.4E-10	5.5E-11	
Ce-144	1.5E-10	1.6E-10	1.3E-10	
Tc-99	7.7E-11	5.6E-11	3.1E-11	
Ni-63	5.5E-11	4.5E-11	2.6E-11	
Co-60	5.1E-11	3.8E-11	1.9E-11	
Se-79	5.1E-11	3.8E-11	2.2E-11	
Cd-113m	4.6E-11	3.0E-11	1.6E-11	
Cs-137	3.7E-11	2.6E-11	1.3E-11	
Eu-154	2.9E-11	2.1E-11	1.1E-11	

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Sr-90	2.9E-11	1.9E-11	9.7E-12	
Pm-147	2.0E-11	1.7E-11	1.1E-11	
Sb-125	1.4E-11	1.1E-11	6.2E-12	
Eu-155	1.2E-11	9.3E-12	5.6E-12	
Cs-134	7.5E-12	6.1E-12	3.4E-12	
Te-125m	4.8E-12	3.5E-12	2.5E-12	
Mn-54	2.8E-13	2.8E-13	1.8E-13	
Y-90	2.7E-13	2.9E-13	3.0E-13	
Sm-151	2.2E-13	1.4E-13	7.7E-14	
Total	1.9E-07	1.1E-07	6.3E-08	

Table X-2-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), Average ingestion)

	Exposure as	Exposure assessment result (mSv/year)		
Nuclide	Adult	Children under school age	Infants	Remarks
C-14	3.8E-07	3.3E-07	1.9E-07	
I-129	3.6E-07	2.7E-07	1.1E-07	
Se-79	7.5E-08	2.5E-07	2.2E-07	
Cd-113m	6.4E-08	5.4E-08	6.7E-08	
H-3	3.2E-08	2.8E-08	2.3E-08	
Am-241	1.7E-08	1.1E-08	6.1E-08	
Pu-239	1.6E-08	1.1E-08	5.4E-08	
Pu-240	1.6E-08	1.1E-08	5.4E-08	
Pu-238	1.5E-08	1.0E-08	5.1E-08	
Pu-241	1.1E-08	6.5E-09	2.6E-08	
Cm-243	8.7E-09	6.2E-09	3.6E-08	
Co-60	8.6E-09	2.2E-08	2.7E-08	
Cm-244	7.0E-09	5.4E-09	3.3E-08	
Ru-106	6.6E-09	1.2E-08	1.5E-08	
Tc-99	6.5E-09	1.1E-08	1.9E-08	
Ce-144	5.8E-09	1.0E-08	1.4E-08	
Ni-63	3.2E-09	4.9E-09	6.8E-09	
Eu-154	6.6E-10	1.1E-09	1.6E-09	
Pm-147	6.2E-10	1.2E-09	1.7E-09	
Cs-137	4.3E-10	1.6E-10	1.4E-10	_
Mn-54	4.2E-10	5.7E-10	6.4E-10	
Np-237	4.2E-10	2.7E-10	1.5E-09	

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Eu-155	3.3E-10	5.6E-10	8.7E-10	
Cs-134	2.5E-10	8.5E-11	7.0E-11	
Sb-125	2.4E-10	3.7E-10	4.9E-10	
Te-125m	1.9E-10	3.6E-10	5.8E-10	
U-234	5.9E-11	5.2E-11	8.6E-11	
U-238	5.4E-11	4.7E-11	7.9E-11	
Sr-90	9.6E-12	8.1E-12	1.6E-11	
Sm-151	3.2E-12	5.5E-12	9.8E-12	
Y-90	9.3E-13	1.7E-12	2.1E-12	
Total	1.0E-06	1.1E-06	1.0E-06	

Table X-2-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

	Exposure as	sessment resu	lt (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
I-129	1.7E-06	1.3E-06	5.4E-07	
C-14	1.4E-06	1.3E-06	7.0E-07	
Cd-113m	3.4E-07	2.9E-07	3.4E-07	
Se-79	2.8E-07	9.3E-07	8.0E-07	
H-3	1.2E-07	1.1E-07	8.7E-08	
Pu-239	8.5E-08	5.6E-08	2.8E-07	
Pu-240	8.5E-08	5.6E-08	2.8E-07	
Am-241	8.2E-08	5.5E-08	2.9E-07	
Pu-238	7.8E-08	5.3E-08	2.6E-07	
Pu-241	5.9E-08	3.4E-08	1.3E-07	
Co-60	4.7E-08	1.2E-07	1.5E-07	
Cm-243	4.2E-08	3.1E-08	1.7E-07	
Cm-244	3.4E-08	2.7E-08	1.6E-07	
Ru-106	3.3E-08	5.9E-08	7.6E-08	
Tc-99	3.1E-08	5.5E-08	9.2E-08	
Ce-144	2.9E-08	5.3E-08	7.1E-08	
Ni-63	1.3E-08	2.1E-08	2.8E-08	
Eu-154	3.5E-09	5.8E-09	8.6E-09	
Pm-147	3.4E-09	6.2E-09	9.0E-09	
Np-237	2.5E-09	1.6E-09	8.8E-09	_
Mn-54	2.4E-09	3.2E-09	3.6E-09	
Eu-155	1.8E-09	3.0E-09	4.6E-09	

	Exposure as	sessment resu	lt (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
Cs-137	1.6E-09	5.8E-10	5.1E-10	
Cs-134	9.1E-10	3.2E-10	2.5E-10	
Sb-125	8.4E-10	1.3E-09	1.7E-09	
Te-125m	6.7E-10	1.3E-09	2.0E-09	
U-234	2.9E-10	2.6E-10	4.3E-10	
U-238	2.7E-10	2.4E-10	3.9E-10	
Sr-90	4.3E-11	3.6E-11	7.0E-11	
Sm-151	1.7E-11	2.9E-11	5.2E-11	
Y-90	4.1E-12	7.7E-12	9.4E-12	
Total	4.5E-06	4.5E-06	4.5E-06	

Table X-3-1 Internal exposure assessment result from ingestion of seawater (Source term based on measured values (J1-C tank group))

Exposure assessment result (mSv/year)				
Nuclide	Adult	Children under school age	Infants	Remarks
H-3	3.0E-07	5.2E-07	Exempted	
I-129	2.3E-09	3.5E-09	Exempted	
C-14	5.8E-10	9.9E-10	Exempted	
Pu-239	4.4E-10	5.8E-10	Exempted	
Pu-240	4.4E-10	5.8E-10	Exempted	
Pu-238	4.0E-10	5.4E-10	Exempted	
Am-241	3.5E-10	4.7E-10	Exempted	
Pu-241	3.0E-10	3.4E-10	Exempted	
Se-79	2.7E-10	1.8E-09	Exempted	
Cs-137	2.7E-10	2.0E-10	Exempted	
Cm-243	2.6E-10	3.9E-10	Exempted	
Cm-244	2.1E-10	3.3E-10	Exempted	
Ru-106	2.1E-10	7.5E-10	Exempted	
Np-237	1.9E-10	2.5E-10	Exempted	
Ce-144	1.8E-10	6.5E-10	Exempted	
Cd-113m	1.2E-10	2.1E-10	Exempted	
U-234	8.6E-11	1.5E-10	Exempted	
Ni-63	8.3E-11	2.5E-10	Exempted	
Cs-134	8.0E-11	5.5E-11	Exempted	
U-238	7.9E-11	1.4E-10	Exempted	
Sr-90	5.6E-11	9.4E-11	Exempted	
Tc-99	5.2E-11	1.9E-10	Exempted	

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Co-60	4.9E-11	2.4E-10	Exempted	
Eu-154	1.3E-11	4.1E-11	Exempted	
Pm-147	1.2E-11	4.3E-11	Exempted	
Sb-125	9.6E-12	3.0E-11	Exempted	
Te-125m	7.6E-12	2.9E-11	Exempted	
Y-90	5.4E-12	2.0E-11	Exempted	
Eu-155	3.6E-12	1.2E-11	Exempted	
Mn-54	1.7E-12	4.5E-12	Exempted	
Sm-151	6.1E-14	2.1E-13	Exempted	
Total	3.1E-07	5.4E-07	Exempted	

Table X-3-2 Assessment result of internal exposure from inhalation of seawater spray (Source term based on measured values (J1-G tank group))

	Exposure as	sessment resu		
Nuclide	Adult	Children under school age	Infants	Remarks
H-3	7.3E-08	5.0E-08	3.4E-08	
Pu-239	5.1E-08	2.5E-08	1.1E-08	
Pu-240	5.1E-08	2.5E-08	1.1E-08	
Pu-238	4.6E-08	2.3E-08	1.1E-08	
Am-241	4.1E-08	2.0E-08	9.8E-09	
Pu-241	3.5E-08	1.5E-08	5.4E-09	
Cm-243	2.9E-08	1.6E-08	8.7E-09	
Cm-244	2.4E-08	1.4E-08	8.1E-09	
Np-237	2.1E-08	9.9E-09	5.3E-09	
U-234	4.0E-09	3.1E-09	1.8E-09	
U-238	3.4E-09	2.7E-09	1.6E-09	
C-14	1.4E-09	1.0E-09	5.9E-10	
Ru-106	4.8E-10	4.0E-10	2.4E-10	
Ce-144	4.4E-10	4.6E-10	3.8E-10	
Tc-99	2.5E-10	1.8E-10	1.0E-10	
Cs-137	1.9E-10	1.4E-10	7.0E-11	
I-129	1.8E-10	1.2E-10	4.6E-11	
Ni-63	1.7E-10	1.4E-10	8.2E-11	
Se-79	1.5E-10	1.2E-10	6.7E-11	
Cd-113m	1.4E-10	9.2E-11	5.0E-11	
Co-60	1.1E-10	8.0E-11	4.1E-11	
Eu-154	8.0E-11	5.7E-11	3.1E-11	

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
Sr-90	7.7E-11	5.1E-11	2.6E-11	
Pm-147	5.4E-11	4.7E-11	2.9E-11	
Sb-125	2.5E-11	2.0E-11	1.1E-11	
Cs-134	2.0E-11	1.6E-11	9.1E-12	
Eu-155	1.9E-11	1.5E-11	9.1E-12	
Te-125m	8.9E-12	6.5E-12	4.6E-12	
Mn-54	8.6E-13	8.5E-13	5.5E-13	
Y-90	7.2E-13	8.0E-13	8.1E-13	
Sm-151	6.0E-13	4.0E-13	2.1E-13	
Total	3.8E-07	2.1E-07	1.1E-07	

Table X-3-3 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-G tank group), Average ingestion)

	Exposure assessment result (mSv/year)			
Nuclide	Adult	Children under school age	Infants	Remarks
C-14	1.0E-06	8.8E-07	5.1E-07	
I-129	3.0E-07	2.3E-07	9.5E-08	
Se-79	2.3E-07	7.5E-07	6.6E-07	
Cd-113m	2.0E-07	1.7E-07	2.0E-07	
Am-241	4.4E-08	2.9E-08	1.6E-07	
Pu-239	4.2E-08	2.8E-08	1.4E-07	
Pu-240	4.2E-08	2.8E-08	1.4E-07	
Pu-238	3.9E-08	2.6E-08	1.3E-07	
H-3	3.2E-08	2.8E-08	2.3E-08	
Pu-241	2.9E-08	1.6E-08	6.6E-08	
Cm-243	2.3E-08	1.6E-08	9.3E-08	
Tc-99	2.1E-08	3.7E-08	6.4E-08	
Co-60	1.8E-08	4.6E-08	5.7E-08	
Cm-244	1.8E-08	1.4E-08	8.4E-08	
Ce-144	1.7E-08	3.0E-08	4.1E-08	
Ni-63	1.0E-08	1.5E-08	2.2E-08	
Ru-106	6.9E-09	1.2E-08	1.6E-08	
Cs-137	2.3E-09	8.3E-10	7.5E-10	
Eu-154	1.8E-09	3.0E-09	4.5E-09	
Pm-147	1.7E-09	3.2E-09	4.7E-09	
Mn-54	1.3E-09	1.7E-09	1.9E-09	
Np-237	1.1E-09	6.9E-10	3.9E-09	
Cs-134	6.7E-10	2.3E-10	1.9E-10	

Attachment X-11

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
Eu-155	5.3E-10	9.0E-10	1.4E-09	
Sb-125	4.4E-10	6.9E-10	9.1E-10	
Te-125m	3.5E-10	6.7E-10	1.1E-09	
U-234	1.5E-10	1.3E-10	2.2E-10	
U-238	1.4E-10	1.2E-10	2.0E-10	
Sr-90	2.6E-11	2.2E-11	4.3E-11	
Sm-151	8.9E-12	1.5E-11	2.7E-11	
Y-90	2.5E-12	4.6E-12	5.8E-12	
Total	2.1E-06	2.4E-06	2.5E-06	

Table X-3-4 Assessment result of internal exposure from ingestion of seafood (Source term based on measured values (J1-C tank group), More ingestion)

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
C-14	3.9E-06	3.4E-06	1.9E-06	
I-129	1.4E-06	1.1E-06	4.5E-07	
Cd-113m	1.0E-06	8.8E-07	1.1E-06	
Se-79	8.5E-07	2.8E-06	2.4E-06	
Pu-239	2.2E-07	1.4E-07	7.1E-07	
Pu-240	2.2E-07	1.4E-07	7.1E-07	
Am-241	2.1E-07	1.4E-07	7.5E-07	
Pu-238	2.0E-07	1.4E-07	6.8E-07	
Pu-241	1.5E-07	8.6E-08	3.4E-07	
H-3	1.2E-07	1.1E-07	8.7E-08	
Cm-243	1.1E-07	8.0E-08	4.5E-07	
Tc-99	1.0E-07	1.8E-07	3.0E-07	
Co-60	1.0E-07	2.5E-07	3.1E-07	
Cm-244	8.7E-08	6.9E-08	4.1E-07	
Ce-144	8.5E-08	1.6E-07	2.1E-07	
Ni-63	4.2E-08	6.5E-08	8.8E-08	
Ru-106	3.4E-08	6.1E-08	8.0E-08	
Eu-154	9.8E-09	1.6E-08	2.4E-08	
Pm-147	9.2E-09	1.7E-08	2.5E-08	
Cs-137	8.2E-09	3.1E-09	2.7E-09	
Mn-54	7.4E-09	9.9E-09	1.1E-08	
Np-237	6.4E-09	4.1E-09	2.3E-08	
Eu-155	2.8E-09	4.9E-09	7.4E-09	

	Exposure as	sessment resu	It (mSv/year)	
Nuclide	Adult	Children under school age	Infants	Remarks
Cs-134	2.4E-09	8.5E-10	6.8E-10	
Sb-125	1.6E-09	2.5E-09	3.2E-09	
Te-125m	1.2E-09	2.4E-09	3.7E-09	
U-234	7.5E-10	6.8E-10	1.1E-09	
U-238	6.9E-10	6.2E-10	1.0E-09	
Sr-90	1.2E-10	9.8E-11	1.9E-10	
Sm-151	4.8E-11	8.1E-11	1.4E-10	
Y-90	1.1E-11	2.1E-11	2.5E-11	
Total	9.0E-06	9.9E-06	1.1E-05	_

X-2. Assessment result regarding environmental protection

For the following exposure assessments shown in chapter 7. "Assessment regarding environmental protection", Tables X-4 to 6 show the assessment result of each nuclide.

Source term based on measured values of 31 nuclides

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

Table X-4 Assessment result of environmental protection (Source term based on measured values (K4 tank group))

	Exposure as	sessment resu	ılt (mGy/day)	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Co-60	6.5E-07	6.5E-07	7.1E-07	
Ce-144	7.8E-08	4.6E-08	7.8E-08	
Eu-154	6.1E-08	5.7E-08	6.1E-08	
Ru-106	5.4E-08	5.4E-08	6.4E-08	
C-14	4.0E-08	3.3E-08	2.7E-08	
Mn-54	2.3E-08	2.1E-08	2.3E-08	
Eu-155	7.7E-09	7.5E-09	7.7E-09	
H-3	4.7E-09	4.7E-09	1.8E-09	
Se-79	3.4E-09	3.4E-09	1.5E-10	
Cs-137	2.0E-09	1.9E-09	2.0E-09	
Sb-125	7.0E-10	6.6E-10	8.7E-10	
Cs-134	5.8E-10	5.4E-10	5.7E-10	

	Exposure assessment result (mGy/day)			
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Cd-113m	4.1E-10	1.8E-09	3.4E-11	
Cm-243	3.2E-10	8.3E-10	5.2E-10	
Te-125m	1.9E-10	2.0E-10	1.7E-09	
Pm-147	9.7E-11	1.3E-09	9.0E-10	
Am-241	6.3E-11	2.0E-10	6.4E-11	
Ni-63	4.5E-11	1.1E-09	3.3E-10	
Sr-90	4.3E-11	2.4E-10	4.2E-11	
Pu-238	3.8E-11	2.6E-11	6.3E-11	
Pu-240	3.6E-11	2.4E-11	5.9E-11	
Pu-239	3.6E-11	2.4E-11	5.9E-11	
Tc-99	2.5E-11	5.6E-09	1.6E-08	
I-129	1.1E-11	6.4E-09	2.8E-09	
Cm-244	4.1E-12	5.2E-10	2.0E-10	
Pu-241	1.6E-12	1.1E-12	2.7E-12	
Np-237	3.1E-13	5.8E-12	7.5E-13	
U-234	1.2E-13	4.7E-13	1.1E-12	
U-238	1.1E-13	4.2E-13	9.9E-13	
Sm-151	9.1E-14	1.9E-12	7.9E-13	
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide Sr-90
Total	9.3E-07	9.0E-07	1.0E-06	

Table X-5 Assessment result of environmental protection (Source term based on measured values (J1-C tank group))

	Exposure as	sessment resu	lt (mGy/day)	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Ce-144	1.6E-07	9.5E-08	1.6E-07	
Eu-154	1.3E-07	1.2E-07	1.3E-07	
Co-60	1.1E-07	1.1E-07	1.2E-07	
Mn-54	3.1E-08	2.8E-08	3.1E-08	
Eu-155	1.8E-08	1.8E-08	1.8E-08	
C-14	1.1E-08	9.2E-09	7.4E-09	
Ru-106	1.1E-08	1.1E-08	1.3E-08	
H-3	4.7E-09	4.7E-09	1.8E-09	
Cm-243	3.9E-09	1.0E-08	6.3E-09	
Se-79	7.9E-10	7.9E-10	3.4E-11	
Am-241	7.6E-10	2.5E-09	7.8E-10	
Pu-238	4.7E-10	3.2E-10	7.6E-10	
Cd-113m	4.5E-10	2.0E-09	3.7E-11	
Pu-240	4.4E-10	3.0E-10	7.1E-10	

	Exposure as	sessment resu	lt (mGy/day)	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Pu-239	4.3E-10	3.0E-10	7.1E-10	
Cs-134	2.3E-10	2.1E-10	2.2E-10	
Cs-137	2.1E-10	2.0E-10	2.1E-10	
Sb-125	1.1E-10	1.1E-10	1.4E-10	
Pm-147	9.5E-11	1.3E-09	8.8E-10	
Cm-244	4.9E-11	6.3E-09	2.4E-09	
Ni-63	4.0E-11	9.6E-10	3.0E-10	
Te-125m	3.1E-11	3.2E-11	2.7E-10	
Pu-241	1.6E-11	1.1E-11	2.7E-11	
Tc-99	9.8E-12	2.2E-09	6.5E-09	
Np-237	3.8E-12	7.0E-11	9.1E-12	
Sr-90	1.6E-12	9.1E-12	1.6E-12	
I-129	1.5E-12	8.5E-10	3.7E-10	
U-234	1.4E-12	5.7E-12	1.3E-11	
U-238	1.3E-12	5.1E-12	1.2E-11	
Sm-151	2.6E-13	5.5E-12	2.2E-12	
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide Sr-90
Total	4.9.E-07	4.3.E-07	5.1.E-07	

Table X-6 Assessment result of environmental protection (Source term based on measured values (J1-G tank group))

	Exposure as	sessment resu	lt (mGy/day)	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Ce-144	4.8E-07	2.8E-07	4.8E-07	
Eu-154	3.6E-07	3.4E-07	3.6E-07	
Co-60	2.4E-07	2.4E-07	2.6E-07	
Mn-54	9.3E-08	8.5E-08	9.3E-08	
C-14	3.0E-08	2.5E-08	2.0E-08	
Eu-155	3.0E-08	2.9E-08	3.0E-08	
Ru-106	1.1E-08	1.1E-08	1.3E-08	
Cm-243	1.0E-08	2.6E-08	1.6E-08	
H-3	4.7E-09	4.7E-09	1.8E-09	
Se-79	2.4E-09	2.4E-09	1.0E-10	
Am-241	2.0E-09	6.4E-09	2.0E-09	
Cd-113m	1.4E-09	6.2E-09	1.1E-10	
Pu-238	1.2E-09	8.2E-10	2.0E-09	
Pu-240	1.1E-09	7.6E-10	1.8E-09	
Pu-239	1.1E-09	7.6E-10	1.8E-09	

	Exposure as	sessment resu	ılt (mGy/day)	
Nuclide	Flatfish	Crab	Brown seaweed	Remarks
Cs-137	1.1E-09	1.0E-09	1.1E-09	
Cs-134	6.0E-10	5.7E-10	6.0E-10	
Pm-147	2.6E-10	3.5E-09	2.4E-09	
Sb-125	2.1E-10	2.0E-10	2.6E-10	
Ni-63	1.3E-10	3.0E-09	9.4E-10	
Cm-244	1.3E-10	1.6E-08	6.2E-09	
Te-125m	5.7E-11	6.0E-11	5.0E-10	
Pu-241	4.1E-11	2.8E-11	6.8E-11	
Tc-99	3.2E-11	7.3E-09	2.1E-08	
Np-237	9.7E-12	1.8E-10	2.3E-11	
Sr-90	4.4E-12	2.5E-11	4.3E-12	
U-234	3.7E-12	1.5E-11	3.5E-11	
U-238	3.3E-12	1.3E-11	3.1E-11	
I-129	1.2E-12	7.1E-10	3.1E-10	
Sm-151	7.1E-13	1.5E-11	6.2E-12	
Y-90	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide Sr-90
Total	1.3E-06	1.1E-06	1.3E-06	

Attachment XI Conservativeness of the external exposure dose conversion factor

The dose conversion factor used for the dose assessment of external exposure is quoted from the Handbook for Determining Environmental Impacts of Decommissioning Work (hereinafter called "Decommissioning Handbook"). It has some defects: for example, its target is only the gamma radiation and conversion factors are not prepared for some of the nuclides subject to be assessed. For the unprepared conversion factors, conservativeness is secured by quoting the most conservative conversion factor for each of the $\beta\gamma$ and α nuclides, Co-60 and Am-241, respectively. For verification, comparison was performed using the dose conversion factor of external exposure created overseas.

As the target of comparison, we used Federal Guidance Report No.15, "External Exposure to Radionuclides in Air, Water and Soil" (Environmental Protection Agency, 2019; hereinafter called "FGR15") [XI-1] provided by the U.S. Environmental Protection Agency for radiation protection of U.S. citizens. FGR15 shows the dose conversion factor for the calculation of external exposure of humans from radioactive materials on the ground surface and in the soil, air, and water, and the target nuclides include all of the nuclides subject to the assessment of ALPS treated water, so we attempted an assessment using the dose conversion factor shown in FGR15.

XI-1. Assessment method

Same as the exposure assessment method shown in the chapter 6-1. "Exposure assessment under normal conditions" and only the dose conversion factor is switched. However, external exposure from radioactive materials adhered to fishing nets are excluded from comparison targets because there is no appropriate dose conversion factor in FGR15. The following shows the assessment model and used parameters of each exposure pathway in FGR15.

(1) External exposure from the seawater surface

The effective dose conversion factor from radiation from seawater is calculated by multiplying the external dose conversion factor in immersion in water shown in Table 4-7. Reference person effective dose rate coefficients for water immersion. of FGR15 by the reduction factor of 0.5 considering that there is no radiation source (seawater) upward (Table XI-1). Figure XI-1 shows an image diagram of the assessment model. Shielding by hulls was ignored in the safe side.

Equation (XI-1) shows the calculation equation of the effective dose D₁(mSv/year) from radiation from the seawater surface.

$$D_1 = 1000 \cdot 1000 \cdot 3600 \cdot \sum_{i} (K_1)_i \cdot (x_1)_i \cdot t_1$$
 (XI-1)

where

- $(K_1)_i$ is the effective dose conversion factor from radiation from nuclide i in immersion in water ((Sv/s)/(Bq/m³))
- $(x_1)_i$ is the concentration of nuclide i in seawater (Bq/L)
- t_1 is the annual exposure time (h/year)
- 1000 is the factor of unit conversion (Sv to mSv) of the effective dose
- 1000 is the factor of unit conversion (Bq/L to Bq/m³) of the concentration in seawater
- 3600 is the factor of unit conversion (h/year to s/year) of the annual exposure time

As in the chapter 6-1. "Exposure assessment under normal conditions", the concentration of radioactive materials in seawater used for the assessment was the annual average concentration of the sea surface (top layer) within the 10 km \times 10 km area around the power plant.

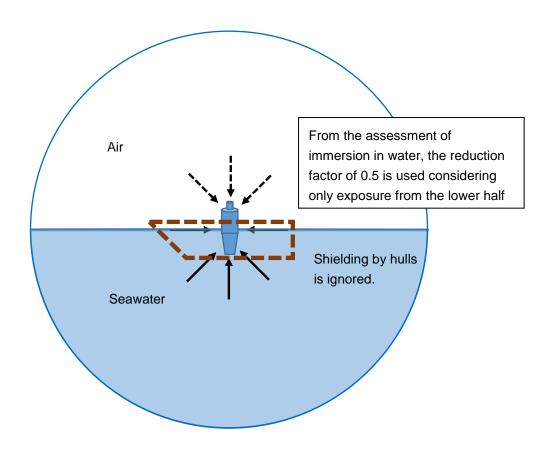


Figure XI-1 Conceptual diagram of the exposure assessment model from radioactive materials in seawater during work at sea

(2) External exposure from hulls

Assess the external radiation exposure from radioactive materials migrated from seawater to hulls during work at sea. The effective dose conversion factor from radiation from radioactive materials migrated from seawater to hulls is the external dose conversion factor in immersion in water shown in Table 4-1. Reference person effective dose rate coefficients for ground surface. of FGR15. (Table XI-2). Figure XI-2 shows an image diagram of the assessment model.

Equations (XI-2) and (XI-3) show the calculation equation of the effective dose $D_2(mSv/year)$ from radioactive materials adhered to hulls.

$$D_2 = 1000 \cdot 3600 \cdot \sum_{i} (K_2)_i \cdot (S_2)_i \cdot t_2$$
 (XI-2)

$$(S_2)_i = (F_2)_i \cdot (x_2)_i$$
 (XI-3)

where

 $(K_2)_i$ is the effective dose conversion factor from radiation from nuclide *i* from hulls $((Sv/s)/(Bq/m^2))$

 $(S_2)_i$ is the contamination density of nuclide *i* in hulls (Bq/m²)

 t_2 is the annual exposure time (h/year)

 $(F_2)_i$ is the migration factor of nuclide *i* from seawater to hulls ((Bq/m²)/(Bq/L))

 $(x_2)_i$ is the concentration of nuclide *i* in seawater (Bq/L) at the assessment point

1000 is the factor of unit conversion (Sv to mSv) of the effective dose

3600 is the factor of unit conversion (h/year to s/year) of the annual exposure time

As in the chapter 6-1. "Exposure assessment under normal conditions", the migration factor to hulls is $100((Bq/m^2)/(Bq/L))$ from the Application for the Designation of Reprocessing Business at Rokkasho business facility.

As in the chapter 6-1. "Exposure assessment under normal conditions, the concentration of radioactive materials in seawater used for the assessment was the annual average concentration of the sea surface (top layer) within the 10 km \times 10 km area around the power plant.

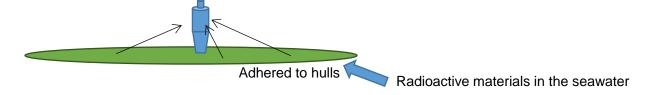


Figure XI-2 Conceptual diagram of the exposure assessment model from radioactive materials adhered to hulls during work at sea

(3) External exposure under water such as during swimming

Assess the external exposure from radioactive materials in the surrounding seawater during swimming and underwater work. The effective dose conversion factor from radiation from radioactive materials in seawater is the external dose conversion factor in immersion in water shown in Table 4-7. Reference person effective dose rate coefficients for water immersion. of FGR15 (Table XI-3). Figure XI-3 shows an image diagram of the assessment model.

Equation (XI-4) shows the calculation equation of the effective dose D₃ (mSv/year) from radiation during swimming and underwater work.

$$D_3 = 1000 \cdot 1000 \cdot 3600 \cdot \sum_{i} (K_3)_i \cdot (x_3)_i \cdot t_3$$
 (XI-4)

where

 $(K_3)_i$ is the effective dose conversion factor from radiation from nuclide *i* from seawater ((Sv/s)/(Bq/m³))

 $(x_3)_i$ is the concentration of nuclide i in seawater (Bq/L)

 t_3 is the annual exposure time (h/year)

1000 is the factor of unit conversion (Sv to mSv) of the effective dose

1000 is the factor of unit conversion (Bq/L to Bq/m³) of the concentration in seawater

3600 is the factor of unit conversion (h/year to s/year) of the annual exposure time

As in the chapter 6-1. "Exposure assessment under normal conditions", the concentration of radioactive materials in seawater used for the assessment site and for the assessment is the average concentration in sea water around the beach to the north of the power plant where the evacuation order has been lifted.

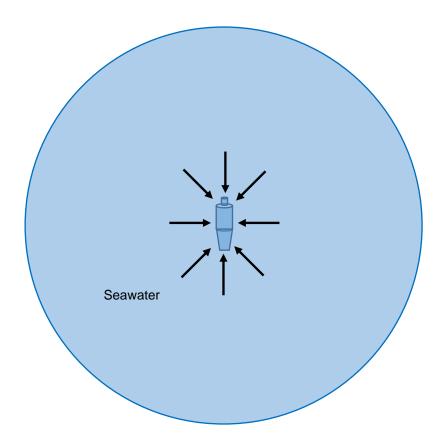


Figure XI-3 Conceptual diagram of the exposure assessment model from radioactive materials in seawater

(4) External exposure from beach sand

Assess the external exposure from radioactive materials migrated from seawater to beach sand while staying at a beach. The effective dose conversion factor from radiation from radioactive materials at a beach is the external dose conversion factor regarding exposure from radioactive materials in the soil shown in Table 4-5. Reference person effective dose rate coefficients for soil to infinite depth. of FGR15 (Table XI-4). Figure XI-4 shows an image diagram of the assessment model.

Equation (XI-5) shows the calculation equation of the effective dose D_4 (mSv/year) from the gamma radiation from beach sand.

$$D_4 = 1000 \cdot 1600 \cdot 3600 \cdot \sum_{i} (K_4)_i \cdot (x_4)_i \cdot (F_4)_i \cdot t_4$$
(XI-5)

where

 $(K_4)_i$ is the effective dose conversion factor from radiation from nuclide *i* from beach sand $((Sv/s)/(Bq/m^3))$

 $(x_4)_i$ is the concentration of nuclide i in seawater (Bq/L)

 $(F_4)_i$ is the migration factor of nuclide i from seawater to beaches ((Bq/kg)/(Bq/L))

 t_4 is the annual exposure time (h/year)

1000 is the factor of unit conversion (Sv to mSv) of the effective dose

1600 is the factor of unit conversion (Bq/kg to Bq/m³) of the radioactive material concentration in the soil

3600 is the factor of unit conversion (h/year to s/year) of the annual exposure time

As with the chapter 6-1. "Exposure assessment under normal conditions", the migration factor of nuclides to beaches is 1,000[(Bq/kg)/(Bq/L)] for all nuclides based on "Dose Assessment to the General Public in the Safety Review of Commercial Light Water Reactor Facilities."

As in the chapter 6-1. "Exposure assessment under normal conditions", the concentration of radioactive materials in seawater used for the assessment site and for the assessment is the average concentration in sea water around the beach to the north of the power plant where the evacuation order has been lifted.

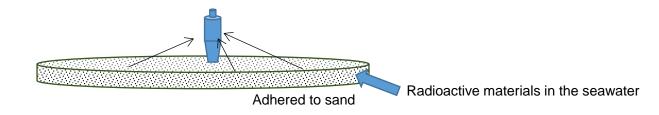


Figure XI-4 Conceptual diagram of the exposure assessment model from radioactive materials adhered to beach sand

XI-2. Setting of the representative person subject to the exposure assessment The features of representative persons subject to the exposure assessment were the same as 6-2-5. as follows.

- Engage in fishing 120 days (2,880 hours) a year, of which 80 days (1,920 hours) are spent near fishing nets.
- Stay at the beach 500 hours a year and swim for 96 hours.

Table XI-1 Dose conversion factor for the effective dose from the radiation from the sea surface using FGR15

		1
Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks
H-3	3.1E-27	
C-14	1.4E-21	
Mn-54	4.0E-17	
Co-60	1.3E-16	
Ni-63	3.9E-24	
Se-79	1.7E-21	
Sr-90	5.4E-20	
Y-90	4.7E-19	
Tc-99	1.5E-20	
Ru-106	1.0E-17	The progeny nuclide Rh-106 is considered
Cd-113m	5.2E-20	
Sb-125	1.9E-17	
Te-125m	3.0E-19	
I-129	2.6E-19	
Cs-134	7.3E-17	
Cs-137	2.8E-17	The progeny nuclide Ba-137 is considered
Ce-144	3.1E-18	The progeny nuclide Pr-144, Pr-144m are considered
Pm-147	4.7E-21	
Sm-151	3.1E-23	
Eu-154	6.1E-17	
Eu-155	2.0E-18	
U-234	5.8E-21	
U-238	1.5E-18	The progeny nuclide Th-234, Pa-234m are considered
Np-237	9.7E-18	The progeny nuclide Pa-233 is considered
Pu-238	3.3E-21	
Pu-239	3.6E-21	
Pu-240	3.2E-21	
Pu-241	5.7E-23	

Nuclide	Dose conversion factor for the effective dose	Remarks
Am-241	((Sv/s)/(Bq/m ³)) 6.0E-19	
Cm-243	5.0E-18	
Cm-244	3.9E-21	

Table XI-2 Dose conversion factor for the effective dose from the radiation from hulls using FGR15

Dose conversion	
factor for the	Remarks
effective dose	Kemane
((Sv/s)/(Bq/m ²))	
6.7E-22	
6.1E-19	
5.3E-16	
1.5E-15	
8.0E-20	
6.8E-19	
6.5E-18	
1.5E-16	
2.0E-18	
3.4E-16	The progeny nuclide Rh-106 is considered
6.3E-18	
2.7E-16	
4.1E-18	
4.4E-18	
1.0E-15	
4.0E-16	The progeny nuclide Ba-137 is considered
2.2E-16	The progeny nuclide Pr-144, Pr- 144m are considered
9.4E-19	
1.1E-19	
7.9E-16	
3.1E-17	
6.4E-20	
	factor for the effective dose ((Sv/s)/(Bq/m²)) 6.7E-22 6.1E-19 5.3E-16 1.5E-15 8.0E-20 6.8E-19 6.5E-18 1.5E-16 2.0E-18 3.4E-16 6.3E-18 2.7E-16 4.1E-18 4.4E-18 1.0E-15 4.0E-16 9.4E-19 1.1E-19 7.9E-16 3.1E-17

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m²))	Remarks
U-238	1.4E-16	The progeny nuclide Th-234, Pa- 234m are considered
Np-237	1.4E-16	The progeny nuclide Pa-233 is considered
Pu-238	2.1E-20	
Pu-239	4.2E-20	
Pu-240	2.2E-20	
Pu-241	1.7E-21	
Am-241	9.9E-18	
Cm-243	7.1E-17	
Cm-244	3.1E-20	

Table XI-3 Dose conversion factor for the effective dose from seawater during swimming and underwater work using FGR15

	Dose conversion	
	factor for the	
Nuclide	effective dose	Remarks
	((Sv/s)/(Bq/m ³))	
H-3	6.2E-27	
C-14	2.8E-21	
Mn-54	8.0E-17	
Co-60	2.5E-16	
Ni-63	7.8E-24	
Se-79	3.3E-21	
Sr-90	1.1E-19	
Y-90	9.5E-19	
Tc-99	3.1E-20	
Ru-106	2.1E-17	The progeny nuclide Rh-106 is considered
Cd-113m	1.0E-19	
Sb-125	3.8E-17	
Te-125m	6.0E-19	
I-129	5.1E-19	
Cs-134	1.5E-16	

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks
Cs-137	5.6E-17	The progeny nuclide Ba-137 is considered
Ce-144	6.1E-18	The progeny nuclide Pr-144, Pr- 144m are considered
Pm-147	9.4E-21	
Sm-151	6.1E-23	
Eu-154	1.2E-16	
Eu-155	3.9E-18	
U-234	1.2E-20	
U-238	2.9E-18	The progeny nuclide Th-234, Pa- 234m are considered
Np-237	1.9E-17	The progeny nuclide Pa-233 is considered
Pu-238	6.6E-21	
Pu-239	7.3E-21	
Pu-240	6.5E-21	
Pu-241	1.1E-22	
Am-241	1.2E-18	
Cm-243	1.0E-17	
Cm-244	7.9E-21	

Table XI-4 Dose conversion factor for the effective dose from the radiation from beach sand using FGR15

Nuclide	Dose conversion factor for the effective dose ((Sv/s)/(Bq/m³))	Remarks
H-3	3.4E-23	
C-14	3.1E-20	
Mn-54	2.6E-17	
Co-60	8.3E-17	
Ni-63	4.1E-21	
Se-79	3.5E-20	
Sr-90	2.6E-19	
Y-90	2.3E-18	
Tc-99	1.0E-19	
Ru-106	1.0E-17	The progeny nuclide Rh-106 is considered

	Dose conversion	
Nuclide	factor for the effective	Remarks
Nuclide	dose	Remarks
	((Sv/s)/(Bq/m ³))	
Cd-113m	2.5E-19	
Sb-125	1.2E-17	
Te-125m	5.1E-20	
I-129	7.9E-20	
Cs-134	4.8E-17	
Cs-137	1.8E-17	The progeny nuclide Ba-137 is considered
Ce-144	4.7E-18	The progeny nuclide Pr-144, Pr-144m are considered
Pm-147	4.8E-20	
Sm-151	5.5E-21	
Eu-154	3.9E-17	
Eu-155	9.5E-19	
U-234	1.9E-21	
U-238	2.6E-18	The progeny nuclide Th-234, Pa-234m are considered
Np-237	5.8E-18	The progeny nuclide Pa-233 is considered
Pu-238	5.3E-22	
Pu-239	1.5E-21	
Pu-240	5.5E-22	
Pu-241	7.5E-23	
Am-241	2.2E-19	
Cm-243	2.9E-18	
Cm-244	1.0E-21	

XI-3. Exposure assessment result

Table XI-6 shows comparison with the assessment result of Table 6-1-22 in the results of the external exposure dose assessments of the following three cases.

Source term based on the composition of nuclides of the measured value

- i. K4 tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.28)
- ii. J1-C tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.23)
- iii. J1-G tank group (Sum of the ratios to regulatory concentration limits of 30 nuclides other than tritium: 0.12)

Overall, the assessment using the conversion factor in the Decommissioning Handbook had similar resuts as those using the conversion factor in FGR15. This is thought to be due to the

fact that the number of the nuclides for which conversion factors were not shown in the Decommissioning Handbook was reduced due to the selection of nuclides to be measured and assessed, and the use of conservative conversion factors such as Co-60 was reduced.

Table XI-6 Comparison with the external exposure dose assessment result using the dose conversion factor of FGR15

Source	Source term based on measured values						
term	erm i. K4 tank group		ii. J1-C tank group		iii. J1-G tank group		
Dose conversio n factor	Decommissio ning Handbook	FGR15	FGR15 Decommissio ning FGR15 Handbook		Decommissio ning Handbook	FGR15	
Seawater surface	7.6E-10	6.3E-10	2.3E-10	1.3E-10	4.8E-10	2.8E-10	
Hull	7.2E-10	1.1E-09	2.2E-10	3.1E-10	4.6E-10	5.5E-10	
Swimming	5.2E-10	3.1E-10	1.6E-10	6.2E-11	3.2E-10	1.4E-10	
Beach sand	9.1E-07	5.7E-07	2.7E-07	1.2E-07	5.6E-07	2.6E-07	

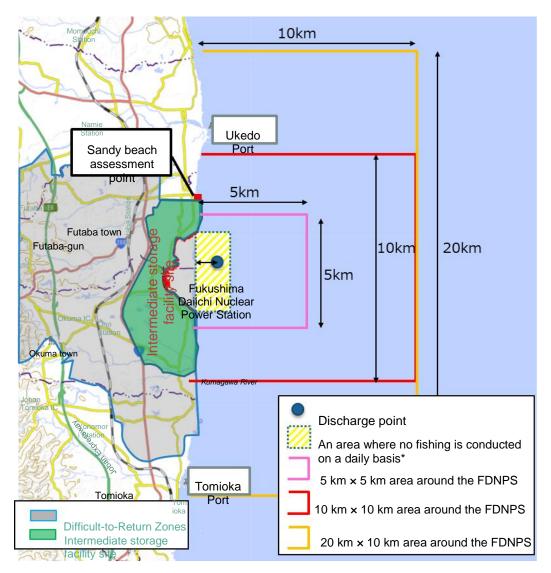
References

[XI-1] EPA, FEDERAL GUIDANCE REPORT NO.15 "EXTERNAL EXPOSURE TO RADIONUCLIDES IN AIR, WATER AND SOIL",2019

Attachment XII Impact of the assessment range of concentrations in seawater used for the assessment of exposures

In the chapter 6-1-2. (4) "Setting of the representative person", for the concentration in the seawater used for the exposure assessment, the average concentration within 10 km \times 10 km around the FDNPS is used considering the distance from the nearby fishing port (about 6 km) because fishing is assumed as the feature of the representative person. However, since the actual behaviors of the representative person is uncertain, we changed the assessment target range from 5 km \times 5 km to 20 km in the north-south direction \times 10 km in the east-west direction to calculate exposure.

The target range of the sea area is set to 5 km \times 5 km and 20 km \times 10 km around the power plant as shown in Figure XII-1.



*Areas where common fishery rights are not established

Figure XII-1 Assessment range to confirm the impact of the range of concentrations in seawater used for the assessment of exposures

XII-1. Assessment method

We performed the same assessment as 6-1. Exposure assessment under normal conditions and changed the calculation range of the average concentration of tritium only for the concentration in the seawater used for the assessment.

Table XII-1 shows the annual average concentration within 5 km \times 5 km and 20 km \times 10 km around the FDNPS in the case of the annual discharge amount of 22 TBq (2.2E+13Bq) of tritium. We compared the concentrations in 2014 and 2019 and decided to use the concentration of 2019, which is higher, for the exposure assessment.

Tables XII-2 to 4 show this result and the radioactive material concentration in the seawater for the assessment calculated from the annual discharge amount of each nuclide shown in Tables 6-1-1 to 6-1-3 used for the assessment in each term. Since the sandy beach assessment point was the same, the concentration in the seawater used for the assessment of exposure from swimming, ingestion of water, inhalation of seawater spray, and beach sand was set to the same regardless of the assessment target range.

Table XII-1 Tritium concentration in the seawater in the case of the annual tritium

discharge amount of 2.2E+13Bq

alborial go amba		Calculation result (Bq/L)			
	Depth	Meteorologi cal and oceanograp hic data of 2014	Meteorologi cal and oceanograp hic data of 2019	Difference (%)	Concentration for assessment (Bq/L)
Annual average concentration within 5 km × 5 km around the FDNPS	All layers	1.5E-01	1.7E-01	13	1.7E-01
	Top layer	2.1E-01	2.4E-01	14	2.4E-01
Annual average concentration within 20 km × 10 km around the FDNPS	All layers	4.1E-02	4.8E-02	17	4.8E-02
	Top layer	8.8E-02	1.1E-01	25	1.1E-01

Table XII-2 Concentration in the seawater used for the assessment (Source term based on measured values (K4 tank group))

	Annual	Concentration in the seawater used for the assessment (Bq/L)			
Target nuclide	volume of discharge (Bq)	Average of all layers within 5km×5km	Average of the top layers within 5km×5km	Average of all layers within 20km×10km	Average of all layers within 5km×5km
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01
C-14	1.7E+09	1.3E-05	1.9E-05	3.8E-06	8.7E-06
Mn-54	7.8E+05	6.0E-09	8.5E-09	1.7E-09	3.9E-09
Co-60	5.1E+07	3.9E-07	5.6E-07	1.1E-07	2.5E-07
Ni-63	2.5E+08	2.0E-06	2.8E-06	5.6E-07	1.3E-06
Se-79	1.7E+08	1.3E-06	1.9E-06	3.8E-07	8.7E-07
Sr-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07
Y-90	2.5E+07	2.0E-07	2.8E-07	5.6E-08	1.3E-07
Tc-99	8.1E+07	6.3E-07	8.8E-07	1.8E-07	4.1E-07
Ru-106	1.9E+08	1.4E-06	2.0E-06	4.0E-07	9.3E-07
Cd-113m	2.1E+06	1.6E-08	2.3E-08	4.5E-09	1.0E-08
Sb-125	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07
Te-125m	3.8E+07	3.0E-07	4.2E-07	8.3E-08	1.9E-07
I-129	2.4E+08	1.9E-06	2.7E-06	5.3E-07	1.2E-06
Cs-134	5.2E+06	4.0E-08	5.7E-08	1.1E-08	2.6E-08
Cs-137	4.9E+07	3.8E-07	5.3E-07	1.1E-07	2.4E-07
Ce-144	7.3E+06	5.6E-08	8.0E-08	1.6E-08	3.6E-08
Pm-147	2.2E+07	1.7E-07	2.4E-07	4.8E-08	1.1E-07
Sm-151	1.0E+05	8.1E-10	1.1E-09	2.3E-10	5.2E-10
Eu-154	1.4E+06	1.1E-08	1.5E-08	3.0E-09	6.9E-09
Eu-155	3.8E+06	3.0E-08	4.2E-08	8.3E-09	1.9E-08
U-234	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
U-238	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Np-237	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Pu-238	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Pu-239	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Pu-240	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Pu-241	3.2E+06	2.5E-08	3.5E-08	7.1E-09	1.6E-08
Am-241	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Cm-243	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Cm-244	7.3E+04	5.6E-10	8.0E-10	1.6E-10	3.6E-10
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls

Table XII-3 Concentration in the seawater used for the assessment (Source term based on measured values (J1-C tank group))

	Annual	Concentration in the seawater used for the assessment (Bq/L)			
Target nuclide	volume of discharge (Bq)	Average of all layers within 5km×5km	Average of the top layers within 5km×5km	Average of all layers within 20km×10km	Average of all layers within 5km×5km
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01
C-14	4.8E+08	3.7E-06	5.3E-06	1.1E-06	2.4E-06
Mn-54	1.0E+06	7.9E-09	1.1E-08	2.2E-09	5.1E-09
Co-60	8.9E+06	6.8E-08	9.7E-08	1.9E-08	4.4E-08
Ni-63	2.3E+08	1.8E-06	2.5E-06	5.0E-07	1.1E-06
Se-79	4.0E+07	3.1E-07	4.4E-07	8.8E-08	2.0E-07
Sr-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
Y-90	9.7E+05	7.5E-09	1.1E-08	2.1E-09	4.8E-09
Tc-99	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Ru-106	3.8E+07	2.9E-07	4.1E-07	8.2E-08	1.9E-07
Cd-113m	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Sb-125	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
Te-125m	6.2E+06	4.8E-08	6.7E-08	1.3E-08	3.1E-08
I-129	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Cs-134	2.0E+06	1.6E-08	2.2E-08	4.4E-09	1.0E-08
Cs-137	5.1E+06	3.9E-08	5.6E-08	1.1E-08	2.5E-08
Ce-144	1.5E+07	1.2E-07	1.7E-07	3.3E-08	7.6E-08
Pm-147	2.1E+07	1.7E-07	2.3E-07	4.7E-08	1.1E-07
Sm-151	3.0E+05	2.3E-09	3.2E-09	6.4E-10	1.5E-09
Eu-154	3.0E+06	2.3E-08	3.2E-08	6.4E-09	1.5E-08
Eu-155	9.1E+06	7.0E-08	1.0E-07	2.0E-08	4.6E-08
U-234	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
U-238	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Np-237	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-238	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-239	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-240	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Pu-241	3.2E+07	2.5E-07	3.5E-07	7.0E-08	1.6E-07
Am-241	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-243	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Cm-244	8.9E+05	6.8E-09	9.7E-09	1.9E-09	4.4E-09
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls

Table XII-4 Concentration in the seawater used for the assessment (Source term based on measured value (J1-G tank group))

	Annual	Concentration	n in the seawater	used for the asses	ssment (Bq/L)
Target nuclide	volume of discharge (Bq)	Average of all layers within 5km×5km	Average of the top layers within 5km×5km	Average of all layers within 20km×10km	Average of all layers within 5km×5km
H-3	2.2E+13	1.7E-01	2.4E-01	4.8E-02	1.1E-01
C-14	1.3E+09	1.0E-05	1.4E-05	2.8E-06	6.5E-06
Mn-54	3.1E+06	2.4E-08	3.4E-08	6.8E-09	1.5E-08
Co-60	1.9E+07	1.4E-07	2.0E-07	4.1E-08	9.4E-08
Ni-63	7.2E+08	5.5E-06	7.8E-06	1.6E-06	3.6E-06
Se-79	1.2E+08	9.4E-07	1.3E-06	2.7E-07	6.1E-07
Sr-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Y-90	2.6E+06	2.0E-08	2.8E-08	5.7E-09	1.3E-08
Tc-99	1.1E+08	8.2E-07	1.2E-06	2.3E-07	5.3E-07
Ru-106	3.9E+07	3.0E-07	4.3E-07	8.5E-08	2.0E-07
Cd-113m	7.0E+06	5.4E-08	7.6E-08	1.5E-08	3.5E-08
Sb-125	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
Te-125m	1.1E+07	8.8E-08	1.2E-07	2.5E-08	5.7E-08
I-129	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
Cs-134	5.5E+06	4.2E-08	6.0E-08	1.2E-08	2.7E-08
Cs-137	2.7E+07	2.1E-07	2.9E-07	5.9E-08	1.3E-07
Ce-144	4.5E+07	3.5E-07	4.9E-07	9.8E-08	2.2E-07
Pm-147	5.9E+07	4.5E-07	6.4E-07	1.3E-07	2.9E-07
Sm-151	8.1E+05	6.3E-09	8.9E-09	1.8E-09	4.1E-09
Eu-154	8.1E+06	6.3E-08	8.9E-08	1.8E-08	4.1E-08
Eu-155	1.5E+07	1.1E-07	1.6E-07	3.2E-08	7.3E-08
U-234	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
U-238	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Np-237	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-238	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-239	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-240	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Pu-241	8.1E+07	6.3E-07	8.9E-07	1.8E-07	4.1E-07
Am-241	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Cm-243	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Cm-244	2.3E+06	1.8E-08	2.5E-08	5.0E-09	1.1E-08
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	From fishing nets Ingestion of seafood	From sea surface From hulls

XII-2. Assessment results

Tables XII-5 to 10 show the assessment results. When the assessment result with the assessment area set to $10 \text{ km} \times 10 \text{ km}$, the assessment results are 0.000002 (2E-06) to 0.00002 (2E-05) mSv/year, when the assessment area is $5 \text{ km} \times 5 \text{ km}$, the value were 0.000004 (4E-06) to 0.00006 (6E-05) mSv/ year, which are two to three times higher. Moreover, when the assessment area is set to $20 \text{ km} \times 10 \text{ km}$, the results ranged from 0.00002 (2E-06) to 0.00002 (2E-05) mSv/year, almost same as the case of $10 \text{ km} \times 10 \text{ km}$. In all cases, the results remained significantly smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year for domestic nuclear power plants, which is equivalent to the dose constraint value.

Even for infants, whose effective dose factor and the assessment value of internal exposure are intended to high, the assessment result of internal exposure from ingestion of seafood is not exceeded value of adult and, 0.000001 (1.0E-06) to 0.00002 (2.0E-05) mSv/year with the assessment area set to 5 km × 5 km, which is 2 to 3 times higher than 0.000031 (3.1E-06) to 0.000037 (3.7E-05) mSv/year with $10 \text{ km} \times 10 \text{ km}$.

Moreover, when the assessment area is set to 20 km \times 10 km, the result is 0.00000087 (8.7E-07) to 0.00001 (1.0E-05) mSv/year, which is lower than that of 10 km \times 10 km.

Table XII-5 Human exposure assessment result (Source term based on measured values (K4 tank group))

Assessed	Assessment area of the concentration	10 km >	10 km × 10 km		∢ 5 km	20 km × 10 km		
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
	Sea surface	7.68	7.6E-10		1.5E-09		7.0E-10	
	Hull	7.28	≣-10	1.4E-09		6.68	≣-10	
External exposure (mSv/year)	During swimming	5.2E-10		5.2E-10		5.2E-10		
	Beach sand	9.1E-07		9.1E-07		9.1E-07		
	Fishing net	1.8E-07		5.4E	E-07	1.5E	E-07	
	Ingestion of water	3.3	E-07	3.3E-07		3.3E-07		
Internal exposure (mSv/year)	Inhalation of spray	of 9.1E-08		9.16	E-08	9.16	E-08	
	Ingestion of seafood	4.7E-06	2.0E-05	1.4E-05	4.7E-06	4.0E-06	1.8E-05	
Total (mSv/year)		6E-06	2E-05	2E-05	6E-06	5E-05	2E-05	

Table XII-6 Human exposure assessment result (Source term based on measured values (J1-C tank group))

Assessed	Assessment area of the concentration	10 km × 10 km		10 km × 10 km 5 km × 5 km		20 km × 10 km		
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
	Sea surface	2.38	2.3E-10		4.6E-10		2.1E-10	
	Hull	2.2	≣-10	4.5E-10		2.16	≣-10	
External exposure (mSv/year)	During swimming	1.6E-10		1.6E-10		1.6E-10		
	Beach sand	2.7E-07		2.7E-07		2.7E-07		
	Fishing net	5.3E-08		1.6E	E-07	4.66	E-08	
	Ingestion of water	3.1E	E-07	3.1E-07		3.1E-07		
Internal exposure (mSv/year)	Inhalation of spray	1.98	E-07	1.9E	E-07	1.96	E-07	
	Ingestion of seafood	1.0E-06	4.5E-06	3.2E-06	1.4E-05	9.0E-07	3.9E-06	
Total (mSv/year)		2E-06	5E-06	4E-06	1E-06	2E-06	5E-06	

Table XII-7 Human exposure assessment result (Source term based on measured values (J1-G tank group))

Assessed	Assessment area of the concentration	10 km × 10 km		5 km >	∢ 5 km	20 km :	≺ 10 km	
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
	Sea surface	4.88	4.8E-10		9.5E-10		4.4E-10	
	Hull	4.68	≣-10	9.1E-10		4.2E-10		
External exposure (mSv/year)	During swimming	3.2E-10		3.2E-10		3.2E-10		
	Beach sand	5.6E-07		5.6E-07		5.6E-07		
	Fishing net	1.1E-07		3.3E	E-07	9.36	E-08	
	Ingestion of water	3.16	E-07	3.1E-07		3.1E-07		
Internal exposure (mSv/year)	Inhalation of spray	3.8	E-07	3.8E	E-07	3.8	E-07	
	Ingestion of seafood	2.1E-06	9.0E-06	6.4E-06	2.7E-05	1.8E-06	7.7E-06	
Total (mSv/year)		3E-06	1E-05	8E-06	3E-05	3E-06	9E-06	

Table XII-8 Age-specific internal exposure assessment result (Source term based on measured values (K4 tank group))

Assessed	Assessment range of the concentration	10 km >	10 km × 10 km		5 km × 5 km		20 km × 10 km	
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
Internal	Adult	3.3E	3.3E-07		E-07	3.3E-07		
from ingestion of water	gestion of school age		5.7E-07		5.7E-07		5.7E-07	
(mSv/year)	Infant	-		-		-		
Internal	Adult	9.1E-08		9.1E-08		9.1E-08		
from inhalation of	Child under school age	6.0E-08		6.08	E-08	6.08	E-08	
spray (mSv/year)	Infant	3.9E-08		3.9E-08		3.98	E-08	
Internal	Adult	4.7E-06	2.0E-05	1.4E-05	6.2E-05	4.0E-06	1.8E-05	
from ingestion of	Child under school age	4.6E-06	2.0E-05	1.4E-05	6.1E-05	3.9E-06	1.7E-05	
seafood (mSv/year)	Infants	2.9E-06	1.2E-05	8.8E-06	3.7E-05	2.5E-06	1.0E-05	

Table XII-9 Age-specific internal exposure assessment result (Source term based on measured values (J1-C tank group))

Assessed	Assessment range of the concentration	10 km >	10 km × 10 km		5 km × 5 km		20 km × 10 km	
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
Internal exposure	Adult	3.1E	3.1E-07		Ξ-07	3.1E-07		
from ingestion of water	Child under school age	5.3E-07		5.3E-07		5.3E-07		
(mSv/year)	Infant	-		-		-		
Internal	Adult	1.9E-07		1.9E-07		1.9E-07		
from inhalation of	Child under school age	1.1E-07		1.16	E-07	1.16	E-07	
spray (mSv/year)	Infant	6.3E	6.3E-08		6.3E-08		6.3E-08	
Internal	Adult	1.0E-06	4.5E-06	3.2E-06	1.4E-05	9.0E-07	3.9E-06	
from ingestion of	Child under school age	1.1E-06	4.5E-06	3.2E-06	1.4E-05	9.0E-07	3.9E-06	
seafood (mSv/year)	Infants	1.0E-06	4.5E-06	3.1E-06	1.4E-05	8.7E-07	3.9E-06	

Table XII-10 Age-specific internal exposure assessment result (Source term based on measured values (J1-G tank group))

Assessed	Assessment range of the concentration	10 km :	10 km × 10 km		5 km × 5 km		20 km × 10 km	
case	Ingestion of seafood	Average	Large	Average	Large	Average	Large	
Internal exposure	Adult	3.16	≣-07	3.18	≣-07	3.1E-07		
from ingestion of water	Child under school age	5.4E-07		5.4E-07		5.4E-07		
(mSv/year)	Infant	-		-		-		
Internal	Adult	3.8E-07		3.8E-07		3.8E-07		
from inhalation of	Child under school age	2.1E-07		2.1E-07		2.1E-07		
spray (mSv/year)	Infant	1.1E-07		1.1E-07		1.1E-07		
Internal	Adult	2.1E-06	9.0E-06	6.4E-06	2.7E-05	1.8E-06	7.7E-06	
from ingestion of	Child under school age	2.4E-06	9.9E-06	7.2E-06	3.0E-05	2.0E-06	8.5E-06	
seafood (mSv/year)	Infants	2.5E-06	1.1E-05	7.7E-06	3.4E-05	2.2E-06	9.5E-06	

Attachment XIII Application of uncertainty in the analysis of ALPS treated water

ALPS treated water analysis includes analysis methods for gamma-ray emitting nuclides, which have been widely used in our power station, and other methods introduced after the 2011 off the Paciffic coast of Tohoku Earthquake in 2011, which have been developed by JAEA to confirm the radioactivity concentration of power plant waste and research facility waste, focusing on the change of nuclides in cooling water caused by contacts with fuel debris. Especially for methods that have been modified or newly adopted after the Earthquake, it is necessary to confirm that the intended analysis has been appropriately performed and obtained analytical values are appropriate.

Since the analytical value of ALPS treated water is used for the operational management of discharging ALPS-treated water and measuring the degree of environmental impact, it is necessary to manage and evaluate the analytical value after grasping the degree of variation. This degree of the variation was assessed by using "expanded uncertainty", which was obtained by grasping and evaluating individual features of the analytical process and sample preparation quantity, calibration and environment of analytical instruments for usage, and pretreatment. By introducing "expanded uncertainty" quantified into error bars, we also evaluated the uncertainty possessed by the analytical method, and we examined the method of matching with the analytical results by designated third party laboratories.

XIII-1 Process to assess uncertainties of measurements

The expanded uncertainty is assessed according to the following procedure [1].

Step 1: Development of a Measurement Model

Clarify the relationship between the radioactivity concentration of measured quantity and the input quantity (count measured by instrument, sample quantity, correction coefficients etc.).

Step 2: Identification of uncertainty sources

The measurement procedure is clarified, and potential factors of uncertainty are listed in Fishbone Diagrams and Tables of Source summary table.

Step 3: Quantification of uncertainty components

The magnitude of the components of uncertainty associated with the identified potential factors is estimated by using a budget sheet.

Step 4: Calculation of combined standard uncertainty

The magnitude of the contribution of uncertainty in each potential factor is expressed in standard deviations. Combined standard uncertainty is calculated based on general rules.

Step 5: Calculation of expanded uncertainty

The expanded uncertainty is calculated by multiplying the combined standard uncertainty by the coverage factor k. This result is also shown in the measurement results.

XIII-1-1 Step 1: Development of a Measurement Model

In this step, the relationship between the radioactivity concentration of measured quantity and the input quantity of the counting in the measuring instrument, the measured sample quantity, and half-life correction coefficient for each nuclide is clarified.

For example, for measuring gamma-ray emitting nuclides by Ge semiconductor detectors, the radioactivity concentration is expressed as a function of the input quantity, as shown below.

$$C_{\gamma} = f(x_1, x_2 \cdots) = f(X, Y, Z, E, V) = \frac{X \times Z}{(\frac{E}{100}) \times (\frac{Y}{100}) \times V}$$

 $f(x_1, x_2 \cdots)$: Function of deriving the radioactivity concentration X, Y, Z, E, V: Amount of input required to determine the radioactivity concentration

 C_{ν} : Radioactivity concentration of gamma-ray emitting nuclide (Bq/L)

E: Peak efficiency of gamma ray of the relevant energy (%)

X: The net counting rate of the sample of the relevant peak (cps)

Y: The emission rate of gamma-ray of the relevant energy of the nuclide (%)

Z: Half-life correction coefficient (–)

V: Sample dispensing volume (L)

XIII-1-2 Step 2: Identification of uncertainty sources

In this step, the measurement procedure of each measurement method is clarified, and the sources of possible uncertainty are summarized in the Fishbone Diagrams and Tables.

The Fishbone Diagrams were developed by referring to the uncertainty assessment of No.7 (gamma nuclide) of the Series of Environmental Radioactivity Measurement Method. The following figure and table show an example of gamma-ray emitting nuclides measured by Ge semiconductor detector.

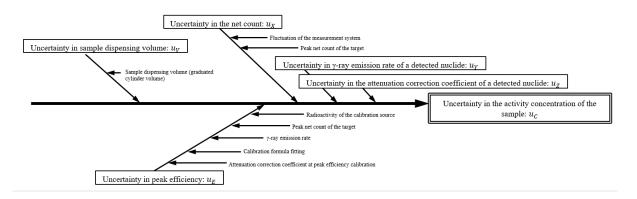


Figure XIII-1 Fishbone Diagram on Uncertainty of Gamma-Ray Emitting Nuclide Measured by Ge Semiconductor Detector

Table XIII-1 Summary of Uncertainty Souces for Gamma-Ray Emitting Nuclide measured by Ge Semiconductor Detectors

Major Source	Symbol	Breakdown of source
Sample dispensing volume	u_V	Sample dispensing volume (graduated cylinder volume)
Peak efficiency	$u_{\scriptscriptstyle E}$	Radioactivity of calibration source, peak net count of the calibration source, and gamma-ray emission rate of the calibration source Calibration formula fitting, attenuation correction coefficient at peak efficiency calibration
Net count	u_X	Fluctuation of the measurement system, peak net count of the target p
Gamma-ray emission rate	u_Y	Detected nuclide gamma-ray emission rate

Attenuation correction coefficient	u_Z	Half-life
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XIII-1-3 Step 3: Quantification of uncertainty components

The uncertainty sources identified in Step 2 are quantitatively evaluated by using either Type A or Type B as below, and standard uncertainty for each uncertainty source is determined.

Type A: Method in which measurements are performed repeatedly to actually obtain data, and the standard deviation is determined from the variation of the data.

Type B: Method of determining the standard deviation from available information, such as literature, the standard value specified by the manufacturer, calibration certificate, etc.

For example, the standard uncertainty of the sample dispensing volume u_V , was calculated through Type A with repetitive measurement and through Type B with the manufacturer's specification value, as shown below.

Table XIII-2 Quantification of Standard Uncertainty for Sample Dispensing Volume

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Major Source	Uncertainty Source	Uncertainty Abbreviation	Туре	Uncertainty assessment method
Uncertainty		u_V	-	$u_V = \sqrt{u_{V1}^2 + u_{V2}^2}$
in sample dispensing	Dispensing volume of the	u_{V1}	В	Calculated based on the manufacturer's specifications
volume	test sample (graduated cylinder) measured value	u_{V2}	Α	The standard deviation of repeated measurements

XIII-1-4 Step 4: Calculation of Combined Standard Uncertainty

Standard uncertainty of the measurement result is calculated by combining the standard uncertainties obtained through Steps 1 to 3 above in accordance with the propagation law of uncertainties.

The propagation law of uncertainties is given by the following equation.

$$u_C = \sqrt{\sum_{i=1}^n \left\{ \frac{\partial f}{\partial x_i} u(x_i) \right\}^2}$$

 u_C : Combined standard uncertainty of radioactivity concentration $u(x_i)$: Input quantity of standard uncertainty x_1, x_2, \dots, x_n

For instance, in the case of gamma-ray emitting nuclides measured by Ge semiconductor detector, the standard uncertainties obtained up to Step 3 are combined by the propagation law of uncertainties, as follows.

$$u_{\gamma} = \sqrt{\left(\frac{\partial f}{\partial V}u_{V}\right)^{2} + \left(\frac{\partial f}{\partial E}u_{E}\right)^{2} + \left(\frac{\partial f}{\partial X}u_{X}\right)^{2} + \left(\frac{\partial f}{\partial Y}u_{Y}\right)^{2} + \left(\frac{\partial f}{\partial Z}u_{Z}\right)^{2}}$$

 u_{γ} : Combined standard uncertainty of radioactive concentration for gamma-ray emitting nuclides

XIII-1-5 Step 5: Calculation of expanded uncertainty

In this step, the expanded uncertainty is obtained by multiplying the combined standard uncertainty obtained in Step 4 by the coverage factor "k" which reflects the level of confidence. This result is described in the measurement results.

For the coverage factor, k=2 is typically used when there is no particular requirement for confidence level (coverage factors are determined as appropriate when there is a special requirement).

The variation in the measurement results of the managed measurements is generally considered normally distributed in most cases [2]. In this case, when k=2 is used, the probability of confidence level is approximately 95% (i.e., 95% confidence interval). This means when the expanded uncertainty $U_{\mathcal{C}}=2u_{\mathcal{C}}$ is obtained from the measurement result C, this measurement result has variation in the interval $[\mathcal{C}-U_{\mathcal{C}}$, $\mathcal{C}+U_{\mathcal{C}}]$ with the probability of about 95%.

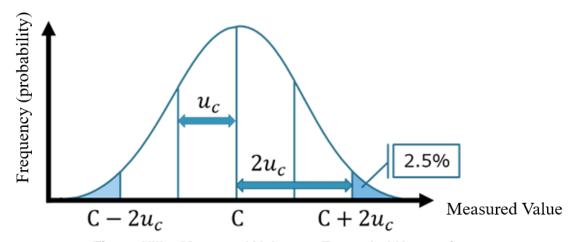


Figure XIII-2 Measured Value vs. Expanded Uncertainty

XIII-2 Evaluation Results of Expanded Uncertainty Sources

This chapter presents the assessment results for the uncertainty sources identified for ALPS treated water analytical methods. The uncertainty assessment was conducted for the radioactivity measurements of Ge semiconductor detector, liquid scintillation counting device, and alpha-ray automatic measurement device while using as a referrence the uncertainty assessment of Series-7 (gamma nuclide) of Environmental Radioactivity Measurement Methods. Further, the uncertainty assessment of the measurement for I-129 and Tc-99 by ICP-MS was carried out by referring to the uncertainty assessment using ICP-MS calibration curves for general metals.

With regard to the uncertainty assessment of undetected nuclides, it is estimated that measurement or evaluation values are within the range smaller than the lower limit of detection (0 to the lower limit of detection). Therefore, it is assumed that measurement value is in the vicinity of the lower limit of detection so that discharge control can be implemented conservatively.

The uncertainty sources of gamma-ray emitting nuclides determined by Ge semiconductor detector are shown in Figure XIII-1 and table XIII-1 above. Below are the uncertainty sources for other methods.

XIII-2-1 Uncertainty in Tritium Radioactivity Concentration Measurements by Liquid Scintillation Counter (LSC)

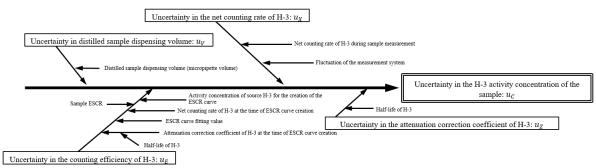


Figure XIII-3 Uncertainty Sources of Tritium Radioactivity Concentration Measurement by LSC

Table XIII-3 Summary of Uncertainty Sources of Tritium Radioactivity Concentration

Measurement by LSC

Major Source	Symbol	Breakdown of source
Distilled sample dispensing volume	u_V	Distilled sample dispensing volume (micropipette volume)
H-3 counting efficiency	$u_{\scriptscriptstyle E}$	(at the time of created ESCR curve creation) H-3 activity concentration, H-3 net count, curve fitting value, H-3 attenuation correction
H-3 net count rate	u_X	Fluctuation of the measurement system, H-3 net counting
Attenuation correction coefficient of H-3	u_Z	Half-life

XIII-2-2 Uncertainty in Carbon-14 Radioactivity Concentration Measurement by Liquid Scintillation Counter (LSC)

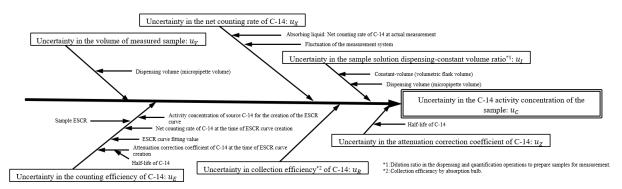


Figure XIII-4 Uncertainty Sources of C-14 Radioactivity Concentration Measurement by LSC

Table XIII-4 Summary of Uncertainty Sources of C-14 Radioactivity Concentration

Measurement by LSC

Major Source	Symbol	Breakdown of source
Measured sample volume	u_V	Dispensing volume (micropipette volume)
C-14 counting efficiency	$u_{\scriptscriptstyle E}$	(at the time of ESCR curve creation) C-14 activity concentration, C-14 net count, curve fitting value, C-14 attenuation correction
C-14 net count rate	u_X	Variations in the measurement system, C-14 net counts
C-14 collection efficiency	u_R	C-14 Net Counting Rate (Collection bottle 1 and collection bottle 2)
Sample solution dispensing-constant volume ratio	u_I	Dispensing volume (Micro Pipette Volume), Constant Volume (Female Flask Volume)
Attenuation correction coefficient of C-14	u_Z	Half-life

XIII-2-3 Uncertainty in Nickel-63 Radioactivity Concentration Measurement by Liquidscintillation Counter (LSC)

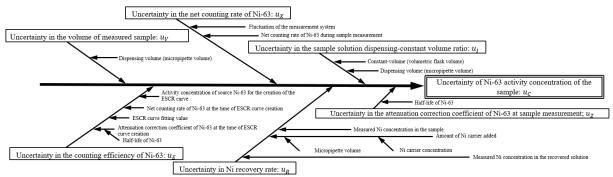


Figure XIII-5 Uncertainty Sources of Ni-63 Radioactivity Concentration Measurement by LSC

Table XIII-5 Summary of Uncertainty Sources of Ni-63 Radioactivity Concentration Measurement by LSC

Major Source	Symbol	Breakdown of source
Measured sample volume	u_V	Dispensing volume (micropipette volume)
Ni-63 counting efficiency	u_E	(at the time of ESCR curve-making) Ni-63 activity concentration, Ni-63 net count Curve-fitting value, Ni-63 attenuation correction
Ni-63 net count rate	u_X	Fluctuation of the measurement system, Ni-63 net counting
Ni recovery rate	u_R	Ni concentration in recovered solution, amount of Ni carrier added, Ni concentration in the sample
Sample solution dispensing-constant volume ratio	u_I	Dispensing volume (Micro Pipette Volume), Constant Volume (Female Flask Volume)
Attenuation correction coefficient of Ni-63	u_Z	Half-life

XIII-2-4 Uncertainty in Cadmium 113m Radioactivity Concentration Measurement by Liquid Scintillation Counter (LSC)

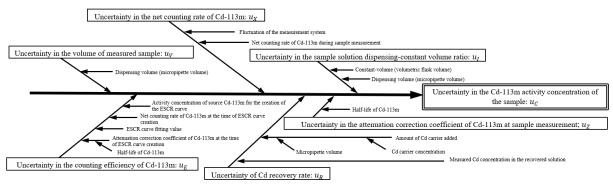


Figure XIII-6 Uncertainty Sources of Cd-113m Radioactivity Concentration

Measurement by LSC

Table XIII-6 Summary of Uncertainty Sources of Cd-113m Radioactivity Concentration

Measurement by LSC

Major Source	Symbol	Breakdown of source
Measured sample volume	u_V	Dispensing volume (micropipette volume)
Cd-113m counting efficiency	u_E	(at the time of ESCR curve creation) C-14 activity concentration, C-14 net count, curve fitting value, attenuation correction of C-14 (alternative estimation of Cd-113m calibration source)
Cd-113m net count rate	u_X	Fluctuation of the measurement system, Cd-113m net count
Cd recovery rate	u_R	Cd concentration in recovered solution, amount of Cd carrier added
Sample solution dispensing-constant volume ratio	u_I	Dispensing volume (Micropipette Volume), Constant Volume (Volumetric Flask Volume)
Attenuation correction coefficient of Cd-113m	u_Z	Half-life

XIII-2-5 Uncertainty in Iodine-129 Radioactivity Concentration Measurement by ICP-MS

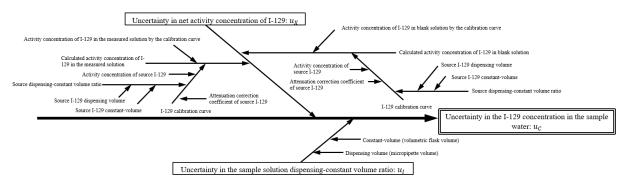


Figure XIII-6 Uncertainty Sources of I-129 Radioactivity Concentration Measurement by ICP-MS

Table XIII-6 Summary of Uncertainty Sources of I-129 Radioactivity Concentration Measurement by ICP-MS

Major Source	Symbol	Breakdown of source
I-129 net activity concentration in test solution	u_X	Calculated I-129 activity concentration in blank solution, calculated I-129 activity concentration in the test solution
Sample solution dispensing-constant volume ratio	u_I	Dispensing volume (Micropipette Volume), Constant Volume (Volumetric Flask Volume)

XIII-2-6: Uncertainty in Technetium-99 Radioactivity Concentration Measurement by ICP-MS

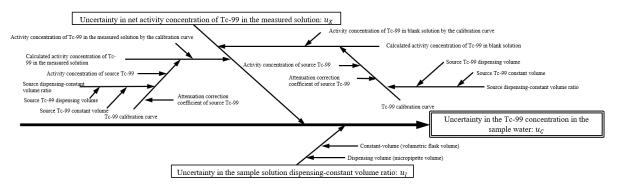


Figure XIII-7 Uncertainty Sources of Tc-99 Radioactivity Concentration Measurement by ICP-MS

Table XIII-7 Summary of Uncertainty Sources of Tc-99 Radioactivity Concentration Measurement by ICP-MS

Main source	Symbol	Breakdown of source
Net activity concentration of Tc-99 in the measured solution	u_X	Calculated Tc-99 activity concentration in blank solution, calculated Tc-99 activity concentration in the test solution
Sample solution dispensing-constant volume ratio	u_{I}	Dispensing volume (Micropipette Volume), Constant Volume (Volumetric Flask Volume)

XIII-2-7: Uncertainty in Strontium-89 and -90 Radioactivity Concentration Measurement by Beta Nuclide Analyzer

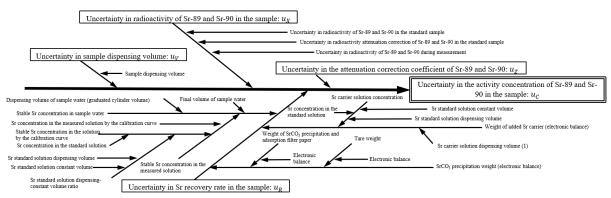


Figure XIII-8 Uncertainty Sources of Sr-89/90 Radioactivity Concentration

Measurement by Beta-Nuclide Analyzer

Table XIII-8 Summary of Uncertainty Sources of Sr-89/90 Radioactivity Concentration Measurement by Beta-Nuclide Analyzer

Major source	Symbol	Breakdown of source
Sample dispensing volume	u_V	Sample dispensing volume (graduated cylinder volume)
Sr-89 and Sr-90 activity intensity in the sample	u_X	Sr-89, Sr-90 activity intensity in standard sample, Sr-89, Sr-90 activity attenuation correction, and Sr-89, Sr-90 activity intensity at measurement
Sample Sr recovery rate	u_R	Weight of SrCO3 precipitation, concentration of stable Sr in sample water, amount of Sr carrier added
Attenuation correction coefficient of Sr-89 and Sr-90	u_Z	Half-life

XIII-2-8: Uncertainty in Alpha-Ray Emitting Nuclides Radioactivity Concentration Measurement by Automatic Alpha-Ray Measuring Device

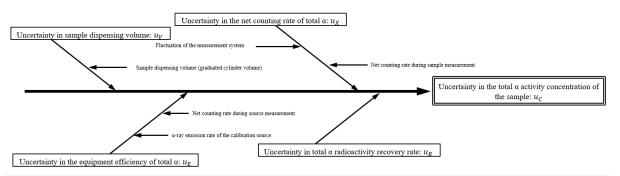


Figure XIII-9 Uncertainty Sources of Radioactivity Concentration of Alpha-Ray Emitting Nuclides by Automatic Alpha-Ray Measuring Device

Table XIII-9 Summary of Uncertainty Sources of Radioactivity Concentration of Alpha-Ray Emitted Nuclides by Automatic Alpha-Ray Measuring Device

Major source	Symbol	Breakdown of source
Sample dispensing volume	u_V	Sample dispensing volume (graduated cylinder volume)
Gross α Equipment Efficiency	$u_{\scriptscriptstyle E}$	Net count rate at measurement of the source, $\alpha\mbox{-ray}$ emission rate from the calibration source
Gross α Net Count	u_X	Fluctuations in the measurement system and the net count rate at sample measurement
Gross α radiation recovery rate	u_R	-

XIII-3 Evaluation results of expanded uncertainty

In this chapter, examples of expanded uncertainty calculated based on the radioactivity concentration measurement of J1-C tank group are shown for each measurement method. In all cases, the coverage factor is k=2.

Table XIII-10 Examples of Uncertainty in Gamma-Ray Emitting Nuclides Concentration

Measurement by Ge semiconductor detector

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty u_C
	Units: Bq/L	Units: Bq/L
Ru-106	1.43E+00	3.7E-01
Cd-115m	< 2.70E+00	2.6E+00
Sb-125	2.26E-01	1.0E-01
Cs-134	< 7.60E-02	5.2E-02
Cs-137	1 85F-01	4 1F-02

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\it C}$
	Units: Bq/L	Units: Bq/L
Ce-144	< 5.69E-01	4.0E-01
Eu-154	< 1.14E-01	7.7E-02
Eu-155	< 3.36E-01	2.3E-01
Mn-54	< 3.83E-02	2.6E-02
Co-60	3.33E-01	6.1E-02

Table XIII-11 Examples of Uncertainty in Radioactivity Concentration Measurement by LSC

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\mathcal{C}}$
	Units: Bq/L	Units: Bq/L
H-3	8.22E+05	4.8E+04
C-14	1.76E+01	4.6E+00

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\mathcal{C}}$
	Units: Bq/L	Units: Bq/L
Ni-63	< 8.45E+00	3.7E-01
Cd-113m	< 8.52E-02	3.8E-03

Table XIII-12 Examples of Uncertainty in Radioactivity Concentration Measurement by ICP-MS

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\mathcal{C}}$
	Units: Bq/L	Units: Bq/L
I-129	1.16E+00	1.8E-01

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\mathcal{C}}$
	Units: Bq/L	Units: Bq/L
Tc-99	< 1.23E+00	1.6E-02

Table XIII-13 Examples of Uncertainty in Radioactivity Concentration Measurement by Beta-Nuclide Analyzer

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty u_c	
	Units: Bq/L	Units: Bq/L	
Sr-89	< 5.36F-02	9.7F-03	

Nuclide	Measurement results C (J1-C tank group)	Expanded uncertainty $u_{\mathcal{C}}$	
	Units: Bq/L	Units: Bq/L	
Sr-90	3 57F-02	1 1F-∩2	

Table XIII-14 Example of Uncertainty in Radioactive Concentration Measurement by

<u>Automatic Alpha-Ray Measuring Device</u>

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Nuclide	Measurement results C	Extedded uncertainty	
	(J1-C tank group)	u_{c}	
	Units: Bq/L	Units: Bq/L	
Gross α radioactivity	< 3.25E-02	6.4E-03	

XIII-4 Method to compare our analytical results with the analytical results of designated third party laboratories

In the measurement of radioactivity concentration, even if the same sample is measured, the same radioactivity concentration is not necessarily obtained as a result because the disintegration of the radioactive nuclide to be measured (also called decay) is stochastic event and the analysis procedure and the equipment to be used are different.

Expanded uncertainty is used to compare the multiple measurement results with different measurement systems and evaluate the validity of the analytical results.

This is illustrated in Figure XIII-10 below. Our analysis results in orange and third-party analysis results in light blue are identical in both cases (a) and (b). However, the length of the error bars indicating expanded uncertainty are different.

Expanded uncertainty for each analytical result at each analytical organization is determined, using the coverage factor k=2. Then, confidence intervals are obtained usinig the expanded uncertainty added to and subtracted from the analytical result, and these intervals are usually indicated by error bars. If the error bars of the analytical results from different organizations to be compared do overlap with each other, as in the case of (a), it is evaluated that the same results have been obtained.

On the other hand, even if the same measured values are obtained, when the error bars do not overlap as in the case of (b), the two evaluation results are considered as being inconsistent.

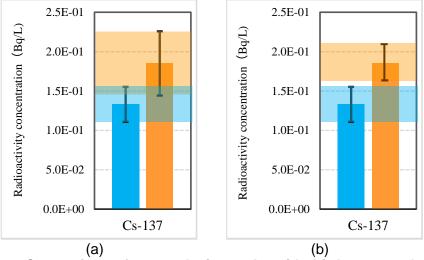


Figure XIII-10 Comparison of our analysis results with third-party analysis results

Reference A Site boundary dose assessment of Fukushima Daiichi Nuclear Power Station and the regulatory concentration limit in the Japanese laws

In the Fukushima Daiichi Nuclear Power Station, which is a specific nuclear facility, it is required to take appropriate inhibition measures for radioactive materials discharged to the environment including air, sea, etc., to reduce the dose around the site as much as possible, and make the effective dose on the site boundary from debris, contaminated water, etc., generated and stored in the facility after the accident (assessment value of the effective dose including additional discharge of radioactive materials from the entire facility) less than 1 mSv/year.

In addition, to dispose of liquid waste including radioactive materials, it is required to reduce the concentration of radioactive materials in wastewater as much as possible by filtration, evaporation, adsorption by the ion exchange resin method, etc., attenuation of radioactivity over time, dilution with a large amount of water, etc., at the wastewater facility, and keep the concentration of radioactive materials in wastewater below the concentration limit set by the Nuclear Regulation Authority at drains and the wastewater surveillance facility. In accordance with "public notice that stipulates the required matters regarding the safety of TEPCO Fukushima Daiichi Nuclear Power Station reactor facilities and the protection of specified nuclear fuel materials", the concentration limit set by the Nuclear Regulation Authority is defined as the concentration set by Appended table 1 "Pronouncement which set the dose limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials", if only one type of a radioactive material is contained and the type of the radioactive material is identified. This concentration is called "regulatory concentration limit."

This concentration is set so that the average dose from internal exposure of adults drinking 2L of the water every day for 70 years will be 1 mSv/year. In other words, the laws set a limit so that even if a person drinks water directly from a drain, the average does of 70 years will not exceed 1 mSv/year.

For example, the limits for tritium and Cs-137 are 60Bq/cm³ (60,000Bq/L) and 0.09 Bq/cm³ (90Bq/L), respectively. Therefore, if a person drinks 2L of water containing 60,000Bq/L of tritium alone or 90Bq/L of Cs-137 alone every day for 70 years, the average exposure of 70 years will be 1 mSv/year.

On the other hand, if liquid waste containing two or more types of radioactive materials is disposed of and a person drinks 2L of water containing the nuclides each of which reaches the regulatory concentration limit (e.g. water containing 60,000Bq/L of tritium and 90Bq/L of Cs-137) every day for 70 years, the exposure from each nuclide alone will reach 1 mSv/year, 2 mSv/year in total, thereby the overall exposure exceeding 1 mSv/year. Therefore, to not exceed 1 mSv/year, the regulatory concentration limits of nuclides are set in a way that the sum of their ratios does not exceed 1. In other words, it is set in a way that R_n in the following equation does not exceed 1.

$$R_n = \sum_{i=1}^{n} \frac{C_{i,measured}}{C_{i,limit}}$$

where

 R_n Sum of the ratios to regulatory concentrations limits (dimensionless)

C_{i, measured} Concentration of nuclide *i* in liquid waste to be discharged (Bq/cm³)

 $C_{i, limit}$ Regulatory concentration limit of nuclide i (Bq/cm³)

n Number of types of nuclides contained in liquid waste to be discharged

For discharge of ALPS treated water into the sea we are currently planning, the following conditions are to be verified:

- (1) The sum of the ratios to regulatory concentrations limits of nuclides excluding tritium falls below 1 in the facility for measurement and confirmation before dilution with seawater;
- (2) The sum of the ratios to regulatory concentrations limits of nuclides excluding tritium falls below 1 in the discharge vertical shaft after dilution with seawater.

In (2), the water shall be diluted with seawater 100 or more times so that the tritium concentration falls below 1,500Bq/L. If the tritium concentration can be diluted by 100 times up to 1,500Bq/L, the sum of the ratios to regulatory concentrations limits of radioactive materials at the discharge vertical shaft will be up to

(Sum of the ratios to regulatory concentrations limits of nuclides other than tritium)

+ (Regulatory concentration ratio of tritium)

$$= \frac{R_{(1)}}{100} + \frac{1,500}{60,000} = \frac{1}{100} + \frac{1}{40} = 0.035$$

because the sum of the ratios to regulatory concentrations limits of other than tritium before dilution is managed to be less than 1 in (1) and the concentration of tritium is 1,500Bq/L. Among the dose assessments on the site boundary mentioned at the beginning, the assessment of the contribution of the wastewater of liquid waste is also calculated according to this concept. If the sum of the ratios to regulatory concentrations limits is exactly 1, exposure of this discharge of ALPS treated water into the sea is assessed to be less than 0.035 mSv/ in this assessment method because the exposure dose on the site boundary (drain) is assessed to be 1 mSv/year.

Reference B Timeline of consideration of each disposal method of ALPS treated water

B1. Timeline of consideration

At the Committee on Countermeasures for Contaminated Water Treatment¹ on December 10, 2013, the risks associated with storage of water treated (hereinafter called "ALPS" treated water") with the advanced liquid processing system (hereinafter called "ALPS"), etc. at the TEPCO Fukushima Daiichi Nuclear Power Station (hereinafter called "FDNPS") were clarified. On December 4, 2013, the review team of the International Atomic Energy Agency (hereinafter called "IAEA") advised to "examine all options" for handling of ALPS treated water.

Therefore, the government extracted all options from the neutral viewpoint as the basic material for the determination of long-term treatment of ALPS treated water, as well as set up the Tritiated Water Taskforce (hereinafter called "the Taskforce") under the Committee on Countermeasures for Contaminated Water Treatment for the purpose of the technical assessment of each option (not for harmonizing views among stakeholders or unifying options) and has been proceeding with technical consideration for 2 years and 5 months. After that, the government established the Subcommittee on Handling of the ALPS Treated Water (hereinafter called "the Subcommittee") under the Committee on Countermeasures for Contaminated Water Treatment and have conducted comprehensive consideration for 38 months from the professional perspective, in terms of international best practices, options with the least adverse impact on human health and the environment, social impacts such as reputation damage, and technical feasibility in accordance with the knowledge summarized in the Taskforce report.

(1) Overview of consideration by the Taskforce

The Taskforce took place a total of 15 times from December 25, 2013 to May 27, 2016, with the participation of the Nuclear Regulation Authority and related ministries and agencies, in addition to nine members who are experts in the fields of nuclear energy, environmental science, radiation medicine, radiation biology, and fishery chemistry. The Taskforce organized the basic knowledge as such on tritium regarding its property, dynamics in the atmospheric/geosphere/marine environment, and impacts on the environment and human body (radiation dose, biological concentration, in vivo half-life,

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¹ Committee set up under the ministerial meeting on measures for decommissioning/ contaminated water/ treated water. This committee was set up to totally examine the contaminated treatment measures of Fukushima Daiichi and consider the measures to radically solve the problems and to handle leakage accidents of contaminated water including tritium treatment measures

etc.)^{2 3 4}, set the assessment cases based on the uniformed handling conditions for parallel comparison of 11 options combining five methods (geosphere injection, discharge into the sea, vapor release, hydrogen release, and underground burial) with the presence or absence of pretreatment such as dilution or isotope separation considering foreign cases, etc., and performed technical assessments.

For technical assessments, technical feasibility and regulatory feasibility were set as the basic requirements (items used as criteria to judge feasibility). As conditions which may be constraints on selection, the following evaluation items were set: time and cost required for disposal, scale (area required for disposal), whether any secondary waste is generated/its type and amount, the occurrence of excessive worker exposure from the disposal, and incidental conditions (other conditions which may be constraints).

(2) Overview of consideration by the Subcommittee

The Subcommittee met a total 17 times from November 11, 2016 to January 31, 2020, with the participations of 13 experts in the fields of nuclear power, geotechnical engineering, sociology, environmental science, agriculture, radiobiology, radiation science, and fishery chemistry, and related ministries. The Subcommittee had further discussions about the impact of tritium on organisms⁵ 6 as well as comprehensively

⁶ It was explained that tritium was not concentrated on specific organisms or organs because molecules containing tritium had



² Regarding the environment dynamics of tritium, it was reported that tritium discharged into air exhibited such behaviors such as turbulent dispersion in air, dry or wet deposition on the ground surface, underground advection and diffusion, and evaporation from the ground surface; that a simple assessment is difficult due to a big variation in the dispersion state depending on the weather conditions at the time of discharge; and that the concentration is reduced as it gets away from the location of discharge though it depends on the discharge method and discharge position (Summary of an explanation by Mr. Haruyasu Nagai at the 4th Taskforce, Pages 1 to 9 of the minutes).

³ As for the environmental impact of tritium, it was explained that there were two types of tritium in organic substances, namely free water tritium (hereinafter called "FWT") and organically bound tritium (hereinafter called "OBT"), OBT was easy to be absorbed by organisms and has long biological half-life, the in vivo FWT concentration and water tritium concentration counterweighed (becomes almost equal) immediately in the aquatic environment, the concentration factor of tritium (ratio of the in vivo concentration to the water concentration) is 1 or less, dose assessments of marine organisms were performed for "reference animals" (e.g. marine organisms with different shapes such as flatfish and crab), generally the calculation was performed from the radioactive material concentration (Bq/kg - raw organism), and there would be no significant impact on aquatic habitat unless an extremely high concentration of tritium is retained in the aquatic environment (Summary of an explanation by the Taskforce Member Mr. Hideki Kakiuchi at the 3rd meeting of the Taskforce, pp.2-10 of the minutes, Summary of an explanation by the Taskforce Member Takami Morita in the 3rd Taskforce, Pages 14 to 18 of the minutes).

⁴ As for the impact of tritium on human bodies, it was explained that the impact of tritium on human bodies was much smaller than that of radioactive cesium set as the standard of radioactive materials in foods, about 1/1,000; tritium caused almost no external exposure, and internal exposure would be considered because it is radionuclide with low-energy beta rays; and tritium exists in two forms, namely FWT and OBT, in organisms and, according to ICRP (International Commission on Radiological Protection), the in vivo half-lives of FWT and OBT were about 10 days and 40 days, respectively (Summary of an explanation by the Taskforce Member Mr. Hideki Kakiuchi in the 3rd Taskforce, Pages 2 to 10 of the minutes; Summary of an explanation by the Taskforce Member Mr. Hideo Tatsuzaki at the 3rd Taskforce, Pages 21 to 25 of the minutes; Summary of an explanation by the Taskforce Member Mr. Hiroshi Tauchi at the 3rd Taskforce, Pages 26 to 33 of the minutes).

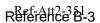
⁵ It was explained that tritium just emits weak beta rays, the only exposure form with significant impact was internal exposure, it is said that there was almost no in-vivo concentration as characteristics, and it was passed out of the human body by metabolism about 10 days after entering the body since it was a kind of water (Summary of a statement by the Subcommittee Member Yamanishi at the 2nd Subcommittee, Page 34 of the minutes).

considered the expansion of the tank storage capacity, the possibility to continue tank storage, etc., in addition to the technical viewpoints of the disposal methods and the advantages and disadvantages of the disposal methods taking into consideration the social and environmental impacts of disposal for each of the five disposal methods of ALPS treated water.

The proceedings of the meetings were open to the public, and those who applied and were registered in advance were able to listen to the proceedings at the venue as observers. All of the contents and materials from the discussion of each meeting are available on the website of METI⁷. The following shows the details of consideration at the Taskforce and the Subcommittee.

the same properties as normal water molecules (Summary of an explanation by the Subcommittee Member Tauchi at the 11th Subcommittee, Page 19 to 24, 32 of the minutes). The following shows the discussion related to these:

https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/archive/task_force3.html https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/archive/task_force4.html https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku.html#osensuitaisaku mt



^{(1) &}quot;For example, data from Sellafield Bay in the UK shows that the concentration of organically bound tritium in fish is higher than the concentration in seawater when measured at a certain point in time. However, this is because there was a very high concentration of tritiated water that was previously discharged into the sea. When that was taken in, the OBT remained because it has a longer half-life than water. The data shows that, as the years go by, the organic-bound form of the substance decreases rapidly when its concentration in seawater is almost undetectable. Therefore, this is not something that should be called bioaccumulation. Bioaccumulation means that substances in the environment accumulate and become more concentrated in living organisms. I hope you understand that this will not happen with tritium" (statement by the Subcommittee Member Tauchi at the 11th Subcommittee, Page 32 of the minutes).

⁽²⁾ In response to the question "Have there been any examples of tritium concentrated in nature?" (statement by the Committee Member Mr. Tauchi at the 11th meeting of the Subcommittee, p.32 of the minutes), the answer was "As far as I know, there have been no such cases. If there had been, the tritiated water in the tank could be concentrated by living organisms and removed, but that is not the case" (statement by the Subcommittee Member Tauchi at the 11th Subcommittee, Pages 32 to 33 of the minutes).

^{(3) &}quot;As far as I know, there have been no cases where microorganisms have been cultured in tritiated water in so-called laboratory experiments, and where water-to-biological concentration has been observed. In addition, as Mr. Hiroshi Tauchi mentioned, the tritium concentration in living organisms can appear to be high in the environment. This is due to the fact that organic matter has been accidentally discharged from factories in the past. Because fish migrate, the opposite phenomenon is observed when fish grown in areas with low tritium concentrations go to areas with high concentrations. We have observed that living organisms grown in a place with high tritium concentration appear to be highly tritium-concentrated when they go to a place with low tritium concentration. This is the reality of the situation" (statement of the Subcommittee Member Kakiuchi at the 11th Subcommittee, Pages 33 to 34 of the minutes).

B2. Discussion about each disposal method and result of the comparison

(1) Taskforce

The Taskforce set and evaluated the basic requirements (technical feasibility and regulatory feasibility) as well as conditions which may be constraints (time, cost, scale, secondary waste, worker exposure, etc.) as evaluation items for each case (as shown in the Table B-1) and prepared a report as a basic material for future consideration ("Tritiated Water Taskforce Report") in June 3, 2016 after the discussion and consideration on the technical point of view of each disposal method, environmental impacts, difficulty of monitoring, issues to secure the site, comparisons to precedents, increasing capacity of storage in tanks, and issues arising from storing water in tanks as mentioned below in footnotes of B2. (2) (ii), (3) and (4) using excerption of the discussions,

This report suggests that consideration should be proceeded with from comprehensive viewpoints including not only technical ones such as the feasibility, economy, required time, etc., as well as social ones such as reputation damage because the result may cause big impact on the reputation.

Table: Conditions which may be constraints

Table. Conditions which may be constraints					
Disposal method	Geosphere injection	Discharge into the sea	Vapor release	Hydrogen release	Underground burial
Period ⁹	104+20n months 912 months (for monitoring) (n=Number of survey points)	91 months	120 months	106 months	98 months 912 months (for monitoring)
Cost ¹⁰	18+0.65n billion yen+Monitoring cost (n=Number of survey points)	3.4 billion yen	34.9 billion yen	100 billion yen	243.1 billion yen
Scale	380 m ²	400 m ²	2000 m ²	2.000 m ²	285.000 m ²

Available on the web site of the Ministry of Economy, Trade and Industry. https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/20160915_01a.pdf

⁹ The procedure is divided in to the plant construction phase and treatment phase, but depending on the method, technical development and some lead time may be required before plant construction (summary of a statement by the Taskforce Member Tokuhiro Yamamoto at the 12th meeting, Page 19 of the minutes)

¹⁰ The following shows the related discussion in the Taskforce.

⁽¹⁾ It turned out that there is no realistic technology to solve the problem with the treatment method of tritium in France within the allowable range of costs. Such a technology may exist but will be too costly. Therefore, it was concluded that such technologies would not be feasible (Summary of a statement by Mr. Jean-Luc Lachaume, at the 7th Taskforce, Page 15 of the minutes).

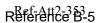
⁽²⁾ In France, not segregation but direct discharge of tritium into a river or the sea was adopted considering the cost, advantages, etc. (Summary of a statement by the Committee Member, Mr. Jean-Luc Lachaume, at the 7th Taskforce, Page 21 of the minutes).

Disposal method	Geosphere injection	Discharge into the sea	Vapor release	Hydrogen release	Underground burial
Secondary waste	N/A	N/A	Depending on the components of treated water, incineration ash may be generated.	Residues may be generated as secondary waste.	N/A
Radiation Exposure of Workers ¹¹	No points to consider in particular	No points to consider in particular	There are no points to consider in particular since the height of the exhaust pipe will be sufficiently high.	There are no points to consider in particular since the height of the exhaust pipe will be sufficiently high.	To prevent radiation exposure of workers during the burial operation, installing a cover etc. is needed.
Others	The costs and duration of the exploration will increase in the event that it is difficult to find a suitable geosphere layer.	In the case of using a divider between the intake water pit and the discharge port, the cost will increase. 12	The duration may be extended, in case the release operation needs to be suspended due to precipitation. ¹³	The duration may be extended, in case the release operation needs to be suspended due to precipitation. 14	A large amount of concrete and bentonite will be needed. Construction spoil will be produced. ¹⁵

(2) Subcommittee

On February 10, 2020, the Subcommittee prepared a report ("The Subcommittee on Handling of the ALPS Treated Water Report" of considering the result of the Taskforce. The following shows the major contents of consideration.

Available on the web site of the Ministry of Economy, Trade and Industry. https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/018_00_01.pdf



[&]quot;I believe the exposure of workers is quite important, and it should be taken into account. With regard to exposure of workers, if the workers to be deployed were changed rapidly, it would be possible to comply with laws and regulations, but I would like to keep this to a realistic level" (statement by the Taskforce Member Hideo Tatsuzaki at the 13th Taskforce, Page 14 of the minutes).

[&]quot;In the case of discharge into the sea, if tritium were released and the same water was taken in again, it would make no sense whatsoever. In order to deal with this, some methods of partitioning with wharves, etc. are described, but I'm wondering whether or not it is necessary to state this as an ancillary condition when the cost is calculated" (statement by the Taskforce Member Takami Morita at the 14th Taskforce, Page 13 of the minutes).

[&]quot;When it comes to implementation of vapor release or hydrogen release, I wonder if it is possible to do so in the midst of heavy snow or rain. If so, I believe the annual operating results, or the actual number of operations, may vary" (statement by the Taskforce Member Mr. Takami Morita at the 13th meeting of the Taskforce, p.13 of the minutes).

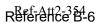
¹⁴ Same as the above.

[&]quot;There is a problem of residual soil buried underground, which hardly arises when it is placed above the groundwater level. This makes me think that the story will be quite different depending on whether we build the plant above or below this groundwater level" (statement by the Taskforce Member Takami Morita at the 13th Taskforce, Page 13 of the minutes).

- (i) Social impacts of each disposal method
 - As for social impacts, the impacts on life and economy (reputation damage) are assumed but it is difficult to comprehensively compare their significance.¹⁷ Therefore, it was concluded that no matter which disposal method of discharge into the sea/vapor release is selected, it will be necessary to prepare for possible reputation damage after disposal considering the characteristics of each disposal method.
 - (ii) Technical viewpoints of each disposal method considering environmental and social impacts

The Subcommittee considered the realistic options considering in terms of environmental impacts including the continuation of tank storage (as shown in B2. (4) below) based on the technical viewpoint in accordance with the five disposal methods consideration results proposed at the Taskforce (geosphere injection, hydrogen release, underground burial, vapor release, and discharge into the sea.) As a result, for geosphere injection, there was an issue with securing of the site and also the method had not been established to monitor the behavior and effects of tritiated water after geosphere injection¹⁸ ¹⁹. For hydrogen release, further technical development

- (7) Especially as for geosphere injection, there is no precedent case, so there is no regulation. However, it is a waste of opportunity to abandon it due to the lack of regulatory standards. It would be appreciated if consideration could be made (Summary of a statement by Mr. Takasaka, an expert observer, at the 13th Taskforce, Page 17 of the minutes).
- (8) For example, though the method is underground burial, the disposal site of even low-level radioactive waste is a great concern. There may be no candidate for the place of storage of tritium water. If so, the span of time up to construction will be massive (Summary of a statement by the Taskforce Member Yoshihisa Takakura at the 14th Taskforce, Page 16 of the minutes).



[&]quot;I do not believe that the superiority of social impact is necessarily clear in our discussions so far, as to which has a greater or lesser social impact" (Summary of a statement by the Subcommittee Member Tokuhiro Yamamoto at the 16th Subcommittee, Page 25 of the minutes).

As for geosphere injection, lack of knowledge of appropriate stratum, monitoring, etc. are difficult (Summary of our statement at the 14th Subcommittee, Page 37 of the minutes).

¹⁹ The following shows the related matters discussed at the Subcommittee and then the Taskforce.

⁽¹⁾ If geosphere injection is performed other than at the site, thousands of trucks with water will drive on roads in the prefecture and even an accident of one of the truck will stop the entire process, which is risky (Summary of a statement by Mr. Chuck Negin at the 6th Taskforce, Page 36 of the minutes).

⁽²⁾ The French regulations prohibit geosphere disposable of radioactive materials (Summary of a statement by Mr. Jean-Luc Lachaume, at the 7th Taskforce, Page 5 of the minutes).

⁽³⁾ Of course, those without standards require much time and effort. Other one than discharge into the sea after dilution and vapor release after dilution are difficult to assess without knowing the details (Summary of a statement by the regulatory authorities (Chief Mr. Shinji Kinjo) at the 8th Taskforce, Page 35 of the minutes).

⁽⁴⁾ It is very important how to explain the option of underground burial while there is a case in France. It cannot be assessed because no underground experiment has been conducted (Summary of a statement by the Taskforce Member Hiroshi Tauchi at the 8th Taskforce, Page 40 of the minutes).

⁽⁵⁾ The current legal system does not assume burial disposal of fluid, so it is not an easy task (Summary of a statement by Taskforce Member Hideo Tatsuzaki at the 9th Taskforce, Page 27 of the minutes).

⁽⁶⁾ Judging from the requirements of the international guidelines of IAEA and ICRP, direct injection of tritium water is not allowed globally (Summary of a statement by the regulatory authorities (Chief Shinji Kinjo) at the 12th Taskforce, Page 11 of the minutes).

was required and there is the possibility of hydrogen explosion²⁰. For underground burial, there was a risk of vapor release of tritium caused by heat generated by solidification, new legislation was required, and there was an issue of securing of the site²¹ ²² ²³. In addition, the Subcommittee showed its view that there was no realistic model of assessment of environmental impacts of geosphere injection, hydrogen release, and underground burial. However, for vapor release and discharge into the

- (1) With hydrogen distillation, even a small device can achieve a high segregation efficiency thanks to the large separation factor, which is an advantage, but it also has disadvantages: the cost is high due to the necessity for ancillary facilities for achieving a very low liquid hydrogen temperature of about 20 kelvin and it is necessary to consider safety measures for the issue of explosion protection of hydrogen gas, etc., due to high pressure caused by gasification of hydrogen when running out of the coolant and use of massive hydrogen gas (Summary of an explanation by the Taskforce Member Toshihiko Yamanishi at the 2nd Taskforce, Page 11 of the minutes).
- (2) The electrolysis method consumes a lot of energy, so as of now electrolysis is rarely used alone for segregation (Summary of an explanation by the Taskforce Member Toshihiko Yamanishi at the 2nd Taskforce, Page 13 of the minutes).
- (3) Though the concentration is low, it is significantly different from past research and development and actually operating plants in that extensive treatment is required. Water treatment in Fukushima is much different from that of the past plants and had no track record (Summary of an explanation by the Taskforce Member Toshihiko Yamanishi at the 2nd Taskforce, Page 16 of the minutes).
- (4) The treatment amount is thousands of times greater than that of currently operating plants. Normally, in the engineering field, scale-up means making the scale 10 or less times greater, not applying a three-digit figure as it is. It is a difficult question whether the current technology is applicable (Summary of a statement by the Taskforce Member Toshihiko Yamanishi at the 2nd Taskforce, Page 17 of the minutes).
- ²¹ The following shows the related discussion in the Taskforce.
 - (1) Currently, it is not assumed at all to dispose of liquid waste by injection in Japan. It is only assumed to dispose of solid waste. It is stipulated in the rules (Summary of an explanation by Mr. Yoshiaki Sakamoto at the 4th Taskforce, Page 22 of the minutes)
 - (2) Basically, the result of the safety assessment depends on the assumed extent of deterioration of concrete; based on it, the degree of leakage is assessed (Summary of an explanation by the Committee Member Yoshiaki Sakamoto at the 4th Taskforce, Page 24 of the minutes)
 - (3) "For the 800,000 cubic meters, we will need at least 300,000 square meters of land, which will be a very difficult situation" (Summary of an explanation by Mr. Yoshiaki Sakamoto at the 10th Taskforce, Page 7 of the minutes).
 - (4) In the case of tritium, some effects may appear due to combination of flow of water and dispersion (Summary of an explanation by Mr. Yoshiaki Sakamoto at the 10th Taskforce, Page 12 of the minutes).
 - (5) For treatment and disposal of radioactive waste, the current basic philosophy is that it should be disposed of in waste body. Cementation of tritium water is somewhat out of the course of this philosophy (Summary of a statement by the regulatory authorities (Chief Shinji Kinjo) at the 10th Taskforce, Page 14 of the minutes)
 - (6) "I think you are assuming concrete burial but this is only for solid waste from demolition. Also, it is clearly stated in the laws and regulations. However, there is nothing that allows to bury liquid waste as well" (Summary of a statement by the regulatory authorities (Chief Shinji Kinjo) at the 13th Taskforce, Page 19 of the minutes).
 - (7) For example, though the method is underground burial, the disposal site of even low-level radioactive waste is a great concern. There may be no candidate for the place of storage of tritium water. If so, the span of time up to construction will be massive (Summary of a statement by the Taskforce Member Yoshihisa Takakura at the 14th Taskforce, Page 16 of the minutes)
- As for underground burial, there is no track record of disposal, a larger land is required than continuation of storage because solidification makes the volume three or six times larger, and it was reported that solidification generates heat, which causes evaporation of moisture. For this report, no opinion was provided from the Committee (Summary of our report at the 14th Subcommittee, Page 22 of the minutes)
- Hydrogen release is the same as vapor release because even if waste is buried underground, tritium will move from the corresponding location, which makes monitoring difficult (Summary of an explanation by the Subcommittee Member Toshihiko Yamanishi at the 16th Subcommittee, Page 31 of the minutes)



²⁰ The following shows the related discussion in the Taskforce.

sea, environmental impacts were assessed using the assessment model of public exposure in the event of exposure of radioactive nuclides to the environment set by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and all results were sufficiently lower than the annual exposure amount from the nature in Japan, 2.1 mSv (the environmental impact of discharge into the sea is half or less than that of vapor release)²⁴.

On one hand, since it is difficult to expect the time required to solve these issues and temporal constraints have to be considered, so geosphere injection, hydrogen discharge, and underground burial are associated with many issues from regulatory, technical, and temporal viewpoints. On the other hand, vapor release and discharge into the sea²⁵ were concluded as realistic options²⁶ ²⁷.

(3) Advantages and disadvantages of vapor release and discharge into the sea The Subcommittee compared the advantages and disadvantages of the realistic options, namely vapor release and discharge into the sea.

As a result, it was concluded that though vapor release had a precedent case of the accident reactor at Three Mile Island in the United States occurred in 1979 as well as actual cases of discharge at the time of ventilation even in normal reactors, the wastewater amount in the precedent case of Three Mile Island was significantly smaller than ALPS treated water and there was no domestic case of vaporizing liquid for vapor

Among the five disposal methods, only discharge into the sea and vapor discharge are technically feasible (Summary of an explanation by the Subcommittee Member Toshihiko Yamanishi at the 16th Subcommittee, Page 31 of the minutes).



²⁴ Explanation by the Secretariat at the 15th Subcommittee, Pages 13 to 16 of the minutes. Even if all treated water stored in tanks is treated in one year, the environmental impact is about 0.052μSV to 0.62μSV per year and 1.3μSV per year in discharge into the sea and air, respectively. The following shows the discussion related to these:

⁽¹⁾ To the question of whether the impact is an order of magnitude smaller than exposure from natural radiation even under excessive assumption that the total amount stored in tanks, 860 trillion Bq, is discharged every year for 100 years (Summary of a statement by the Subcommittee Member Sakita at the 15 Subcommittee, Page 19 of the minutes), the answer was yes (Summary of the answer by the Secretariat at the 15th Subcommittee, Page 19 of the minutes).

⁽²⁾ Even in the case of a heavy water moderated reactor in Canada, which discharges a lot of tritium, the impact of the concentration of tritium drops to a level close to the background in a location about 5 km away, so there was a statement that the simulation result based on UNSCEAR was appropriate as a simulation result of the impact on residents in locations about 5 km away from the facility (Summary of a statement by the Subcommittee Member Kakiuchi at the 15th Subcommittee, Pages 19 to 20 of the minutes).

It was explained that tritium had been generated by domestic and foreign nuclear power plants, etc., associated with their operation and a part of such tritium had been discharged into the sea, rivers, lakes and marshes, and air according to the regulations in each country (Summary of an explanation by the Secretariat at the 8th Subcommittee, Pages 4 of the minutes).

It is important to commit to perform the proven options, namely discharge into the sea and vapor release, among the five disposal methods (Summary of an explanation by the Subcommittee Member Yuko Sakita at the 16th Taskforce, Page 28 of the minutes).

release for the purpose of disposal of liquid radioactive waste²⁸ ²⁹. In addition, prediction is difficult due to deposition on the ground surface and evaporation into the air after vapor release, and there will be demerit that the fluctuation of the monitoring result caused by the weather conditions is larger than discharge into the sea³⁰ ³¹. Moreover, from social viewpoints, a wider range of industries are expected to be affected as compared to the case of discharge into the sea and reputation damage may occur in

- (1) The amount of water handled at TMI (Note: Three Mile Island) is completely different from that of Fukushima, so naturally technical discussion will be different. It was reported that the amounts of contaminated water were about 10 thousand tons and the evaporated amount was about 8,400 tons. Therefore, naturally the technologies to be provided and the assessment will be different, but even TMI achieved the goal in more than 10 years (Summary of a statement by the regulatory authorities (Chief Shinji Kinjo) at the 1st Taskforce, Page 28 of the minutes).
- (2) Though the concentration is low, it is significantly different from past research and development and actually operating plants in that extensive treatment is required. Water treatment in Fukushima is much different from that of the past plants and had no track record (Summary of an explanation by the Taskforce Member Toshihiko Yamanishi at the 2nd Taskforce, Page 16 of the minutes).
- (3) The scales of Three Mile and Fukushima are completely different. In the case of Three Mile, an accident occurred in only one reactor and the condition has calmed down, but the condition of Fukushima has yet to calm down (Summary of a statement by the Taskforce Member Yoshihisa Takakura at the 6th Taskforce, Page 18 of the minutes).
- (4) I understand that there is a big difference between the two accidents. And I also understand that the problem in Japan is much more significant than in TMI. In principle, we had no problem of accumulation. So we could wait and see. However, in the case of Fukushima, it is very important to solve the problem as soon as possible (Summary of a statement by Mr. Chuck Negin at the 6th Taskforce, Page 18 of the minutes).
- (5) It is necessary to proceed with discussion understanding the similarity to and difference from TMI, but we must remember that although the concentration of the tritium is very close, the amount is much larger in Fukushima. In the case of TMI, in reality, the reactor is 160 km away from the coast, which would be almost equivalent to the case of a reactor at an inland site in the case of Japan, so the geographical environment seems to be much different (Summary of a statement by the Taskforce Member Tokuhiro Yamamoto at the 6th Taskforce, Page 21 of the minutes).
- (6) In France, the amount of tritium discharged in liquid is much greater than that discharged into air. This is because tritium causes a greater impact on human body when released in gas than in liquid (Summary of an explanation by Mr. Jean-Luc Lachaume, at the 7th Taskforce, Page 7 of the minutes).
- (7) In the case of Three Mile, it was possible because the amount was very limited, but it is too different from the case of Fukushima to be applicable (Summary of a statement by the Committee Member Yoshihisa Takakura at the 13th Taskforce, Page 11 of the minutes).
- In terms of the required time and cost, discharge into the sea is easier. The reason vapor release was performed in the case of the Three Mile accident is that the reactor was not adjacent to the sea (Summary of a statement by the Subcommittee Member Ichiro Yamamoto at the 14th Subcommittee, Page 39 of the minutes).
- It was reported that there was a problem with monitoring for vapor release because it is difficult to predict generation and dispersion of waste, especially salt, caused by evaporation of ALPS water. For this report, no opinion was provided from the Committee (Summary of our report at the 14th Subcommittee, Page 22 of the minutes).
- ³¹ The following shows the related discussion in the Taskforce.
 - (1) As for atmospheric dispersion, the speed of especially redispersion of tritium is high. Tritium is much different from other radioactive materials in that most of it evaporates again and returns to the air (Summary of an explanation by Mr. Haruyasu Nagai at the 4th Taskforce, Page 2 of the minutes).
 - (2) The dispersion condition greatly depends on the weather conditions at the time of discharge. It also greatly varies within a day. As the weather condition varies from hour to hour, the conditions change from moment to moment, so the necessity for adjusting the assessment based on the conditions is a difficult point in atmospheric dispersion (Summary of an explanation by Mr. Haruyasu Nagai at the 4th Taskforce, Pages 2 and 3 of the minutes).
 - (3) We assessed the reduction of the concentration caused by marine dispersion from the viewpoint of the degree of dilution by advection and diffusion assuming discharge from a typical Pacific coast. The concentration of the lattice in the discharge position and 2 km lattice decreases by 1, 2, and 3 digits about 10 km, 50 km, and 100 km downstream. This is different from air. The current varies little, so prediction is easier (Summary of an explanation by Mr. Haruyasu Nagai at the 4th Taskforce, Page 8 of the minutes).



²⁸ The following shows the related discussion in the Taskforce.

industries in Fukushima and the whole of the surrounding areas.

On the other hand, there are many actual cases of discharge into the sea as being implemented in domestic and foreign nuclear facilities on daily bases and about 31.6 billion to 83 trillion Bq/year (actual average of 3 years before the accident) per site is diluted and discharged into the sea, etc., from the domestic nuclear power plants. Therefore, the discharge into the sea was concluded to be possible within the proven range even considering the disposal amount. In addition, because the composition of the discharge facility is simpler than the composition of the vapor release facility, and knowhow on the design of the discharge system and its handling are known. Thus, it was concluded that it will be able to surely dispose the waster better than vapor release in knowledge of the facility and operation point of view. Moreover, in the case of discharge into the sea, the condition of dilution dispersion after discharge is relatively easy to predict because the variation in the current is smaller than the impacts of rain and wind direction in the case of vapor release, so it was easier to consider the construction of the surveillance framework by monitoring 32 33 34.

From social viewpoints, discharge into the sea may cause reputation damage in the fishing industry and tourism in Fukushima and the surrounding sea area. Especially, the catches of the fishing industry in Fukushima, which is now in test operation, are yet to be less than 20% of that before the earthquake and the Fukushima Daiichi accident. Considering these, it is necessary to consider countermeasures³⁵.

(4) Consideration of the expansion of the tank storage capacity and continuation of tank storage

The Subcommittee considered the measure to expand the tank storage capacity and continue tank storage without disposing of ALPS treated water as follows³⁶.

For our explanation that there is no technically difficult issue in discharge into the sea, no opinion was shown (Summary of our report at the 14th Subcommittee, Page 21 of the minutes).

⁽²⁾ As long as a lot of tritium water is stored, the risk will not become zero. There must be some risks associated with



³² See footnote [31] (3)

There are several methods of discharge into the sea including construction of a new pool or equalizing the concentration before discharge in a new tank, etc., and then rechecking them, which is not technically difficult up to construction (Summary of a statement by the Subcommittee Member Yoshihisa Takakura at the 16th Subcommittee, Page 37 of the minutes).

It was explained that the social impacts of discharge in the sea widely affects areas outside Fukushima, but the impacts on land areas are limited and the directly affected parties are limited to the fishing industry and a part of tourism, such as sea bathing while vapor release widely affects up to areas outside Fukushima and may directly affects all products. There was no objection (Summary of an explanation by the Secretariat at the 12th Subcommittee, Pages 13 of the minutes).

³⁶ The following shows the related discussion in the Taskforce.

^{(1) &}quot;Even if it is stored, there is a possibility of sudden leakage.", "Even if it is stored in tanks, is it enough to just store it? I think that some sort of tank maintenance will probably be necessary during that period, and depending on the endurance of the tanks, it may be necessary to transfer it from one tank to another, and so on, and the risk of accidents, including radiation exposure of workers, must be considered." (Statement of the Taskforce Member Hideo Tatsuzaki at the 1st Taskforce, Pages 18 and 19 of the minutes).

(i) Expansion of the tank storage capacity

The Subcommittee considered storage in large-capacity aboveground tanks and storage in underground and offshore tanks. As a result, it was concluded that the storage capacity of large-capacity aboveground and underground tanks is not significantly larger than that of the existing standard tanks but had issues such as much greater leakage amounts in the case of damage. Offshore tanks of the size adopted for oil storage bases are difficult to install because the water depth is shallow in the Fukushima Daiichi port. Moreover, it is difficult to collect leaked water before dilution. In accordance of those considerations, there was no advantage in installation of the large tanks, etc. at Fukushima Daiichi³⁷.

Though storage by transfer to outside of the site was also considered, in order to prevent leakage or accident caused by transfer of water before dilution, it takes much time to plan and prepare a method to transfer a lot of treated water due to the necessity for transfer facilities compliant with laws and regulations (e.g. nuclear material protection facility surrounding the piping for transfer (fence, etc.)) as well as getting approval from the local governments on the transfer route. In addition, it was concluded to take much time because proper facilities, diverse preliminary adjustments, and procedures for permission are required due to the necessity for permission as a radioactive waste storage facility since radioactive materials are handled³⁸.

³⁸ It was explained that storage outside the site requires approval from the local governments on the transfer route in the case of transfer without dilution and transfer facilities, etc., compliant with laws and regulations were required, and there was no opinion to it (Summary of our explanation at the 13th Subcommittee, Page 35 of the minutes).



continuation of storage (Summary of a statement by the Taskforce Member Tokuhiro Yamamoto at the 1st Taskforce, Page 22 of the minutes).

⁽³⁾ In reality, one 1,000-ton tank is prepared every two days, which is associated with concerns of leakage and human errors. Tritium must be handled smoothly, otherwise there will be so many tanks that management, etc., may be very difficult. If it continues for 30 or 40 years, we will run out of space for tanks (Summary of a statement by the Taskforce Member Yoshihisa Takakura at the 4th Taskforce, Page 28 of the minutes).

⁽⁴⁾ For storage, it is necessary to consider the possibility of future relocation of the storage space; if we wait for the half-life, it will be unrealistic to wait for, for example, three half-lives because it is too long. In addition, we have to take some countermeasures against the risk of unexpected accidents during storage such as the risk of discharge of stored water (Summary of a statement by the Taskforce Member Hideo Tatsuzaki at the 4th Taskforce, Pages 32 and 33 of the minutes).

^{(5) &}quot;Of course, accidents can occur in the course of the construction of the tanks, and there is also the risk of massive leakage if the tanks are damaged. In that sense, we think it is riskier to keep the water in the tanks on the site" (Statement of the regulatory authorities (Chief Shinji Kinjo) at the 13th Taskforce, Page 22 of the minutes).

^{(6) &}quot;At present, for example, we have already built almost all the tanks in the areas that are relatively close to where contaminated water is generated and where tanks can be placed. If we build new tanks in the future, we would have to set up pipes to transfer the water over a long distance, and if we transfer the water over such a long distance, there would naturally be risks of leakage and other problems. Even if we manage to increase the capacity of the current area by replacing the tanks with new ones with a larger capacity, there is not much room left in the current area." (Our statement at the 14th Taskforce, Pages 17 and 18 of the minutes).

The advantages and disadvantages of each of the following methods assumed in the case of continuation of storage were explained: storage in large-capacity tanks, storage in large-capacity underground tanks, and storage in offshore tanks (Summary of our explanation at the 13th Subcommittee, Pages 34 and 35 of the minutes)

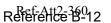
(ii) Continuation of tank storage

At the Subcommittee, the possibility of continuation of storage in tanks was also taken into consideration, however there is an issue pointed out as actual risk of handling of remaining ALPS treated water after storage, including the fracture of the tank due to the earthquake^{39 40}. In principle, it is important to proceed with reconstruction of Fukushima and decommissioning in parallel and it is necessary to finish disposal of ALPS treated water as a part of decommissioning in order to complete decommissioning of Fukushima Daiichi, so it was concluded that the water would have to be treated by the end of decommissioning even if storage was continued⁴¹. In addition, the Subcommittee concluded that transfer of radioactive waste to outside the site and expansion of the site to continue tank storage required understanding from the local governments, etc., of the area where the storage facility would be constructed and get permission as a radioactive waste storage facility, which would require so much adjustments and time up to implementation that the only possible method was to use standard tanks with improved installation efficiency at the site and the room for addition of more tanks than specified in the current plan was limited. The Subcommittee pointed out that decommissioning required securing of places for construction of various facilities such temporary storage facilities for spent fuel and fuel debris, analysis facilities for various samples, storage facilities for fuel debris retrieval equipment, mock-up and training facilities for fuel debris retrieval, and waste recycling facilities⁴².

B3. Assessment by IAEA

While the government had been proceeding with consideration, IAEA reviewed the disposal methods of ALPS treated water at all of the 4th peer review missions and recommended the Government of Japan to urgently determine how to dispose of ALPS treated water, which had been accumulated in the tanks at the Fukushima Daiichi site in the report of the 4th mission issued on January 31, 2019⁴³ 44.

The IAEA also emphasized that the decision of the basic policy on handling of treated water by the Japanese government would encourage the whole procedure of decommissioning saying "The decision on ALPS treated water disposition path



³⁹ Continuation of storage in tanks is associated with a fracture risk of tanks due to earthquake (Summary of a statement by the Subcommittee Member Hideki Kakiuchi at the 13th Subcommittee, Page 25 of the minutes).

Even if we select continuation of storage, eventually it will be necessary to treat remaining tritium (Summary of a statement by the Subcommittee Member Hideki Kakiuchi at the 13th Subcommittee, Page 25 of the minutes)

⁴¹ To the question "Will decommissioning continue as long as storage continues?" the Secretariat answered yes (Summary of a statement by the Subcommittee Member Takami Morita and summary of our statement at the 14th Subcommittee, Pages 24 and 25 of the minutes).

Decommissioning required securing of areas in order not to hinder other operations (Summary of a statement by the Subcommittee Member Tokuhiro Yamamoto at the 13th Subcommittee, Page 26 of the minutes).

IAEA "Mission Report IAEA International Peer Review Mission on Mid-And-Long-Term Roadmap Towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station (Fourth Mission) Tokyo and Fukushima Daiichi NPS, Japan 5-13 November," Page 8, etc.

Then, IAEA appraised the consideration result of the disposal methods of ALPS treated water by the government as mentioned above as follows in the report issued on April 2, 2020, in the review performed as follow-up for the 4th mission.

"Regarding the technical aspects, the IAEA Review Team considers that the recommendations made by the ALPS Subcommittee are based on a sufficiently comprehensive analysis and on a sound scientific and technical basis. The IAEA Review Team considers that the proposed objective of completing the disposition of the ALPS treated water by the time of the end of the decommissioning work is aligned with current international good practices. The IAEA Review Team considers the two options (namely controlled vapor release and controlled discharges into the sea, the latter of which is routinely used by operating nuclear power plants and fuel cycle facilities in Japan and worldwide) selected out of the initial five options are technically feasible and would allow the timeline objective to be achieved.

With the volume of ALPS treated water expected to reach the planned tank capacity of approximately 1.37 million m3 around the summer of 2022⁴⁵, s and taking into account that further treatment to meet regulatory standards for discharge before dilution and control of the stored water before disposition would be needed for implementation of any of the solutions considered by the Government of Japan, a decision on the disposition path should be taken urgently engaging all stakeholders."

B4. Summary

As described above, the Taskforce and Subcommittee discussed disposal of ALPS treated water, which had been an issue in decommissioning of Fukushima Daiichi, in detail for as long as six years, and considered the five disposal methods (geosphere injection, hydrogen release, underground burial, vapor release, and discharge into the sea) and continuation of tank storage from technical viewpoints. Based on the consideration result, the Subcommittee presented the conclusion that proven vapor release or discharge into the sea are the realistic options. Then the Subcommittee compared vapor release and discharge into the sea to present a view that discharge into the sea had more track records in terms of the relationship with the discharge disposal amount and was more reliable

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was an important advisory point of previous reviews, and it will facilitate the implementation of the whole decommissioning plan." (Acknowledgement 2) in the 5th review mission report prepared after the policy was decided.

⁴⁵ The timing when the tanks are expected to be full is as of 2020 and may change depending on conditions.

⁴⁶ IAEA "Review Report IAEA Follow-up Review of Progress Made on Management of ALPS Treated Water and the Report of the Subcommittee on Handling of ALPS Treated water at TEPCO's Fukushima Daiichi Nuclear Power Station," Page 6.

⁴⁷ The Director General Grossi of IAEA also made a similar statement when the Japanese government decided the Basic Policy. "... Controlled water discharges into the sea are routinely used by operating nuclear power plants in the world and in the region under specific regulatory authorisations based on safety and environmental impact assessments.", IAEA website dated April 13, 2021.

 $[\]underline{\text{https://www.iaea.org/newscenter/pressreleases/iaea-ready-to-support-japan-on-fukushima-water-disposal-director-general-grossi-says}$

including ease of handling of discharge facilities and monitoring methods.

The Subcommittee also presented a negative view on the continuation of storage in tanks considering the necessity for disposal of ALPS treated water for decommissioning of Fukushima Daiichi, the substantial need for the land required for future decommissioning due to the limited room for the additional tanks than specified in the current plan, and the risk factors such as the risk of leakage of treated water caused by a rupture of a tank. Thus, the Subcommittee assessed disposal of ALPS treated water is appropriate based on the premise of the disadvantage of continuation of storage in tanks and the advantage of discharge, which has no issue with safety as long as discharge complies with the regulatory standard.

This consideration result of the government was appraised by IAEA.

Reference C Setting of previous management values and exposure assessment of hypothetical ALPS treated water

In discharge of ALPS treated water into the sea, sufficient safety is secured by verifying that the sum of the ratios to regulatory concentrations limits of nuclides other than tritium is less than 1 and diluting with seawater 100 or more times at the time of discharge so that the tritium concentration greatly falls below the regulatory concentration limit, but migration in the environment varies among nuclides, so the impact on exposure is different even among nuclides with the same regulatory concentrations limit. In the assessment of design stage, we proposed individual manage eight nuclides important for exposure in order to limit this uncertainty of the source term and reduce the impacts on the external environment further. On the other hand, in this assessment of construction stage, the source term was newly redefined with 31 nuclides, and accordingly, it was decided to set the management value based on the amount of radioactivity discharged.

The previous management values were set by the following procedure.

- 1. Selection of nuclides important in terms of exposure
- 2. Setting of the previous management values of the selected nuclides

If any concentration exceeding the set previous management value is detected, we do not discharge the water and transfer it to secondary treatment. However, these eight nuclides shall be reviewed as needed based on the review result of nuclides subject to measurement before future discharge.

C1. Selection of nuclides subject to previous management

Regulatory concentration limits are set so that the annual exposure does not exceed 1mSv even in the case of ingestion of radioactive materials contained in the liquid on a daily basis. Therefore, the annual exposure amount from direct ingestion is comparable among different nuclides as long as their regulatory concentration ratios are the same, and the annual exposure will not exceed 1 mSv and as long as the sum of the ratios to regulatory concentrations limits is less than 1 even if multiple nuclides are included.

On the other hand, the behavior varies among elements such as migration to organisms in the environment, so the impact on exposure varies among nuclides discharged even with the same regulator concentration limit.

Therefore, to verify the exposure impact of each nuclide discharged with the same regulator concentration limit, we assessed exposure from discharge of ALPS treated water containing the corresponding nuclides only at the regulatory concentration limits (the sum of the ratios to regulatory concentrations limits is 1) for one year, though it is unrealistic, and selected nuclides important in terms of exposure assessment.

a. Source term

Based on the following conditions, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-1.

- Set the tritium concentration used for assessment at 100,000 Bq/L, which is the lower than the ever since measured tritium concentration of about 150,000 Bq/L, to estimate larger annual discharge volume of water and annual discharge amount of the nuclides other than tritium which proportion to the annual discharge volume of water.
- Set the annual discharge amount by multiplying the regulatory concentration of each nuclide by the annual discharge volume of water.
- b. Concentration of each nuclide used for the exposure assessment in the seawater The concentration of each nuclide in the seawater used for exposure assessment was calculated from the ratio of tritium to the annual discharge amount of each nuclide based on the annual average concentration within $10 \text{ km} \times 10 \text{ km}$ of the tritium concentration in the seawater (all layers) in Table 6-1-17. Table C-2 shows the concentration of each nuclide in the seawater used for the assessment.

c. Assessment targets

The assessment targets are internal exposure from beach sand, which is significantly affected by external exposure, internal exposure from ingestion of seafood, and exposure for environment protection.

The exposure assessment method is the same as 6-1-2. "Assessment method" and persons subject to the assessment evaluation are those who ingest a large amount of seafood.

d. Exposure assessment result and selection of nuclides subject to previous management Table C-3 shows the assessment result of internal exposure of adults from each nuclide discharged at the regulatory concentration limit in descending order of the value. We selected the eight nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit as nuclides subject to previous management, which are nuclides with significant impacts on the exposure assessment.

As for external exposure from beach sand, there are some nuclides whose exposure amount exceeds 0.001 mSv/year when discharged at the regulatory concentration limit, but as shown in Table C-4, the dose conversion factor of Co-60 is used for all of these nuclides and the actual impact on external exposure is much smaller than Co-60 considering the energy and discharge rate of photons discharged by each nuclide, so such nuclides are deemed not to be subject to previous management.

e. Confirmation regarding environmental protection

Consideration had focused on the impact of human exposure, but this time we confirmed whether there is any nuclide subject to previous management from the viewpoint of environmental protection.

Specifically, we assessed the impact of exposure of each nuclide on marine plants and animals by the assessment method shown in 7-2. "Assessment method" using the source term of a. Table C-5 shows the assessment results in descending order of the value. The nuclide with the greatest impact of exposure is Fe-59, but it is lower than the lower limit value of the derived consideration reference level (DCRL). We judged that there was no nuclide to be added as a previous management target from the viewpoint of environmental protection because Fe-59 had been subject to previous management for reduction of human exposure and the assessment values of the other nuclides are an order of magnitude smaller than that of Fe-59.

Table C-1 Source term to verify the impacts of 63 nuclides other than tritium (annual

discharge amount)

	1		discharge am	<u>ou</u>
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	
H-3	1.0E+05	2.2E+08	2.2E+13	•
C-14	2.0E+03	2.2E+08	4.4E+11	tr •
Mn-54	1.0E+03	2.2E+08	2.2E+11	lo S
Fe-59	4.0E+02	2.2E+08	8.8E+10	a
Co-58	1.0E+03	2.2E+08	2.2E+11	٧.
Co-60	2.0E+02	2.2E+08	4.4E+10	а
Ni-63	6.0E+03	2.2E+08	1.3E+12	A
Zn-65	2.0E+02	2.2E+08	4.4E+10	C
Rb-86	3.0E+02	2.2E+08	6.6E+10	to
Sr-89	3.0E+02	2.2E+08	6.6E+10	n
Sr-90	3.0E+01	2.2E+08	6.6E+09	n
Y-90	3.0E+02	2.2E+08	6.6E+10	
Y-91	3.0E+02	2.2E+08	6.6E+10	
Nb-95	1.0E+03	2.2E+08	2.2E+11	
Tc-99	1.0E+03	2.2E+08	2.2E+11	
Ru-103	1.0E+03	2.2E+08	2.2E+11	
Ru-106	1.0E+02	2.2E+08	2.2E+10	
Rh-103m	2.0E+05	2.2E+08	4.4E+13	
Rh-106	3.0E+05	2.2E+08	6.6E+13	
Ag-110m	3.0E+02	2.2E+08	6.6E+10	
Cd-113m	4.0E+01	2.2E+08	8.8E+09	
Cd-115m	3.0E+02	2.2E+08	6.6E+10	
Sn-119m	2.0E+03	2.2E+08	4.4E+11	
Sn-123	4.0E+02	2.2E+08	8.8E+10	
Sn-126	2.0E+02	2.2E+08	4.4E+10	
Sb-124	3.0E+02	2.2E+08	6.6E+10	
Sb-125	8.0E+02	2.2E+08	1.8E+11	
Te-123m	6.0E+02	2.2E+08	1.3E+11	
Te-125m	9.0E+02	2.2E+08	2.0E+11	
Te-127	5.0E+03	2.2E+08	1.1E+12	
Te-127m	3.0E+02	2.2E+08	6.6E+10	
Te-129	1.0E+04	2.2E+08	2.2E+12	
Te-129m	3.0E+02	2.2E+08	6.6E+10	
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• For the annual discharge amount of tritium, the upper limit value is used.

Remarks

- The concentration of tritium is set to a lower value than the concentration of stored ALPS treated water, etc., because a relatively large annual discharge volume of water is set.
- This source term is used for the assessment of the case of discharge of ALPS treated water containing only the corresponding nuclides at their regulatory concentration limits (the sum of the ratios to regulatory concentrations limits is 1) to verify the impact of exposure of each nuclide, and water of such quality will be never been discharged actually.

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
I-129	9.0E+00	2.2E+08	2.0E+09	
Cs-134	6.0E+01	2.2E+08	1.3E+10	
Cs-135	6.0E+02	2.2E+08	1.3E+11	
Cs-136	3.0E+02	2.2E+08	6.6E+10	
Cs-137	9.0E+01	2.2E+08	2.0E+10	
Ba-137m	8.0E+05	2.2E+08	1.8E+14	
Ba-140	3.0E+02	2.2E+08	6.6E+10	
Ce-141	1.0E+03	2.2E+08	2.2E+11	
Ce-144	2.0E+02	2.2E+08	4.4E+10	
Pr-144	2.0E+04	2.2E+08	4.4E+12	
Pr-144m	4.0E+04	2.2E+08	8.8E+12	
Pm-146	9.0E+02	2.2E+08	2.0E+11	
Pm-147	3.0E+03	2.2E+08	6.6E+11	
Pm-148	3.0E+02	2.2E+08	6.6E+10	
Pm-148m	5.0E+02	2.2E+08	1.1E+11	
Sm-151	8.0E+03	2.2E+08	1.8E+12	
Eu-152	6.0E+02	2.2E+08	1.3E+11	
Eu-154	4.0E+02	2.2E+08	8.8E+10	
Eu-155	3.0E+03	2.2E+08	6.6E+11	
Gd-153	3.0E+03	2.2E+08	6.6E+11	
Tb-160	5.0E+02	2.2E+08	1.1E+11	
Pu-238	4.0E+00	2.2E+08	8.8E+08	
Pu-239	4.0E+00	2.2E+08	8.8E+08	
Pu-240	4.0E+00	2.2E+08	8.8E+08	
Pu-241	2.0E+02	2.2E+08	4.4E+10	
Am-241	5.0E+00	2.2E+08	1.1E+09	
Am-242m	5.0E+00	2.2E+08	1.1E+09	
Am-243	5.0E+00	2.2E+08	1.1E+09	
Cm-242	6.0E+01	2.2E+08	1.3E+10	
Cm-243	6.0E+00	2.2E+08	1.3E+09	
Cm-244	7.0E+00	2.2E+08	1.5E+09	

 Table C-2
 Concentration in the seawater used for the assessment

ie C-2 Concen	tration in the seawater used	TOT THE GOOD CHILDIN
	Concentration in the seawater	Concentration in the seawater
-		used for the assessment (Sandy beach assessment point)
(Bq)	Mean concentration of all layers	Mean concentration of all layers
	(Bq/L)	(Bq/L)
2.2E+13	5.6E-02	8.8E-01
4.4E+11	1.1E-03	1.8E-02
2.2E+11	5.6E-04	8.8E-03
8.8E+10	2.2E-04	3.5E-03
2.2E+11	5.6E-04	8.8E-03
4.4E+10	1.1E-04	1.8E-03
1.3E+12	3.4E-03	5.3E-02
4.4E+10	1.1E-04	1.8E-03
6.6E+10	1.7E-04	2.6E-03
6.6E+10	1.7E-04	2.6E-03
6.6E+09	1.7E-05	2.6E-04
6.6E+10	1.7E-04	2.6E-04
6.6E+10	1.7E-04	2.6E-03
2.2E+11	5.6E-04	8.8E-03
2.2E+11	5.6E-04	8.8E-03
2.2E+11	5.6E-04	8.8E-03
2.2E+10	5.6E-05	8.8E-04
4.4E+13	1.1E-01	8.8E-03
6.6E+13	1.7E-01	8.8E-04
6.6E+10	1.7E-04	2.6E-03
8.8E+09	2.2E-05	3.5E-04
6.6E+10	1.7E-04	2.6E-03
4.4E+11	1.1E-03	1.8E-02
8.8E+10	2.2E-04	3.5E-03
4.4E+10	1.1E-04	1.8E-03
6.6E+10	1.7E-04	2.6E-03
1.8E+11	4.5E-04	7.0E-03
1.3E+11	3.4E-04	5.3E-03
2.0E+11	5.0E-04	7.9E-03
1.1E+12	2.8E-03	4.4E-02
6.6E+10	1.7E-04	2.6E-03
2.2E+12	5.6E-03	2.6E-03
6.6E+10	1.7E-04	2.6E-03
	Annual discharge amount (Bq) 2.2E+13 4.4E+11 2.2E+11 8.8E+10 2.2E+11 4.4E+10 1.3E+12 4.4E+10 6.6E+10 6.6E+10 6.6E+09 6.6E+10 2.2E+11 2.2E+11 2.2E+11 2.2E+11 2.2E+11 3.6E+13 6.6E+10 8.8E+09 6.6E+10 4.4E+11 8.8E+10 4.4E+11 1.3E+11 1.3E+11 1.1E+12 6.6E+10 2.2E+12	Annual discharge amount (Bq) Annual discharge amount (Bq) Example 10 km × 10 km) Mean concentration of all layers (Bq/L) 2.2E+11 5.6E-02 4.4E+11 1.1E-03 2.2E+11 5.6E-04 8.8E+10 2.2E-04 2.2E+11 5.6E-04 4.4E+10 1.1E-04 1.3E+12 3.4E-03 4.4E+10 1.7E-04 6.6E+10 1.7E-04 6.6E+09 1.7E-05 6.6E+10 1.7E-04 6.6E+10 1.7E-04 2.2E+11 5.6E-04 4.4E+13 1.1E-01 6.6E+13 1.7E-01 6.6E+10 1.7E-04 8.8E+09 2.2E-05 6.6E+10 1.7E-04 4.4E+11 1.1E-03 8.8E+09 2.2E-05 6.6E+10 1.7E-04 4.4E+11 1.1E-03 8.8E+10 2.2E-04 4.4E+11 1.1E-03 8.8E+10 1.7E-04 1.8E+11 1.1E-04 6.6E+10 1.7E-04 1.8E+11 1.1E-04 6.6E+10 1.7E-04 1.8E+11 1.1E-04 1.8E+11 1.1E-04

Target nuclide Annual discharge amount (Bq)		Concentration in the seawater used for the assessment (within 10 km × 10 km) Mean concentration of all layers	Concentration in the seawater used for the assessment (Sandy beach assessment point) Mean concentration of all layers
1.400	0.05.00	(Bq/L)	(Bq/L)
I-129	2.0E+09	5.0E-06	7.9E-05
Cs-134	1.3E+10	3.4E-05	5.3E-04
Cs-135	1.3E+11	3.4E-04	5.3E-03
Cs-136	6.6E+10	1.7E-04	2.6E-03
Cs-137	2.0E+10	5.0E-05	7.9E-04
Ba-137m	1.8E+14	4.5E-01	7.9E-04
Ba-140	6.6E+10	1.7E-04	2.6E-03
Ce-141	2.2E+11	5.6E-04	8.8E-03
Ce-144	4.4E+10	1.1E-04	1.8E-03
Pr-144	4.4E+12	1.1E-02	1.8E-03
Pr-144m	8.8E+12	2.2E-02	1.8E-03
Pm-146	2.0E+11	5.0E-04	7.9E-03
Pm-147	6.6E+11	1.7E-03	2.6E-02
Pm-148	6.6E+10	1.7E-04	2.6E-03
Pm-148m	1.1E+11	2.8E-04	4.4E-03
Sm-151	1.8E+12	4.5E-03	7.0E-02
Eu-152	1.3E+11	3.4E-04	5.3E-03
Eu-154	8.8E+10	2.2E-04	3.5E-03
Eu-155	6.6E+11	1.7E-03	2.6E-02
Gd-153	6.6E+11	1.7E-03	2.6E-02
Tb-160	1.1E+11	2.8E-04	4.4E-03
Pu-238	8.8E+08	2.2E-06	3.5E-05
Pu-239	8.8E+08	2.2E-06	3.5E-05
Pu-240	8.8E+08	2.2E-06	3.5E-05
Pu-241	4.4E+10	1.1E-04	1.8E-03
Am-241	1.1E+09	2.8E-06	4.4E-05
Am-242m	1.1E+09	2.8E-06	4.4E-05
Am-243	1.1E+09	2.8E-06	4.4E-05
Cm-242	1.3E+10	3.4E-05	5.3E-04
Cm-243	1.3E+09	3.4E-06	5.3E-05
Cm-244	1.5E+09	3.9E-06	6.2E-05
Target exp	osure pathway	Ingestion of seafood	From beach sand

Table C-3 Internal exposure assessment result from ingestion of seafood in the case of discharge of each nuclide at the regulatory concentration limit (adult) (Selected 8 nuclides exceeding 0.001 mSv/year as previous management

targets)

	targets)					
No.	Target nuclide	Regulatory concentration limit (Bq/L)	Internal exposure dose from ingestion of seafood (mSv/year)	Remarks		
1	Sn-126	6.0E+04	2.6E-02	Previous operation and management targets		
2	Sn-123	2.0E+03	2.3E-02	Previous operation and management targets		
3	Sn-119m	1.0E+03	1.9E-02	Previous operation and management targets		
4	Fe-59	4.0E+02	5.6E-03	Previous operation and management targets		
5	Cd-115m	1.0E+03	1.4E-03	Previous operation and management targets		
6	C-14	2.0E+02	1.3E-03	Previous operation and management targets		
7	Cd-113m	6.0E+03	1.3E-03	Previous operation and management targets		
8	Ag-110m	2.0E+02	1.0E-03	Previous operation and management targets		
9	Zn-65	3.0E+02	8.4E-04			
10	Mn-54	3.0E+02	5.2E-04			
11	Co-58	3.0E+01	2.5E-04			
12	Co-60	3.0E+02	2.3E-04			
13	Tc-99	3.0E+02	2.1E-04			
14	Te-129m	1.0E+03	1.4E-04			
15	Te-127	1.0E+03	1.3E-04			
16	Te-123m	1.0E+03	1.3E-04			
17	Eu-155	1.0E+02	1.3E-04			
18	Te-125m	2.0E+05	1.2E-04			
19	Pm-148m	3.0E+05	1.1E-04			
20	Eu-152	3.0E+02	1.1E-04			
21	Te-127m	4.0E+01	1.1E-04			
22	Gd-153	3.0E+02	1.1E-04			
23	Pm-146	2.0E+03	1.1E-04			
24	Pm-148	4.0E+02	1.1E-04			
25	Eu-154	2.0E+02	1.1E-04			
26	I-129	3.0E+02	1.1E-04			
27	Sm-151	8.0E+02	1.0E-04			
28	Pm-147	6.0E+02	1.0E-04			
29	Am-241	9.0E+02	1.0E-04			

No.	Target nuclide	Regulatory concentration limit (Bq/L)	Internal exposure dose from ingestion of seafood (mSv/year)	Remarks
30	Am-243	5.0E+03	1.0E-04	
31	Am-242m	3.0E+02	9.7E-05	
32	Pu-239	1.0E+04	8.4E-05	
33	Pu-240	3.0E+02	8.4E-05	
34	Ce-144	9.0E+00	8.4E-05	
35	Pu-241	6.0E+01	8.1E-05	
36	Pu-238	6.0E+02	7.8E-05	
37	Ni-63	3.0E+02	7.7E-05	
38	Cm-243	9.0E+01	6.3E-05	
39	Cm-244	8.0E+05	5.9E-05	
40	Ce-141	3.0E+02	5.7E-05	
41	Cm-242	1.0E+03	5.0E-05	
42	Tb-160	2.0E+02	4.9E-05	
43	Nb-95	2.0E+04	2.7E-05	
44	Sb-125	4.0E+04	2.4E-05	
45	Sb-124	9.0E+02	2.0E-05	
46	Ru-103	3.0E+03	2.0E-05	
47	Ru-106	3.0E+02	1.9E-05	
48	Y-91	5.0E+02	1.7E-05	
49	Cs-135	8.0E+03	6.2E-06	
50	Cs-137	6.0E+02	6.1E-06	
51	Cs-134	4.0E+02	5.9E-06	
52	Cs-136	3.0E+03	4.7E-06	
53	Te-129	3.0E+03	3.0E-06	
54	Y-90	5.0E+02	2.0E-06	
55	Ba-140	4.0E+00	9.8E-07	
56	Pr-144	4.0E+00	6.7E-07	
57	Rb-86	4.0E+00	6.3E-07	
58	Sr-90	2.0E+02	2.9E-07	
59	Sr-89	5.0E+00	2.7E-07	
60	Rh-103m	5.0E+00	1.8E-07	
61	H-3	5.0E+00	1.3E-07	
62	Rh-106	6.0E+01	0.0E+00	Assessed with the parent nuclide
63	Ba-137m	6.0E+00	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	7.0E+00	0.0E+00	Assessed with the parent nuclide

Table C-4 Result of the external exposure assessment from beach sand in the case

of discharge of each nuclide at the regulatory concentration limit

	of discharge of each nuclide at the regulatory concentration limit						
	Nuclide	Regulatory concentration limit (Bq/L)	Exposure from beach sand (mSv/year)	Remarks			
1	Te-127	5.0E+03	1.0E-02	For the dose conversion factor, refer to the value of Co-60			
2	Eu-155	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of Co-60			
3	Gd-153	3.0E+03	6.2E-03	For the dose conversion factor, refer to the value of Co-60			
4	Sn-119m	2.0E+03	4.1E-03	For the dose conversion factor, refer to the value of Co-60			
5	Nb-95	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60			
6	Ru-103	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60			
7	Ce-141	1.0E+03	2.1E-03	For the dose conversion factor, refer to the value of Co-60			
8	Pm-146	9.0E+02	1.9E-03	For the dose conversion factor, refer to the value of Co-60			
9	Te-123m	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of Co-60			
10	Cs-135	6.0E+02	1.2E-03	For the dose conversion factor, refer to the value of Co-60			
11	Pm-148m	5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of Co-60			
12	Tb-160	5.0E+02	1.0E-03	For the dose conversion factor, refer to the value of Co-60			
13	Co-58	1.0E+03	8.4E-04	For the dose conversion factor, refer to the value of Co-60			
14	Sn-123	4.0E+02	8.3E-04				
15	Mn-54	1.0E+03	7.0E-04				
16	Rb-86	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
17	Sr-89	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
18	Y-91	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
19	Ag-110m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
20	Cd-115m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
21	Sb-124	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
22	Te-127m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
23	Te-129m	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
24	Cs-136	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
25	Ba-140	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
26	Pm-148	3.0E+02	6.2E-04	For the dose conversion factor, refer to the value of Co-60			
27	Eu-152	6.0E+02	5.5E-04				
28	Co-60	2.0E+02	4.1E-04				
29	Eu-154	4.0E+02	4.0E-04				
30	Sb-125	8.0E+02	2.9E-04				
31	Zn-65	2.0E+02	9.7E-05				
32	Cs-134	6.0E+01	8.2E-05				
33	Cs-137	9.0E+01	4.8E-05				
34	Ru-106	1.0E+02	1.9E-05				
35	Pu-241	2.0E+02	1.8E-05				

	Nuclide	Regulatory concentration limit (Bq/L)	Exposure from beach sand (mSv/year)	Remarks
36	Ce-144	2.0E+02	8.8E-06	
37	Te-125m	9.0E+02	7.5E-06	
38	Sn-126	2.0E+02	4.6E-06	
39	Cm-243	6.0E+00	8.2E-07	For the dose conversion factor, refer to the value of Am-243
40	Am-243	5.0E+00	6.8E-07	
41	Sr-90	3.0E+01	1.6E-07	
42	I-129	9.0E+00	5.1E-08	
43	Pm-147	3.0E+03	4.6E-08	
44	Am-242m	5.0E+00	4.4E-08	
45	Am-241	5.0E+00	3.7E-08	
46	Fe-59	4.0E+02	2.8E-08	
47	Tc-99	1.0E+03	2.8E-08	
48	Sm-151	8.0E+03	2.2E-08	
49	Cm-242	6.0E+01	9.8E-09	
50	Cd-113m	4.0E+01	7.2E-09	
51	Cm-244	7.0E+00	1.1E-09	
52	Pu-238	4.0E+00	6.3E-10	
53	Pu-240	4.0E+00	6.2E-10	
54	Pu-239	4.0E+00	3.7E-10	
55	H-3	6.0E+04	0.0E+00	
56	C-14	2.0E+03	0.0E+00	
57	Ni-63	6.0E+03	0.0E+00	
58	Y-90	3.0E+02	0.0E+00	Assessed with the parent nuclide
59	Rh-103m	2.0E+05	0.0E+00	Assessed with the parent nuclide
60	Rh-106	3.0E+05	0.0E+00	Assessed with the parent nuclide
61	Te-129	1.0E+04	0.0E+00	Assessed with the parent nuclide
62	Ba-137m	8.0E+05	0.0E+00	Assessed with the parent nuclide
63	Pr-144	2.0E+04	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	4.0E+04	0.0E+00	Assessed with the parent nuclide

^{*}Nuclides subject to previous management are hatched

Table C-5 Result of the environmental protection assessment in the case of

discharge of each nuclide at the regulatory concentration limit

discharge of each nuclide at the regulatory concentration limit						
		Regulatory concentration	Exposure as	sessment resu	ılt (mGy/day)	_
	Nuclide	limit (Bq/L)	Flatfish	Crab	Brown seaweed	Remarks
1	Fe-59	4.0E+02	5.4E-01	5.4E-01	5.8E-01	
2	Sn-126	2.0E+02	9.7E-03	9.3E-03	9.0E-03	
3	Pm-148m	5.0E+02	7.5E-03	7.2E-03	8.1E-03	
4	Mn-54	1.0E+03	6.6E-03	6.0E-03	6.6E-03	
5	Eu-152	6.0E+02	5.4E-03	5.1E-03	5.4E-03	
6	Pm-146	9.0E+02	5.1E-03	4.9E-03	5.4E-03	
7	Tb-160	5.0E+02	4.2E-03	4.2E-03	4.5E-03	
8	Eu-154	4.0E+02	3.8E-03	3.6E-03	3.8E-03	
9	Nb-95	1.0E+03	2.3E-03	2.3E-03	2.4E-03	
10	Gd-153	3.0E+03	2.2E-03	2.0E-03	2.5E-03	
11	Pm-148	3.0E+02	1.5E-03	1.4E-03	2.0E-03	
12	Eu-155	3.0E+03	1.3E-03	1.3E-03	1.3E-03	
13	Co-58	1.0E+03	1.1E-03	1.1E-03	1.1E-03	
14	Sn-123	4.0E+02	1.0E-03	9.7E-04	1.0E-03	
15	Sn-119m	2.0E+03	9.6E-04	9.1E-04	6.7E-04	
16	Ce-141	1.0E+03	8.6E-04	8.2E-04	8.9E-04	
17	Co-60	2.0E+02	5.6E-04	5.6E-04	6.1E-04	
18	Ce-144	2.0E+02	4.7E-04	2.7E-04	4.7E-04	
19	Ru-103	1.0E+03	7.4E-05	7.4E-05	7.6E-05	
20	Cd-115m	3.0E+02	4.4E-05	1.9E-04	8.3E-06	
21	Ag-110m	3.0E+02	4.1E-05	2.3E-04	3.5E-05	
22	Y-91	3.0E+02	3.6E-05	2.2E-05	1.6E-04	
23	Zn-65	2.0E+02	3.3E-05	6.6E-05	3.2E-05	
24	C-14	2.0E+03	1.0E-05	8.4E-06	6.7E-06	
25	Cs-136	3.0E+02	9.5E-06	9.4E-06	9.4E-06	
26	Te-127	5.0E+03	9.4E-06	9.4E-06	8.7E-05	
27	Am-243	5.0E+00	8.8E-06	1.1E-05	9.7E-06	
28	Ru-106	1.0E+02	6.4E-06	6.4E-06	7.6E-06	
29	Cm-243	6.0E+00	5.8E-06	1.5E-05	9.4E-06	
30	Ba-140	3.0E+02	5.6E-06	7.7E-06	1.0E-05	
31	Sb-124	3.0E+02	5.1E-06	4.8E-06	6.1E-06	
32	Sb-125	8.0E+02	3.2E-06	3.0E-06	4.0E-06	
33	Pm-147	3.0E+03	2.9E-06	3.9E-05	2.7E-05	
34	Cd-113m	4.0E+01	1.7E-06	7.8E-06	1.4E-07	
35	Te-129m	3.0E+02	1.6E-06	1.6E-06	1.5E-05	

		Regulatory	Exposure assessment result (mGy/day)			
	Nuclide	concentration limit (Bq/L)	Flatfish	Crab	Brown seaweed	Remarks
36	Sm-151	8.0E+03	1.5E-06	3.3E-05	1.3E-05	
37	Cs-134	6.0E+01	1.5E-06	1.4E-06	1.5E-06	
38	Te-125m	9.0E+02	1.0E-06	1.0E-06	8.8E-06	
39	Am-241	5.0E+00	9.4E-07	3.1E-06	9.7E-07	
40	Te-123m	6.0E+02	9.0E-07	9.2E-07	5.4E-06	
41	Cs-137	9.0E+01	8.0E-07	7.7E-07	8.0E-07	
42	Rb-86	6.0E+01	7.8E-07	9.9E-05	3.7E-05	
43	Cm-242	3.0E+02	7.7E-07	7.7E-07	7.2E-06	
44	Te-127m	5.0E+00	7.2E-07	8.0E-07	1.3E-06	
45	Am-242m	3.0E+02	6.7E-07	5.3E-07	1.3E-06	
46	Pu-238	4.0E+00	4.6E-07	3.1E-07	7.6E-07	
47	Pu-240	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
48	Pu-239	4.0E+00	4.3E-07	2.9E-07	7.1E-07	
49	Ni-63	6.0E+03	2.3E-07	5.5E-06	1.7E-06	
50	Cm-244	7.0E+00	8.6E-08	1.1E-05	4.2E-06	
51	Tc-99	1.0E+03	6.7E-08	1.5E-05	4.5E-05	
52	Sr-89	3.0E+02	6.1E-08	2.1E-07	6.0E-08	
53	Cs-135	6.0E+02	5.3E-08	2.9E-08	4.3E-08	
54	Pu-241	2.0E+02	2.2E-08	1.5E-08	3.7E-08	
55	Sr-90	3.0E+01	1.1E-08	4.1E-08	1.1E-08	
56	H-3	6.0E+04	4.7E-09	4.7E-09	1.8E-09	
57	I-129	9.0E+00	9.1E-11	5.2E-08	2.3E-08	
58	Y-90	3.0E+02	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
59	Rh-103m	2.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
60	Rh-106	3.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
61	Te-129	1.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
62	Ba-137m	8.0E+05	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
63	Pr-144	2.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide
64	Pr-144m	4.0E+04	0.0E+00	0.0E+00	0.0E+00	Assessed with the parent nuclide

^{*} Nuclides subject to previous management are hatched

C2. Setting of previous management values

In the analysis results of tanks and ALPS outlet water, seven nuclides excluding C-14 were not detected among the nuclides subject to previous management. The management values of the undetected nuclides are obtained by rounding up 120% of the minimum detection limit (larger result of the two tank groups) in the secondary treatment performance test considering errors. That of C-14, which was detected, is obtained by rounding up the concentration twice as high as the maximum value.

Figure C-1 and Table C-6 show the setting flow of previous management values and the set previous management values, respectively.

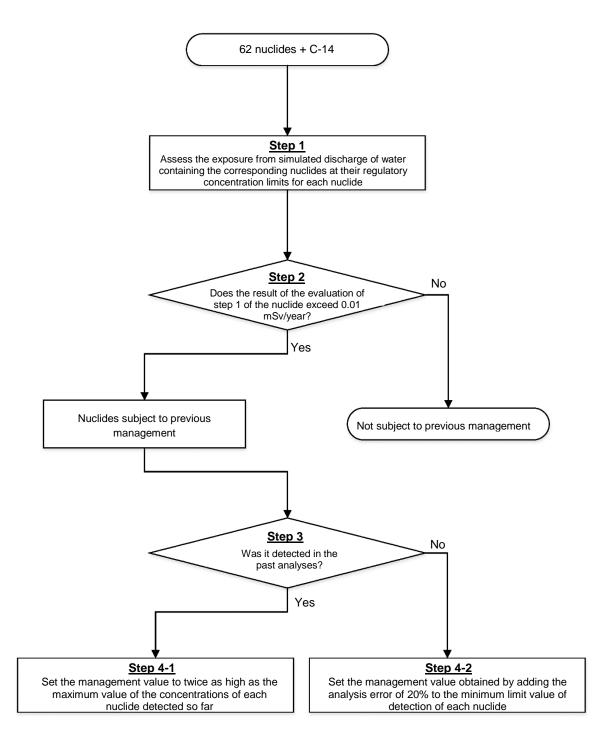


Figure C-1 Flow of setting of previous management values

Table C-6 Setting of previous management values

		Table C-6	setting of previ	ous managem	CIII Values			
	Nuclide	Regulatory concentration limit (Bq/L)	Minimum detection limit (Bq/L)	Minimum detection limit ×1.2 (Bq/L)	Previous operation and management value (Bq/L)	Ratio to regulatory concentration limit		
	Fe-59	4.0E+02	8.66E-02	1.04E-01	2E-01	5.0E-04		
clide	Ag-110m	3.0E+02	4.26E-02	5.11E-02	6E-02	2.0E-04		
Undetected nuclide	Cd-113m	4.0E+01	8.55E-02	1.03E-01	2E-01	5.0E-03		
Undet	Cd-115m	3.0E+02	2.70E+00	3.24E+00	4E+00	1.3E-02		
	Sn-119m	2.0E+03	4.24E+01	5.09E+01	6E+01	3.0E-02		
	Sn-123	4.0E+02	6.59E+00	7.91E+00	8E+00	2.0E-02		
	Sn-126	2.0E+02	2.92E-01	3.50E-01	4E-01	2.0E-03		
Detected nuclide	Nuclide	Regulatory concentration limit (Bq/L)	Maximum detected value (Bq/L)	Maximum detected valuex2 (Bq/L)	Operation and management value (Bq/L)	Ratio to regulatory concentration limit		
Detec	C-14	2.0E+03	2.15E+02	4.30E+02	5E+02	2.5E-01		
	Total of regulatory concentration ratios							

C3. Simulation assessment of human exposure from ALPS treated water To verify that the previous management values set in C2. reduce the risk caused by the uncertainty of the source term, we assessed the exposure from continuous discharge of simulated ALPS treated water containing only nuclides with relatively great impacts of exposure such as the nuclides subject to previous management as a very conservative assessment, though such ALPS treated water cannot exist in reality.

a. Setting of the source terms

Based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-7.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million L (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the previous management value, which is the
 upper limit, is set to the concentrations of 8 nuclides with relatively great impacts on
 exposure. The sum of the ratios to regulatory concentrations limits of the 8 nuclides
 is 0.32.
- For the other 55 nuclides, Zn-65, whose impact on exposure is relatively great following the 8 nuclides subject to previous management, shall be assessed, and the concentration of Zn-65 is set to 140Bq/L, which is equivalent to the regulatory concentration ratio of 0.68. Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium becomes 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 9 nuclides by multiplying the concentrations of the 8 nuclides subject to previous management and Zn-65 by the annual discharge volume of water of 220 million L.
- b. Concentration of each nuclide used for the exposure assessment in the seawater For the concentration of each nuclide in the seawater used for exposure assessment, the concentration of the other nuclides was calculated from the ratio of tritium to the annual discharge amount of the other nuclides in the source term based on the annual average concentration within $10 \text{ km} \times 10 \text{ km}$ and the annual average concentration of the sandy beach assessment point in the tritium concentration in the seawater (all layers) in Table 6-1-17. Table C-8 shows the concentration of each nuclide in the seawater used for the assessment.

c. Exposure assessment method

The migration pathway, the exposure pathway, exposure assessment method, and the setting of the representative person are the same as those of 6-1. "Exposure assessment under normal conditions".

d. Exposure assessment result

Table C-9 shows the result of the exposure assessment using the source term with simulated ALPS treated water containing only the nuclides with relatively great impacts on exposure. Even if the source term that seems to be the most conservative in terms of discharge management is used, the results were much smaller than the dose limit of 1 mSv/year for the general public and the dose target of 0.05 mSv/year, which is equivalent to the dose constraint value.

Table C-7 Source term using hypothetical ALPS treated water (annual discharge amount)

Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual discharge amount (Bq)	Remarks
H-3	1.0E+05	2.2E+08	2.2E+13	For the annual discharge amount of tritium, the upper limit value is used.
C-14	5.0E+02		1.1E+11	In actual discharge, the water is diluted
Fe-59	2.0E-01		4.4E+07	with seawater 100 or more times so that the tritium concentration will become less
Zn-65	1.4E+02		3.1E+10	than 1,500Bq/L, so the Sum of the ratios
Ag-110m	6.0E-02		1.3E+07	to regulatory concentrations limits of 63 nuclides other than tritium in the
Cd-113m	2.0E-01		4.4E+07	discharged water will be less than 0.01.
Cd-115m	4.0E+00		8.8E+08	
Sn-119m	6.0E+01		1.3E+10	
Sn-123	8.0E+00		1.8E+09	
Sn-126	4.0E-01		8.8E+07	

Table C-8 Concentration in the seawater used for the assessment (Source term using hypothetical ALPS treated water)

	40	g nypotnetical ALI	o troutou mator	
	Annual Concentration in the seawater used for the assessment			assessment (Bq/L)
Target nuclide	discharge amount (Bq)	Average of all layers within 10×10 km	Average of the top layers within 10×10 km	Average of all layers of the sandy beach assessment point
H-3	2.2E+13	5.6E-02	1.2E-01	8.8E-01
C-14	1.3E+09	2.8E-04	6.0E-04	4.4E-03
Fe-59	5.9E+06	1.1E-07	2.4E-07	1.8E-06
Zn-65	6.5E+06	7.8E-05	1.7E-04	1.2E-03
Ag-110m	3.3E+06	3.4E-08	7.2E-08	5.3E-07
Cd-113m	7.0E+06	1.1E-07	2.4E-07	1.8E-06
Cd-115m	1.9E+08	2.2E-06	4.8E-06	3.5E-05
Sn-119m	3.3E+09	3.4E-05	7.2E-05	5.3E-04
Sn-123	5.1E+08	4.5E-06	9.6E-06	7.0E-05

	Annual	Concentration in the seawater used for the assessment (Bq/L)		
Target nuclide	discharge amount (Bq)	Average of all layers within 10×10 km	Average of the top layers within 10×10 km	Average of all layers of the sandy beach assessment point
Sn-126	1.2E+07	2.2E-07	4.8E-07	3.5E-06
Target exposure assessment		From fishing nets Ingestion of seafood	From sea surface From hulls	During swimming From beach sand Ingestion of seawater Inhalation of seawater spray

Table C-9 Human exposure assessment result (Assessment area: 10 km × 10 km)

Assessed case	Source term Assessed case		Source term using hypothetical ALPS treated water	
	Ingestion of seafood	Average	Large	
	Sea surface	1.88	E-07	
	Hull	1.46	E-07	
External exposure (mSv/year)	During swimming	1.2E-07		
	Beach sand	2.2E-04		
	Fishing net	4.5E-05		
	Ingestion of water	4.66	E-07	
Internal exposure (mSv/year)	Inhalation of spray	2.1E-07		
	Ingestion of seafood	4.8E-04	2.0E-03	
Total (mSv/year)		7E-04	2E-03	

Table C-10 Assessment result of internal exposure from ingestion of seafood by age

(10 km × 10 km)			
Assessed case	Source term	Source term using hypothetical ALPS treated water	
	Ingestion of seafood	Average	Large
	Adult	4.6E-07	
Internal exposure from ingestion of seawater	Child under school age	8.7E-07	
(mSv/year)	Infant	-	
Internal exposure	Adult	2.1E-07	
from inhalation of seawater spray	Child under school age	1.6E-07	
(mSv/year)	Infant	1.0E-07	
Internal evnosure	Adult	4.8E-04	2.0E-03
Internal exposure from ingestion of seafood	Child under school age	7.5E-04	3.1E-03
(mSv/year)	Infant	9.4E-04	3.9E-03

C4. Assessment of environmental protection with ALPS treated water As with the human exposure assessment, we assessed exposure of animals and plants in the case of continuous discharge of simulated ALPS treated water.

a. Setting of the source terms

As with C3. a. Setting of the source term, based on the following steps, we set the source term of each nuclide (annual discharge amount) of each nuclide as shown in Table C-11.

- The annual discharge amount of tritium shall be the upper limit: 22 TBq (2.2E+13Bq).
- The annual discharge volume of ALPS treated water is conservatively estimated as 220 million L (2.2E+08L) by setting a low tritium concentration of ALPS treated water used for the assessment to 100 thousand Bq/L below the minimum concentration of tritium confirmed so far (about 150 thousand Bq/L). Because of this, the annual discharge amount of nuclides other than tritium is conservatively estimated.
- Among 63 nuclides other than tritium, the previous management value, which is the
 upper limit, is set to the concentrations of 2 nuclides with relatively great impacts on
 exposure. The sum of the ratios to regulatory concentrations limits of the 2 nuclides
 (Fe-59 and Sn-126) is 0.0025 (2.5E-03).
- For the other 61 nuclides, Pm-148m, whose impact on exposure is relatively great following the 2 nuclides subject to previous management, shall be assessed, and the concentration of Pm-148m is set to 499Bq/L, which is equivalent to the regulatory concentration ratio of 0.9975 (9.975E-01)). Because of this, the sum of the ratios to regulatory concentrations limits of 63 nuclides other than tritium becomes 1, which is the upper limit value in discharge management.
- Set the annual discharge amount of 3 nuclides by multiplying the concentrations of the 2 nuclides subject to management and Pm-148m by the annual discharge volume of water of 220 million L.
- b. Concentration of each nuclide used for the exposure assessment in the seawater For the concentration of each nuclide in the seawater used for exposure assessment, the concentration of the other nuclides was calculated from the ratio of tritium to the annual discharge amount of the other nuclides in the source term based on the tritium concentration in the seawater (bottom layer) in Table 7-3-1. Table C-12 shows the concentration of each nuclide in the seawater used for the assessment.

c. Exposure assessment method

The migration pathway, the exposure pathway, exposure assessment method, and the setting of the representative person are the same as those of 7. Assessment of environmental protection.

d. Exposure assessment result

Table C-13 shows the result of the exposure assessment of the standard animals and plants using the source term with simulated ALPS treated water containing only the nuclides with relatively great impacts on exposure. Even if the source term, which seems to be the most conservative in terms of discharge management, is used, the dose rate is much lower than the lower limit value of derived consideration reference level (DCRL)

Table C-11 Source term using hypothetical ALPS treated water (annual discharge amount)

	amoung			
Target nuclide	Nuclide concentration (Bq/L)	Annual discharge volume of water (L)	Annual volume of discharge (Bq)	Remarks
H-3	1.0E+05	2.2E+08	2.2E+13	 For the annual discharge amount of tritium, the upper limit value is used. In actual discharge, the water is diluted
Fe-59	2.0E-01		4.4E+07	with seawater 100 or more times so that the tritium concentration will become less than 1,500Bq/L, so the Sum of the ratios
Sn-126	4.0E-01		8.8E+07	to regulatory concentrations limits of 63 nuclides other than tritium in the discharged water will be less than 0.01.
Pm-148m	5.0E+02		1.1E+11	

Table C-12 Concentration in the seawater used for the assessment (Source term using hypothetical ALPS treated water)

	9, petitiett	,
Target nuclide	Annual volume of discharge (Bq)	Concentration in the seawater used for the assessment (Bq/L) Within 10 × 10 km Average of the bottom layer
H-3	2.2E+13	5.6E-02
Fe-59	4.4E+07	1.2E-07
Sn-126	8.8E+07	2.4E-07
Pm-148m	1.1E+11	3.0E-04
Target exposure assessment		Environmental protection

Table C-13 Assessment result regarding environmental protection

Assessed case		Source term using hy	ypothetical ALPS treated water
	Flatfish		7.8E-03
Exposure (mGy/day)	Crab	7.5E-03	
	Brown seaweed		8.4E-03
derived consideration reference level (DCRL)			
Flatfish: 1-10 mGy/day		Crab: 10-100 mGy/day	Brown seaweed: 1-10 mGy/day

Reference D Assessment result of environmental impacts including other elements than radiation related to discharge of ALPS treated water

We have assessed non-radiological environmental impacts associated with the discharge of ALPS treated water into the sea. This document presents the result of our review of whether non-radiological factors associated with the presence and operation of facilities and its construction related to the discharge of ALPS treated water into the sea "could cause substantial pollution or significant and harmful changes in the marine environment." In conclusion, we have assessed that none of such element was associated with such risks. First, we analyzed the measurement items specified in the Water Pollution Prevention Law and related ordinances of Fukushima Prefecture other than radioactive materials contained in the stored ALPS treated water. The analysis result is described in Attachment II "Properties of ALPS treated water," with which we verified that all measurement items are below the standard values and that even if these water are discharged into the water, any significant or harmful changes will not occur in the marine environment due to nonradioactive substances contained in these water in the case of discharge into the sea. Moreover, we also assessed the possibility for non-radiological environmental impacts from discharge of ALPS treated water into the sea or its method. Tables D-1 and D-2 show the systems subject to the assessment and their overview, and the overview of the assessment result, respectively. We considered the following two factors as those which may cause an impact:

- a. Presence or operation of the facilities related to discharge of ALPS treated water into the sea (facilities related to measurement/confirmation, transfer, dilution, and discharge) (middle column);
- b. Implementation of installation or operation of the facilities (right column).

We assessed the possible impacts of these influencing factors on the components of various environment such as air quality, water quality, geology, terrain, soil, and ecosystem. We also included the impacts of the radioactivity which already exist in the environment as the targets of the assessment. As a result, the expected effects on these components of the environment were evaluated to be either none or sufficiently small to be negligible. The targets are the same conditions as those of discharge of ALPS treated water into the sea, impacts of discharge of contents, and impacts of construction of the related facilities assumed in the radiation impact assessment handled in this report.

Table D-1 Facilities related to discharge of ALPS treated water into the sea

Classification of facilities	Facilities	Specifications
Measurement /confirmation facilities	Measurement/confirmati on tanks	For measurement and confirmation, reuse 30 out of 35 current units (about 34 thousand m³) installed in the K 4 area as facilities
	Circulation pump	160 m ³ /h/unit × 2 units
	Stirring equipment	One unit per tank, A total of 30 units
	Piping, valve, etc.	Connecting tube (nominal diameter of the pressure hose equivalent to 200A or steel pipe 100A) Duplicate boundary valves in series to prevent water mixing among tank groups
Transfer facilities	ALPS treated water transfer pump	30 m³/h/unit × 2 units (1 reserve)
	Emergency isolation valve	Install two valves with different operating principles and installation locations in series for multiplexing and diversification
	Flowmeter	
	Other valves, piping, etc.	
Dilution facilities	Water intake channel	Reuse the Unit 5 facility
	Seawater transfer pump	$7,086 \text{ m}^3/\text{h} \times 3 \text{ units}$
	Flowmeter	
	Seawater pipe header	Nominal diameters of 2200A and 1800A
	Discharge vertical shaft (upper-stream storage)	1 reinforced concrete storage, Height about 37 m × Width about 18 m × Depth about 7 m, Capacity about 2,000 m ³
	Other valves, piping, etc.	
Related facilities	Discharge vertical shaft (down-stream storage)	1 reinforced concrete storage, Height about 7 m × Width about 12m × Depth about 18 m, Capacity about 800 m ³
	Discharge tunnel	Shield tunnel, Inner diameter about 3 m, Overall length about 1 km
	Discharge outlet	Discharge outlet caisson: W about 9 m × D about 12 m × H about 10 m (Discharge outlet: 3 m in four directions, Height 2 m) Backfill the upper base about 40 m × about 40 m, lower base about 16 m × about 16 m, and depth about 11 m in the surrounding with anti-washout underwater concrete, etc.

For the allocation, installation, and operation of these facilities, we made the following considerations in order to reduce the impacts on the environment as much as possible.

- We made considerations to prevent new terrain modifications by reusing 30 tanks out
 of a total of 35 tank of the existing K4 area tank group (about 34,000 m³) for facilities
 for measurement and confirmation (the other 5 tanks continue to be used as ALPS
 treated water storage) as facilities related to discharge of ALPS treated water into the
 sea
- The dilution facilities to be newly installed shall be installed in the existing development area in the FDNPS to prevent new terrain modifications excluding discharge vertical shafts and tunnel outlets.
- For the water intake channel, the existing Unit 5 water intake channel is reused to avoid new terrain modifications.
- Discharge is designed to minimize the impacts of the presence, operation, and construction of facilities by the undersea tunnel method, which affects no impact to the terrain such as seabed surface by drilling bedrock, for maximum environmental protection.

Table D-2 shows the details of the consideration of the items of environmental impact assessments of other elements than radiation based on the plan reflecting these design considerations. All of them were judged to have no impact on the environment.

Table D-2 TEPCO's consideration result of the non-radiological environmental impact assessment of nuclides contained in the ALPS treated water¹

Impact factors	Presence and operation of the facilities	Implementation of construction
Environmental elements	Presence of facilities related to discharge of ALPS treated water into the sea - Discharge of ALPS treated water using the facilities	Construction of facilities related to discharge of ALPS treated water into the sea
Atmosphere environment (Air quality and noise/vibration)	The motor operation method or pneumatic method shall be adopted for the power to drive active components such as pumps or valves and no facility to emit air pollutants shall be installed. In addition, the total flow rate of 3 seawater dilution pumps in normal operation for discharge of ALPS treated water and 1 ALPS treated water transfer pump (maximum daily amount: about 510 thousand m³) is smaller than that in normal operation of the circulation water pump of a general nuclear power plant (about 9 times as large daily amount in Unit 1, which is the smallest, if FDNPS before the accident is used as an example: about 4.25 million m³). The area surrounding the FDNPS is used as an intermediate storage facility	The ships used for construction are 1 dredger, 2 crane barges, and 1 concrete plant vessel (not operated simultaneously). Heavy equipment is up to about 20 units/day. The shield machine (diameter of about 3m) is one unit. Material transportation is up to about 30 units/day. Only the installation of the intake and discharge facilities is construction out of the site and most of the installation of the intake and discharge facilities is construction of the undersea tunnel. The construction is limited to the inside of the FDNPS and the area where no fishing is conducted on a daily basis and the surrounding area of the FDNPS within about 2 km from the place of construction are used for the

¹ Based on table 1.1 in "Environmental Impact Assessment Technical Guide" p.6.

Reference D-3

Impact factors	Presence and operation of the facilities	Implementation of construction
Environmental elements	Presence of facilities related to discharge of ALPS treated water into the sea - Discharge of ALPS treated water using the facilities	Construction of facilities related to discharge of ALPS treated water into the sea
	completely surrounding the land side of the FDNPS, and the closest place in the outside Difficult-to-Return Zone is at least 1 km away from the site boundary of FDNPS and about 2 km away from the place assumed to be the construction site (seaside area of Unit 5). Therefore, there is no target whose impact on the life environment should be assessed within the possible range of noise, vibration, etc.	intermediate storage facilities, so there is no target whose impact on the life environment should be assessed within the range where noise, vibration, etc., caused by the construction may cause any impact.
Water environment (Water quality/Water temperature/Flo w velocity)* Other than radioactive materials	ALPS treated water is contaminated water with the contained radioactive materials eliminated by coagulating sedimentation, absorbents, filters, etc. Heavy metal, infusible suspended substances, organic substances, etc., are eliminated. No treatment to increase the pollution load, which causes an increase in COD, etc., is performed. It was verified in past measurement ² that the water quality of ALPS treated water sufficiently meets the wastewater standard. Moreover, in actual discharge of ALPS treated water, the water to be discharged shall be verified to meet the wastewater standard.	There is no target to be assessed because occurrence of water turbidity caused by the construction is deemed to be limited because the construction of the intake facilities is performed in the port, most of the discharge facilities is constructed by the shield method as undersea tunnels, and a rocky shore is selected as the site for tunnel outlets.
	In addition, seawater to be taken and discharged is only used for dilution of ALPS treated water and is not heated. The temperature of ALPS treated water stored on land may change due to the ambient temperature. However, it is not in an equilibrium state with the seawater temperature and discharged after diluted 100 or more times with seawater, so there is almost no difference between the temperatures of wastewater and seawater. The discharge flow velocity from the discharge outlet is as slow as about 1 m/s even in the case of the maximum flow rate with the three seawater dilution pumps in operation. Water is discharged straight up from the seabed with a water depth of about 12 m. Therefore, changes	

December 28, 2018 "Analysis of chemical substances in ALPS treated water tanks" https://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/012_04_01.pdf

Impact factors	Presence and operation of the facilities	Implementation of construction
Environmental elements	Presence of facilities related to discharge of ALPS treated water into the sea - Discharge of ALPS treated water using the facilities	Construction of facilities related to discharge of ALPS treated water into the sea
	in the flow velocity are limited to near the discharge outlet.	
Other environments (terrain/geology, subgrade, and soil)	The discharge flow velocity from the discharge outlet is as slow as about 1m/s even in the case of the maximum flow rate with the three seawater dilution pumps in operation. Water is discharged straight up from the seabed. The protrusion from the seabed height is limited to a height of about 2 m within about 3 m in the four directions. The square area of about 40 m around the discharge outlet (about 1,600 m²) is backfilled. Therefore, changes in the flow velocity are limited to near the discharge outlet, and there is no risk of scouring. Pumping of groundwater, which causes ground subsidence, shall not be performed and it is planned not to use any substance which causes soil contamination.	Terrain modifications are limited to very small areas, namely the discharge vertical shaft (upper-stream storage of about 670 m², down-stream storage of about 80 m², a total of about 750 m²) and the outlet of the undersea tunnel (about 1,600 m²) by avoiding new terrain modifications by reuse of the existing facilities, installation of the undersea tunnel by the shield method which gives very low change to terrain drilling bedrock.
Animals, plants, and ecosystem	Most of the facilities are installed in places where site preparation has been completed within the site of the FDNPS. The facility for discharge is an undersea tunnel and requires the minimum necessary area of about 40 m x about 40 m (about 1,600 m²) near the outlet. The impact of discharge of ALPS treated water on tidal currents, etc., is small and there is almost no impact of the operation of the facility on organisms, because of ALPS treated water being diluted 100 or more times with the seawater of the adjacent sea and the low discharge flow velocity of about 1 m/s.	New terrain modifications are avoided by reuse of the existing facilities, installation of the undersea tunnel by the shield method, etc. No important species, habitat, etc., have been found in the sea area where construction is to be performed.
Rich natural environment (landscape, etc.)	There is no item to be assessed because the existing facilities are reused and the scale of the facilities to be newly installed is small.	Since the scales of the facilities to be installed are small, the traffic of vehicles for transportation of materials, etc., is assumed to be up to 20 vehicles/day, which is limited.
Environmental loads (waste, emission of greenhouse gas, etc.)	Discharge of ALPS treated water does not generate any new waste. In addition, the motor operation method or pneumatic method shall be adopted for the power to drive active components such as pumps or valves used for the facilities for discharging ALPS treated	Construction waste soil is generated (about 40 thousand m³) associated with excavation of the undersea tunnel, but the generated amount is small and it is disposed of at the existing soil disposal site in the premises without transfer to outside.

Impact factors	Presence and operation of the facilities	Implementation of construction
Environmental elements	Presence of facilities related to discharge of ALPS treated water into the sea - Discharge of ALPS treated water using the facilities	Construction of facilities related to discharge of ALPS treated water into the sea
	water into the sea, so no greenhouse gas including that generated by combustion of fossil fuel is emitted. Therefore, there is no item to be assessed.	Therefore, there is no item to be assessed.
Radioactive materials already exist in environment	The planned discharge outlet is installed in a rocky shore outside the port, the surrounding square area of 40 m is backfilled with concrete, etc., and water is discharge straight up at a low flow velocity of about 1 m per second, so discharge of treated water does not swirl marine sediment or disperse radioactive materials. The seawater for diluting the ALPS treated water is planned to be drawn from the outside of the port (north side of the Unit 5/6 discharge outlet) by blocking the intake path opening channel with partition weir (rubble mound and sheet) from the port of the Unit 1-4 side considering that the concentration of radioactive materials is slightly higher than that of the seawater in the surrounding sea area and that it may swirl marine sediment, etc., in the port. As shown in attachment V "Impacts of intake and discharge of diluted water on outside," the result of the assessment of exposure considering the impact of the radioactive materials, which may be contained in drawn seawater in the case of intake of seawater outside this port is 9.6E-05 mSv/year, which is much lower than 0.05mSv/year.	It is considered that construction in the port has almost no impact such as dispersion of radioactive materials, etc., thanks to installation of contamination prevention fences for construction, careful work at slower construction speed than usual, etc., in order to reduce sedimentation sand swirled in the port. It was confirmed that the concentration of radioactive materials in the seawater did not vary significantly during similar construction performed in the port (pouring materials such as riprap into the sea by using working crafts and backhoes) in the past three years ³ . Actually, the concentration of radioactive materials in the seawater in the port is below the domestic regulatory standard even inside the intake path opening channel of Units 1 to 4, in which the concentrations are relatively high (Cs-137 1E+00Bq/L order, Sr-90 1E+00Bq/L order, 10E+2Bq/L as of 2021) ⁴ . In addition, it is considered that the tunnel outlet construction outside the port has almost no impact, such as swirling of the seabed sediment, because a rocky shore is selected for the construction area, the excavation area is as small as about 40 m × 40 m, the concentration of radioactive materials contained the marine sediment is low ⁵ according to the investigation result of the surrounding sea area, and measures such as temporarily

³ 9th Review Meeting on the Implementation Plan Regarding the Handling of ALPS Treated Water Material 1-1, pp. 39 -40 https://www.tepco.co.jp/en/hd/decommission/information/committee/pdf/2022/alps_22021501-e.pdf

³⁵th Environmental Monitoring and Evaluation Sub-committee of the Safety Monitoring Council on Decommissioning of the Nuclear Power Station of Fukushima Prefecture Material 2-1, p.1 https://www.pref.fukushima.lg.jp/uploaded/attachment/495913.pdf

The Nuclear Regulation Authority "Change of the radioactivity concentration of the sediment in sea area close to Fukushima Daiichi NPS / coastal sea area"

https://radioactivity.nsr.go.jp/en/contents/8000/7747/24/engan_soil.pdf

Impact factors	Presence and operation of the facilities	Implementation of construction
Environmental elements	Presence of facilities related to discharge of ALPS treated water into the sea - Discharge of ALPS treated water using the facilities	Construction of facilities related to discharge of ALPS treated water into the sea
		suspending the construction will be taken if a significant change in the turbidity of seawater is observed during the construction period. Therefore, we assessed that there is almost no impact of construction such as dispersion of radioactive materials, etc.

Reference E State of consultation with domestic and foreign stakeholders

The Basic Policy of the government on the handling of ALPS treated water states that "every effort will be made to foster understanding among the public and international community" and we are proactively working with the government to promote risk communication.

E1. Activities toward steady implementation of the Basic Policy

On April 16, 2021, the government established "the Council of Relevant Cabinet Ministers for Steady Implementation of the Basic Policy on the Handling of ALPS Treated Water," and decided to speedily and steadily take countermeasures stipulated in the Basic Policy as a united government, and to listen carefully voices of stakeholders and those who concern about the impact, and to take necessary additional measures in a flexible countermeasures to dispel their concerns.

Specifically, a working group of the Council was held in various regions including Fukushima, Miyagi, and Ibaraki, and opinions were exchanged with local governments, those who are engaged in agriculture, forestry, fisheries, commerce and tourism etc. The Council also developed the "Immediate Measures Associated with the handling of ALPS Treated Water at the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc. (Decision at the 2nd Ministerial Council on Measures for Steady Implementation of the Basic Policy on the Handling of ALPS treated water, August 2021)" and "Action plan for Steady Implementation of the Basic Policy for the Handling of ALPS Treated Water (Decision at the 3rd Ministerial Council on Measures for Steady Implementation of the Basic Policy on the Handling of ALPS Treated Water, December 2021)"².

In the abovementioned action plan, the results of the assessment of the radiation impacts on humans and the environment and the result of the ocean diffusion simulation shall be explained and disseminated by preparing easy-to-understand materials as part of efforts over the next one year. The results of the assessment will be revised and enhanced based on the review by the IAEA, review by the Nuclear Regulatory Commission, and opinions from the public, and will be verified over the medium to long term based on the latest status and actual discharge data to confirm that no impact has occurred.

Reference E-1

Web site of the Cabinet Secretariat (August 24, 2021) "List of materials distributed at the ministerial meeting on measures for steady implementation of the basic policy on handling of ALPS treated water (2nd)" Material 3 https://www.kantei.go.jp/jp/singi/hairo_osensui/alps_shorisui/dai2/index.html

Web site of the Cabinet Secretariat (December 28, 2021) "List of materials distributed at the ministerial meeting on measures for steady implementation of the basic policy on handling of ALPS treated water (3rd)" Material 1 https://www.kantei.go.jp/jp/singi/hairo osensui/alps shorisui/dai3/index.html

E2. Responses to public comments regarding the Radiological Environmental Impact Assessment Report

After the publication of this report on November 17, 2021, we received 400 or more opinions from both inside and outside of Japan in response to our Public Comment Procedure. For the purpose of further enhancing the report, TEPCO solicited public comments both in Japanese and English for a month. We have revised the contents of the report in April 2022, by taking into account the public comments we received through this procedure³. Table E-1 shows examples of the items reflected in the revision, based on the results of soliciting comments.

Table E-1: Examples of the items to be reflected in the Radiological Environmental Impact Assessment Report, based on the results of public comments on the Report

	Examples of reflected content in the Radiological Environmental Impact Assessment Report
Assessment addition/revision	 Addition of exposure pathways (Ingestion of water while swimming and inhalation of seawater spray) Review of potential assessment methods Consideration of the effects of organically bound tritium Effects of radioactive materials already released into the environment Consideration of effects outside the model due to specific concentrations at model boundaries Case study of sea water concentrations used in the assessment
Enhanced description	 Addition of a chapter and references on the process of selecting a disposal method Added description of nuclide accumulation in the environment Addition of the model used in the simulation and the assessed conditions. Reflecting the progress of the review by the Nuclear Regulation Authority and the review after the publication of the report. Transcription of information from previously published documents (e.g., consideration of discharge period) Assessment results for environmental effects other than radiation
Appropriate description	 Review of difficult-to-understand expressions Improvement of translation quality of English translation Correction of errors

In addition, we explained the contents of the radiological impact assessment in various occasions. For example, on December 6, 2021 and January 19, 2022, we explained the contents of the Radiation Impact Assessment at the Environmental Monitoring and Evaluation Sub-committee of the Safety Monitoring Council on Decommissioning of the Nuclear Power Station of Fukushima Prefecture. Moreover, we have also provided about 3,000 explanations to those who are engaged in fishery, seafood processing and distribution industry, agriculture, commerce and industry and tourism, local governments, civil groups, etc. respectively (result of FY 2021).

- E3. Transmission to and consultation with the international community
- (1) Cooperation with the IAEA

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With regard to the major opinions collected through the call for opinions and our responded, please refer to our reply issues at the same time of the revised report.

On the day following the announcement of the Basic Policy, then Minister of Economy, Trade and Industry, Kajiyama (hereinafter called "Minister Kajiyama"), had a teleconference with Rafael Mariano Grossi, the Director General of IAEA. The Minister Kajiyama requested the IAEA to disseminate information on IAEA's assessment of the safety related aspects of ALPS treated water with the international community as well as Japan based on their scientific knowledge. Also, he made a formal request in the following areas: (1) dispatch of review missions, (2) support to environmental monitoring, and (3) ensuring transparency towards the international community. Director General Grossi welcomed the announcement of the Basic Policy, responded positively to the request made by Minister Kajiyama, and will cooperate and work together with Japan in a highly transparent manner in each stage of the process, before, during and after the discharge⁴. In addition, the Director General Grossi said in the statement announced by IAEA in response to the Basic Policy "The Japanese Government's decision is in line with practice globally, even though the large amount of water at the Fukushima plant makes it a unique and complex case," "Nuclear safety is a national responsibility and it was for the Government of Japan to decide how to address the critical issue of water management. I'm confident that the Government will continue to interact with all parties in a transparent and open way as it works to implement today's decision," and "Our cooperation and our presence will help build confidence – in Japan and beyond – that the water disposal is carried out without an adverse impact on human health and the environment." 5

Based on the communication between the leaders of the government and the IAEA, both parties accelerated preparation for cooperation, and the Terms of Reference (TOR) for the Cooperation Framework for ALPS treated water was signed in July 2021. Following this TOR, IAEA decided to conduct a review regarding safety and other aspects of the handling of ALPS treated water including the assessment of the radiation impact on human and environment in accordance with IAEA safety standards⁶.

Based on the TOR, the review mission of safety aspects of ALPS treated water was conducted from February 14 to 18 in 2022. IAEA members and international experts visited the FDNPS and had discussions with the Ministry of Economy, Trade and Industry. In addition, they also saw and reviewed the ALPS, the K4 tank groups to be reused for measurement and confirmation of the concentration of radioactive materials contained in the treated water before dilution and discharge, and the harbor area which is being considered

Reference E-3

Web site of the Ministry of Economy, Trade and Industry (April 14, 2021) "Minister Kajiyama met with IAEA Director General Grossi" https://www.meti.go.jp/english/press/2021/0414_001.html

Web site of IAEA (April 13, 2021) "IAEA Ready to Support Japan on Fukushima Water Disposal, Director General Grossi Says"
https://www.iaea.org/newscenter/pressreleases/iaea-ready-to-support-japan-on-fukushima-water-disposal-director-general-grossi-says

⁶ This report was reviewed by IAEA as a part of the review of the safety of ALPS treated water based on TOR mentioned above.

for the installation of facilities for dilution and discharge of the treated water⁷. The contents of discussions with the IAEA were also reflected in the review of this report. Main examples of reflected in the report are shown in Table E-2.

Table E-2 Main examples of areas reflected in the report based on the findings of the IAEA review

based off the infamings of the IAEATEVIEW					
No.	IAEA Comments	Our Response	Reflection point		
1	Considering that 12 years have passed since the accident, the source term should be realistic, even if sufficiently conservative.	It is noted that the target nuclide to be assessed will be scrutinized in the future, including whether there are any Nuclides that should be added, and that this assessment will be reviewed as necessary.	Main text 6-1-2(1) Source Term		
	Even if the ALPS-treated water to	Assessed a conservative assumption of	Main text 4. (2) Tritium		
2	be discharged contains little or no organically bound tritium (OBT), the assessment should take OBT into account and be included in the monitoring	10% of tritium to be ingested as OBT along with the ingestion of seafood. In addition, a monitoring plan including OBT measurement for seafood was included in the report.	Main text 9-3-1. Sea area monitoring around the Fukushima Daiichi Nuclear Power Station by TEPCO		
	program to verify the validity of the Assessment.	monuced in the report.	Appendix III Impact of the organically bound tritium in the exposure assessment of tritium		
3	The rationale for setting the Assessment Target area as 10 km x 10 km around the power plant should be documented.	The sea area to be assessed for fisheries is conservatively described as 5 km north and south of the power plant and 10 km offshore (10 km x 10 km around the power plant), as the distance from the power plant to the nearest fishing port is at least 5 km away and fishing operations are conducted mainly around the fishing port. The impact on the assessment due to the difference in the sea area to be assessed is discussed as "Uncertainty depending on the range of the sea area to be assessed (epistemic uncertainty)".	Main text 6-1-2(4) (2) Characteristics of the representative person Main text 8-4-3. Uncertainty depending on the range of the sea area to be assessed (epistemic uncertainty) Appendix XII Impact of the assessment range of concentrations in seawater used for the assessment of exposures		

https://www.meti.go.jp/english/press/2022/0218 001.html

Web site of the Ministry of Economy, Trade and Industry (February 18, 2022) "IAEA conducted a review of the safety of ALPS treated water at TEPCO's Fukushima Daiichi Nuclear Power Station."

No.	IAEA Comments	Our Response	Reflection point
4	The establishment of a representative person's lifestyle and the location of where they receive exposure should be considered for the future as well.	In the section "Situation around the FDNPS" of "Setting of the representative person subject to the exposure assessment," it is stated that "in the area around the FDNPS, measures to prevent the general public from living in the area are taken by setting Difficult-to-Return Zones set in response to the accident, installing intermediate storage facilities surrounding the land side of the FDNPS, etc." and "an assessment shall be performed using the data used for the safety review of the existing reactor facilities, etc." The first nuclear power plant is surrounded by a difficult-to-return zone and an interim storage facility on the land side of the plant, and therefore, the public cannot live there. On the other hand, as the assessed point of exposure by staying on the beach (external exposure during swimming and from beach sand, internal exposure from ingestion of water, and inhalation of seawater spray), the nearest habitable beach to the north of the site was selected.	Main text 6-1-2(4) (1) Situation around the FDNPS, and (2) Characteristics of representative person
5	It should be indicated that the expected exposure pathway is taken into account, even if the contribution is small.	Assessments were also conducted for pathways that were thought to have a small contribution, and relatively small effects on exposure were found. "Ingestion of water due to swimming, etc." and "inhalation of seawater spray" were added to the assessed results.	Main text 6-1-2(3) Setting of exposure pathways Attachment VI Transfer pathways and exposure pathways other than the assessment targets
6	Potential exposure scenarios should consider uncontrolled releases due to External events. Assessed should include all exposure pathways and the source term should consider all radioactive nuclides.	The previous evaluation was limited to external exposure and was assessed using a conservative source term, which is not possible in reality and includes a large amount of only Nuclide, which has a large exposure.	Main text 6-2. Potential exposure assessment
7	Evidence should be provided that tritium and other nuclides behave the same way as cesium in the ocean.	Clearly describe the rationale.	Main text 4(3) Assessment of migration and accumulation of nuclides other than tritium
8	Considering that the discharge period will continue for about 30 years, the accumulation of radioactive materials in the environment should be taken into account and assessed to maximize exposure.	In the assessment of diffusion, the decrease in seawater concentration due to adsorption to seabed soil, etc., is not considered, while adsorption to seabed soil and concentration in organisms are evaluated by conservatively assuming that they are in equilibrium.	Main text 4(3) Assessment of migration and accumulation of nuclides other than tritium
9	The impact on neighboring countries should be assessed in order to respond to the interests of the international community.	At the boundary of the calculation area of the diffusion simulation (approximately 490 km north-south and 270 km east-west) with meteorological and oceanographic data from 2014 to 2020 years, the report states that the maximum value of annual average is 0.00026 Bq/L and the maximum value of day average is 0.014 Bq/L, which is sufficiently low compared to the tritium concentration in sea water (about 0.1 Bq/L) in the sea area around the main island on the day of the report.	Main text 6-1-3(1) Diffusion simulation results Appendix VII Validity of the diffusion simulation

No	. IAEA Comments	Our Response	Reflection point
10	In the consideration of uncertainty, sensitivity analysis (e.g., sorting out the effects of changing parameters) is recommended.	Uncertainty is broadly classified into "aleatory uncertainty" and "epistemic uncertainty," and sensitivity analysis is performed for those that are possible, and the discussion is described in terms of these two types of uncertainty.	Main text 8. Discussion about the uncertainty of the assessment
1	The dose constraint value should be used as an input to the Radiological Impact Assessment Report to indicate that the tritium discharge limit is appropriate and to confirm the discharge limit for other nuclides, if necessary.	On February 16, 2022, the Nuclear Regulation Authority of Japan (NRA) announced the concept and guideline for the confirmation of radiological impact assessment, which is to confirm that "the exposure result for a representative person is sufficiently small compared to the range of variation in the exposure dose between years of a person due to the region and living environment, etc., i.e., the exposure dose is less than 50 μ Sv/year. 50 μ Sv/year is the dose target applicable to light water reactors for power generation during normal operation and corresponds to the dose constraint value in the IAEA safety standards. Assessed by treating 50 μ Sv/year = 0.05 mSv/year as the dose constraint value.	Main text 4(1) Dose constraints Main text 6-1-2(5) Dose assessment method Main text 6-1-3(3) Exposure assessment results

(2) Briefing for diplomats and bilateral exchange of opinions

In addition to providing explanations to domestic parties, we also attended the Video Conference briefing session for diplomats in Tokyo held on November 18, 2021, the day after the publication of the first edition of the report, and the Video Conference briefing session for the Government of Republic of Korea held on December 3, 2021, both in the presence of government officials, to provide detailed explanation of the contents of the report. In addition, we also provided individual explanation to interested countries and regions together with the relevant Ministries of the government.

At these Video Conference briefing sessions, we explained that the result of the assessment of the radiation impacts on humans and environment in accordance with the internationally recognized methods was significantly lower than the dose limit of the public, etc. and that it would take measures according to the international standards and practices, with maximum consideration given to the impacts on the health and safety of environment and humans. We also carefully answered the questions from foreign governments during the question-and-answer session.

The Government of Japan has provided explanations to foreign governments through Embassies, Consulates and Permanent Missions of Japan overseas as well as explanations to diplomats in Tokyo, and we also have provided the necessary information including technical contents at request.

Through these activities, the Government of Japan and we have been engaged in mutual communication with not only domestic parties but also the international community, and in revising this report, we have taken into consideration the opinions provided through these communications.

Reference F Rationale behind the selection of nuclides subject to removal by ALPS

F-1. Selection of nuclides subject to removal

It is assumed that the water to be treated in the advanced liquid processing system (fresh water, RO concentrated salt water, and treatment device outlet water) contains radioactive materials derived from the fuel in the Units 1 to 3 reactors (hereinafter called "FP nuclide") and radioactive materials derived from corrosion products contained in the water retained during plant operation (hereinafter called "CP nuclide"). In order to reduce the risk of radiation exposure to the surrounding public area in the event of leakage of the water to be treated into the environment, it is necessary to estimate the nuclides present at high concentrations so that they can be removed by the advanced liquid processing system among FP nuclides and CP nuclides contained in the water to be treated.

Therefore, in estimating the concentration of radioactive materials contained in the water to be treated, for FP nuclides, nuclides assumed to exist at significant concentrations were selected based on the assessment results of the core inventory; for nuclides for which measurement of radioactive materials was carried out in March 2011, the concentration in the stagnant water was estimated from the measurement results; and for nuclides for which measurement was not carried out, the concentration in the stagnant water was estimated from the assessment results of the core inventory.

The concentration of CP nuclides in the stagnant water was estimated using the measurement results of CP nuclides in the water retained in the reactor and the concentrated waste liquid tank during plant operation, because nuclides contained in the water retained in the reactor during plant operation were transferred to the stagnant water, and it is considered that nuclides contained in the water retained in the concentrated waste liquid tank were mixed when the stagnant water was transferred to the high-temperature incinerator building. The operation of the advanced liquid processing system was assumed to be started 1 year (365 days) after reactor shutdown for both FP and CP nuclides, so the concentration in the stagnant water was estimated by decay correction 365 days after reactor shutdown considering the half-life. Comparing the estimated concentration obtained by decay correction at 365 days after reactor shutdown and nuclides over 1/100 of the regulatory concentration limit were selected as nuclides subject to removal by the advanced liquid processing system assuming that they exist at significant concentrations in the stagnant water. The sum of the ratio of the estimated concentration to the regulatory concentration limit of nuclides which are excluded because they are below 1/100 of the regulatory concentration limit is about 0.05 at maximum. Therefore the concentration of the excluded nuclides is considered to be sufficiently low.

- F-2. Selection method and selection result of nuclides subject to removal
 - (1) Selection method and selection result of nuclides subject to removal from FP nuclides Nuclides subject to removal from FP nuclides were selected according to the flow of Figure F-1. As a result, 56 nuclides were selected as nuclides subject to removal.
 - (2) Selection method and selection result of nuclides subject to removal from CP nuclides Nuclides subject to removal from CP nuclides were selected according to the flow of Figure F-2. As a result, 6 nuclides were selected as nuclides subject to removal.
 - (3) Summary of the selection result of nuclides subject to removal
 A total of 62 nuclides were selected: 56 nuclides selected from FP nuclides and 6 nuclides selected from CP nuclides (See Table F-1).

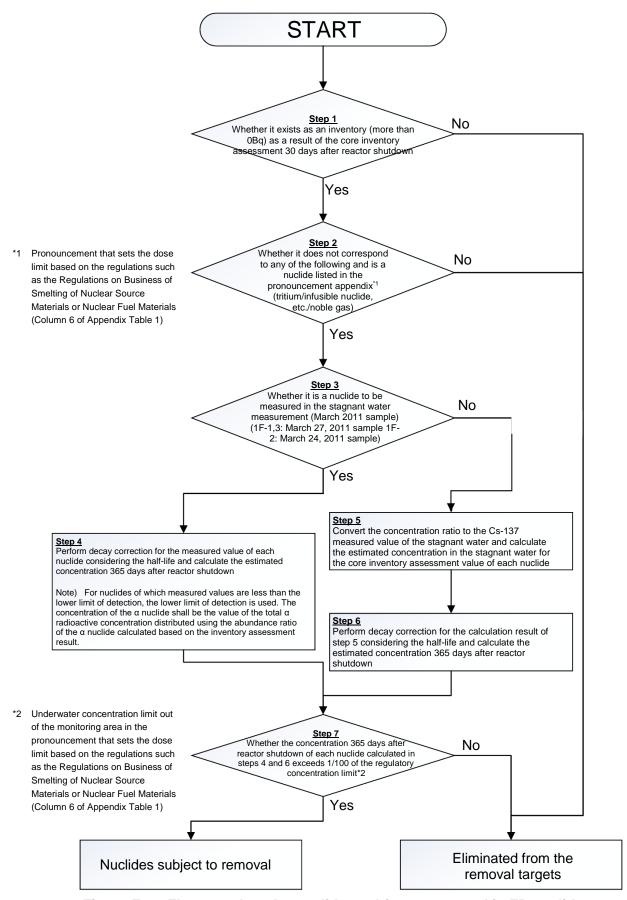


Figure F-1: Flow to select the nuclides subject to removal in FP nuclides

Reference F-3

Step 2 Step 1 For nuclides to be measured in the radioactivity For nuclides to be measured in the radioactivity measurement of the water retained in Units 1 to 3 reactor measurement of the water retained in the concentrated building before the earthquake (January 2009 to February waste liquid tank before the earthquake (May 2010 to 2011) and listed in the pronouncement appendix*1, dilute February 2011) and listed in the pronouncement appendix*1 the maximum measured value to 1/100, perform decay dilute the maximum measured value to 1/100, perform decay correction considering the half-life, and calculate the correction considering the half-life, and calculate the estimated concentration 365 after reactor shutdown. estimated concentration 365 after reactor shutdown. Note) Ni-59, Ni-63, and Nb-94 of which concentrations Ni-59, Ni-63, and Nb-94 of which concentrations can can be estimated based on the theoretical calculation be estimated based on the theoretical calculation method method and scaling factor method for homogeneous/uniform and scaling factor method for homogeneous/uniform vitrified vitrified waste are estimated from the concentration of Cowaste are estimated from the concentration of Co-60, which 60, which is a key nuclide, using the values converted from is a key nuclide, using the values converted from the the theoretical calculation method and the scaling factor. theoretical calculation method and the scaling factor. *1 Pronouncement that sets the dose limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials Step 3 Whether the total value of the (Column 6 of Appendix Table 1) *2 Underwater concentration limit out concentration of each nuclide calculated of the monitoring area in the in steps 1 and 2 exceeds 1/100 of the pronouncement that sets the dose regulatory concentration limit*2 limit based on the regulations such as the Regulations on Business of Smelting of Nuclear Source Materials or Nuclear Fuel Materials Yes (Column 6 of Appendix Table 1) Eliminated from the removal Nuclides subject to removal targets

Figure F-2 Flow to select the nuclides subject to removal in CP nuclides

Table F-1 List of the nuclides subject to removal

No.	Nuclide	Physical half-life	Radiation type	No	Nuclide	Physical half-life	Radiation type
1	Mn-54	310d	γ	32	I-129	1.6E+07y	βγ
2	Fe-59	44 d	Υ	33	Cs-134	2.1y	βγ
3	Co-58	71d	γ	34	Cs-135	2.3E+06y	β
4	Co-60	5.3y	βγ	35	Cs-136	13d	βγ
5	Ni-63	100y	β	36	Cs-137	30y	βγ
6	Zn-65	240d	βγ	37	Ba-137m	2.6m	γ
7	Rb-86	19d	βγ	38	Ba-140	13d	βγ
8	Sr-89	51d	β	39	Ce-141	33d	βγ
9	Sr-90	29y	β	40	Ce-144	280d	βγ
10	Y-90	64h	β	41	Pr-144	17m	βγ
11	Y-91	59d	βγ	42	Pr-144m	7.2m	γ
12	Nb-95	35d	βγ	43	Pm-146	5.5y	βγ
13	Tc-99	2.1E+05y	β	44	Pm-147	2.6y	βγ
14	Ru-103	39d	βγ	45	Pm-148	5.4d	βγ
15	Ru-106	370d	β	46	Pm-148m	41d	γ
16	Rh-103m	56m	βγ	47	Sm-151	90y	βγ
17	Rh-106	30s	γ	48	Eu-152	14y	βγ
18	Ag-110m	250d	βγ	49	Eu-154	8.6y	βγ
19	Cd-113m	14 y	γ	50	Eu-155	4.8y	βγ
20	Cd-115m	45d	βγ	51	Gd-153	240d	γ
21	Sn-119m	290d	γ	52	Tb-160	72d	βγ
22	Sn-123	130d	βγ	53	Pu-238	88y	α
23	Sn-126	2.3E+05y	βγ	54	Pu-239	2.4E+04y	α
24	Sb-124	60d	βγ	55	Pu-240	6.6E+03y	α
25	Sb-125	2.8y	βγ	56	Pu-241	14y	β
26	Te-123m	120d	γ	57	Am-241	430y	α
27	Te-125m	57d	γ	58	Am-242m	140y	α
28	Te-127	9.4h	βγ	59	Am-243	7.4E+03y	α
29	Te-127m	110d	βγ	60	Cm-242	160d	α
30	Te-129	70m	βγ	61	Cm-243	29y	α
31	Te-129m	34d	βγ	62	Cm-244	18y	α

Reference G Annual discharge limit and optimization estimation results for individual nuclide based on dose constraint

G1. Assessment of Annual Discharge Limit for Individual Nuclides

On February 16, 2022, the Nuclear Regulation Authority issued the following opinions regarding its approach to and criteria for confirming the results of radiological environmental impact assessments: It should confirm that the assessment results regarding the representative person is sufficiently small compared to the variation range of the annual exposure dose to humans due to factors such as their region and living environment. In other words, it should confirm that the annual exposures for the representative person are less than $50\mu Sv/year$. The value of $50\ \mu Sv/year$ is the target dose value applied to light water reactors for power generation during normal operation, and it corresponds to the dose constraint provided in IAEA safety standards.

In line with the perspective given by the Nuclear Regulation Authority mentioned above, as part of the optimization processes, the annual radioactivity quantity when the representative person is exposed to 0.05mSv/year, which corresponds to the dose constraint, is evaluated by the following equation.

$$A_{DC,S,N} = \frac{D_C \times A_{E,S,N}}{D_{E,S,N}}$$
 (G-1)

 $A_{DC,S,N}$: Annual discharged radioactivity of nuclide N when the representative person is exposed to dose equivalent to dose constraint (0.05mSv/year) due to the discharge of a source term with a nuclide ratio equivalent to source term S (Bg/year)

 D_C : dose constraint (0.05mSv/year)

 $A_{E,S,N}$: Annual discharge of the radioactivity for nuclide N discharged into the environment due to the discharge of source term S (Bq/year)

 $D_{E,S,N}$: Doses (mSv/year) evaluated to be received from the discharge of source term S for the representative person

Tables G-1-1 to G-1-3 show the results of evaluations for each nuclide included in each source term.

Meanwhile, if the sum of the ratios to regulatory concentrations of radionuclides other than tritium in ALPS treated water exceeds 1 before dilution, the ALPS treated water shall not be discharged. Accordingly, the concentration of each nuclide during discharge does not exceed its respective regulatory concentration limit.

Therefore, in the Tables below, the upper limit of annual discharge for each nuclide based on dose constraint is compared with the annual discharge continued for a year at maximum capacity of the ALPS treated water transfer pump (= 500m³/day) at the ALPS treated water discharge facilities, and the smaller amount of the two is provided in Table G-2 as the maximum amount of annual discharge for each nuclide.

Regarding tritium, the maximum amount of annual discharge is 22 TBq as specified in the Basic Policy.

Table G-1-1 Upper limit of annual discharge for each nuclide (source term according to nuclide composition of K4 tank group)

	to nucli	de composition of r	14 talik group)	
Nuclide	Nuclide concentration (Bq/L)	Annual discharge based on the evaluation (Bq)	Annual discharge based on dose constraint (Bq)	Annual discharge based on regulatory concentration limit (Bq)
H-3	1.9E+05	2.2E+13	5.5E+16	1.1E+13
C-14	1.5E+01	1.7E+09	4.3E+12	3.7E+11
Mn-54	6.7E-03	7.8E+05	1.9E+09	1.8E+11
Co-60	4.4E-01	5.1E+07	1.3E+11	3.7E+10
Ni-63	2.2E+00	2.5E+08	6.4E+11	1.1E+12
Se-79	1.5E+00	1.7E+08	4.3E+11	3.7E+10
Sr-90	2.2E-01	2.5E+07	6.4E+10	5.5E+09
Y-90	2.2E-01	2.5E+07	6.4E+10	5.5E+10
Tc-99	7.0E-01	8.1E+07	2.0E+11	1.8E+11
Ru-106	1.6E+00	1.9E+08	4.6E+11	1.8E+10
Cd-113m	1.8E-02	2.1E+06	5.2E+09	7.3E+09
Sb-125	3.3E-01	3.8E+07	9.6E+10	1.5E+11
Te-125m	3.3E-01	3.8E+07	9.6E+10	1.6E+11
I-129	2.1E+00	2.4E+08	6.1E+11	1.6E+09
Cs-134	4.5E-02	5.2E+06	1.3E+10	1.1E+10
Cs-137	4.2E-01	4.9E+07	1.2E+11	1.6E+10
Ce-144	6.3E-02	7.3E+06	1.8E+10	3.7E+10
Pm-147	1.9E-01	2.2E+07	5.5E+10	5.5E+11
Sm-151	9.0E-04	1.0E+05	2.6E+08	1.5E+12
Eu-154	1.2E-02	1.4E+06	3.5E+09	7.3E+10
Eu-155	3.3E-02	3.8E+06	9.6E+09	5.5E+11
U-234	6.3E-04	7.3E+04	1.8E+08	3.7E+09
U-238	6.3E-04	7.3E+04	1.8E+08	3.7E+09
Np-237	6.3E-04	7.3E+04	1.8E+08	1.6E+09
Pu-238	6.3E-04	7.3E+04	1.8E+08	7.3E+08
Pu-239	6.3E-04	7.3E+04	1.8E+08	7.3E+08
Pu-240	6.3E-04	7.3E+04	1.8E+08	7.3E+08
Pu-241	2.8E-02	3.2E+06	8.1E+09	3.7E+10
Am-241	6.3E-04	7.3E+04	1.8E+08	9.1E+08
Cm-243	6.3E-04	7.3E+04	1.8E+08	1.1E+09
Cm-244	6.3E-04	7.3E+04	1.8E+08	1.3E+09

Nuclide	Nuclide concentration (Bq/L)	Annual discharge based on the evaluation (Bq)	Annual discharge based on dose constraint (Bq)	Annual discharge based on regulatory concentration limit (Bq)
Method of calculating the amount of discharge		K4 tank water is discharged until tritium reaches 22 TBq	K4 tank water is discharged until the dose reaches dose constraint	ALPS treated water at the regulatory concentration limit is discharged for 1 year at maximum capacity of the facility

Table G-1-2 Upper limit of annual discharge for each nuclide (source term according to nuclide composition of J1-C group)

		•		
		Annual discharge		Annual discharge
	Nuclide	based on the	Annual discharge	based on
Nuclide	concentration	evaluation	based on dose	regulatory
	(Bq/L)	(Bq)	constraint (Bq)	concentration limit
		(- 4)		(Bq)
H-3	8.2E+05	2.2E+13	2.2E+17	1.1E+13
C-14	1.8E+01	4.8E+08	4.8E+12	3.7E+11
Mn-54	3.8E-02	1.0E+06	1.0E+10	1.8E+11
Co-60	3.3E-01	8.9E+06	8.9E+10	3.7E+10
Ni-63	8.5E+00	2.3E+08	2.3E+12	1.1E+12
Se-79	1.5E+00	4.0E+07	4.0E+11	3.7E+10
Sr-90	3.6E-02	9.7E+05	9.7E+09	5.5E+09
Y-90	3.6E-02	9.7E+05	9.7E+09	5.5E+10
Tc-99	1.2E+00	3.2E+07	3.2E+11	1.8E+11
Ru-106	1.4E+00	3.8E+07	3.8E+11	1.8E+10
Cd-113m	8.5E-02	2.3E+06	2.3E+10	7.3E+09
Sb-125	2.3E-01	6.2E+06	6.2E+10	1.5E+11
Te-125m	2.3E-01	6.2E+06	6.2E+10	1.6E+11
I-129	1.2E+00	3.2E+07	3.2E+11	1.6E+09
Cs-134	7.6E-02	2.0E+06	2.0E+10	1.1E+10
Cs-137	1.9E-01	5.1E+06	5.1E+10	1.6E+10
Ce-144	5.7E-01	1.5E+07	1.5E+11	3.7E+10
Pm-147	8.0E-01	2.1E+07	2.1E+11	5.5E+11
Sm-151	1.1E-02	3.0E+05	3.0E+09	1.5E+12
Eu-154	1.1E-01	3.0E+06	3.0E+10	7.3E+10
Eu-155	3.4E-01	9.1E+06	9.1E+10	5.5E+11
U-234	3.3E-02	8.9E+05	8.9E+09	3.7E+09

Nuclide	Nuclide concentration (Bq/L)	Annual discharge based on the evaluation (Bq)	Annual discharge based on dose constraint (Bq)	Annual discharge based on regulatory concentration limit (Bq)
U-238	3.3E-02	8.9E+05	8.9E+09	3.7E+09
Np-237	3.3E-02	8.9E+05	8.9E+09	1.6E+09
Pu-238	3.3E-02	8.9E+05	8.9E+09	7.3E+08
Pu-239	3.3E-02	8.9E+05	8.9E+09	7.3E+08
Pu-240	3.3E-02	8.9E+05	8.9E+09	7.3E+08
Pu-241	1.2E+00	3.2E+07	3.2E+11	3.7E+10
Am-241	3.3E-02	8.9E+05	8.9E+09	9.1E+08
Cm-243	3.3E-02	8.9E+05	8.9E+09	1.1E+09
Cm-244	3.3E-02	8.9E+05	8.9E+09	1.3E+09
Method of calculating the amount of discharge		J1-C tank water is discharged until tritium reaches 22 TBq	J1-C tank water is discharged until the dose reaches dose constraint	ALPS treated water at the regulatory concentration limit is discharged for 1 year at maximum capacity of the facility

Table G-1-3 Upper limit of annual discharge for each nuclide (source term according to nuclide composition of J1-G group)

	to hacing composition of 51-6 group)					
Nuclide	Nuclide concentration (Bq/L)	Annual discharge based on the evaluation (Bq)	Annual discharge based on dose constraint (Bq)	Annual discharge based on regulatory concentration limit (Bq)		
H-3	2.7E+05	2.2E+13	1.1E+17	1.1E+13		
C-14	1.6E+01	1.3E+09	6.5E+12	3.7E+11		
Mn-54	3.8E-02	3.1E+06	1.5E+10	1.8E+11		
Co-60	2.3E-01	1.9E+07	9.4E+10	3.7E+10		
Ni-63	8.8E+00	7.2E+08	3.6E+12	1.1E+12		
Se-79	1.5E+00	1.2E+08	6.1E+11	3.7E+10		
Sr-90	3.2E-02	2.6E+06	1.3E+10	5.5E+09		
Y-90	3.2E-02	2.6E+06	1.3E+10	5.5E+10		
Tc-99	1.3E+00	1.1E+08	5.3E+11	1.8E+11		
Ru-106	4.8E-01	3.9E+07	2.0E+11	1.8E+10		
Cd-113m	8.6E-02	7.0E+06	3.5E+10	7.3E+09		
Sb-125	1.4E-01	1.1E+07	5.7E+10	1.5E+11		
Te-125m	1.4E-01	1.1E+07	5.7E+10	1.6E+11		
I-129	3.3E-01	2.7E+07	1.3E+11	1.6E+09		

Nuclide	Nuclide concentration (Bq/L)	Annual discharge based on the evaluation (Bq)	Annual discharge based on dose constraint (Bq)	Annual discharge based on regulatory concentration limit (Bq)
Cs-134	6.7E-02	5.5E+06	2.7E+10	1.1E+10
Cs-137	3.3E-01	2.7E+07	1.3E+11	1.6E+10
Ce-144	5.5E-01	4.5E+07	2.2E+11	3.7E+10
Pm-147	7.2E-01	5.9E+07	2.9E+11	5.5E+11
Sm-151	1.0E-02	8.1E+05	4.1E+09	1.5E+12
Eu-154	1.0E-01	8.1E+06	4.1E+10	7.3E+10
Eu-155	1.8E-01	1.5E+07	7.3E+10	5.5E+11
U-234	2.8E-02	2.3E+06	1.1E+10	3.7E+09
U-238	2.8E-02	2.3E+06	1.1E+10	3.7E+09
Np-237	2.8E-02	2.3E+06	1.1E+10	1.6E+09
Pu-238	2.8E-02	2.3E+06	1.1E+10	7.3E+08
Pu-239	2.8E-02	2.3E+06	1.1E+10	7.3E+08
Pu-240	2.8E-02	2.3E+06	1.1E+10	7.3E+08
Pu-241	1.0E+00	8.1E+07	4.1E+11	3.7E+10
Am-241	2.8E-02	2.3E+06	1.1E+10	9.1E+08
Cm-243	2.8E-02	2.3E+06	1.1E+10	1.1E+09
Cm-244	2.8E-02	2.3E+06	1.1E+10	1.3E+09
Method of calculating the amount of discharge		J1-G tank water is discharged until tritium reaches 22 TBq	J1-G tank water is discharged until the dose reaches dose constraint	ALPS treated water at the regulatory concentration limit is discharged for 1 year at maximum capacity of the facility

Table G-2 Maximum amount of annual discharge for each nuclide (Bq/year)

1 4510	G-Z Waxiiilaiii a	tatii iiatiiat	<u> </u>		
	Annual disc	harge based on dos	Upper limit by regulatory	Maximum	
Nuclide	K4	J1-C	J1-G	concentration limit	amount of annual discharge
H-3	5.5E+16	2.2E+17	1.1E+17	-	2.2E+13
C-14	4.3E+12	4.8E+12	6.5E+12	3.7E+11	3.7E+11
Mn-54	1.9E+09	1.0E+10	1.5E+10	1.8E+11	1.9E+09
Co-60	1.3E+11	8.9E+10	9.4E+10	3.7E+10	3.7E+10
Ni-63	6.4E+11	2.3E+12	3.6E+12	1.1E+12	6.4E+11
Se-79	4.3E+11	4.0E+11	6.1E+11	3.7E+10	3.7E+10
Sr-90	6.4E+10	9.7E+09	1.3E+10	5.5E+09	5.5E+09
Y-90	6.4E+10	9.7E+09	1.3E+10	5.5E+10	9.7E+09
Tc-99	2.0E+11	3.2E+11	5.3E+11	1.8E+11	1.8E+11
Ru-106	4.6E+11	3.8E+11	2.0E+11	1.8E+10	1.8E+10
Cd-113m	5.2E+09	2.3E+10	3.5E+10	7.3E+09	5.2E+09
Sb-125	9.6E+10	6.2E+10	5.7E+10	1.5E+11	5.7E+10

Nuclide	Annual disc	harge based on dos	e constraint J1-G	Upper limit by regulatory concentration limit	Maximum amount of annual discharge
Te-125m	9.6E+10	6.2E+10	5.7E+10	1.6E+11	5.7E+10
I-129	6.1E+11	3.2E+11	1.3E+11	1.6E+09	1.6E+09
Cs-134	1.3E+10	2.0E+10	2.7E+10	1.1E+10	1.1E+10
Cs-137	1.2E+11	5.1E+10	1.3E+11	1.6E+10	1.6E+10
Ce-144	1.8E+10	1.5E+11	2.2E+11	3.7E+10	1.8E+10
Pm-147	5.5E+10	2.1E+11	2.9E+11	5.5E+11	5.5E+10
Sm-151	2.6E+08	3.0E+09	4.1E+09	1.5E+12	2.6E+08
Eu-154	3.5E+09	3.0E+10	4.1E+10	7.3E+10	3.5E+09
Eu-155	9.6E+09	9.1E+10	7.3E+10	5.5E+11	9.6E+09
U-234	1.8E+08	8.9E+09	1.1E+10	3.7E+09	1.8E+08
U-238	1.8E+08	8.9E+09	1.1E+10	3.7E+09	1.8E+08
Np-237	1.8E+08	8.9E+09	1.1E+10	1.6E+09	1.8E+08
Pu-238	1.8E+08	8.9E+09	1.1E+10	7.3E+08	1.8E+08
Pu-239	1.8E+08	8.9E+09	1.1E+10	7.3E+08	1.8E+08
Pu-240	1.8E+08	8.9E+09	1.1E+10	7.3E+08	1.8E+08
Pu-241	8.1E+09	3.2E+11	4.1E+11	3.7E+10	8.1E+09
Am-241	1.8E+08	8.9E+09	1.1E+10	9.1E+08	1.8E+08
Cm-243	1.8E+08	8.9E+09	1.1E+10	1.1E+09	1.8E+08
Cm-244	1.8E+08	8.9E+09	1.1E+10	1.3E+09	1.8E+08

G2 Setting new operation management values

In the evaluation at the design stage, eight important nuclides were selected and operation management values were set based on the concentration. As a result of the selection of the nuclides to be measured and assessed in this time.

- Six out of eight nuclides were not selected as the nuclides to be measured and assessed because of their short half-life and other reasons.
- Of the remaining two nuclides, Cd-113m has never been detected from ALPS treated water in previous analyses.
- In IAEA review, observations have been made that operational management should be based on discharge volume rather than concentration.

Therefore, the operational management was also re-examined accordingly.

A discharge plan of ALPS treated water for the following fiscal year is formulated at the end of each fiscal year and is implemented in order to ensure that tank capacity necessary for the storage of treated water and space required for decommissioning measures are secured, and that ALPS treated water discharge is completed before the end of the decommissioning process. This plan is formulated on the basis of latest data available including the status of total amount of tritium. Therefore, it is not expected that actual discharge will be conducted up to the level of the maximum amount as shown above. However, the operation will be managed to ensure that the annual discharge does not exceed the maximum amount.

In actual operation, three target nuclides are selected by focusing on the contribution ratio of each nuclide to the assessment results of exposure. Specifically, H3, C-14 and I-129 are selected, as their conbributions to the exposure assessment are the most significant and these nuclides have exceeded the detection limit in the past. These three nuclides alone account for approximately 60 to 80% of the entire exposure dose. The operation is managed so that the annual discharge amount for each fiscal year is kept within the maximum amount shown above and does not exceed the maximum amount.

In addition, for the purpose of further optimization of radiological environmental protection, new operation management values for C-14 and I-129 are set by applying the facility utilization factor of 80% to the upper annual discharge limits. When discharge amount is expected to exceed the operation management value, further reduction of the annual discharge amount by measures such as secondary ALPS treatment is considered for optimization. Target nuclides for operational management and operation management values are shown in Table G-4.

Table G-3 Contribution of each nuclide to the assessment of normal exposure

	By a group of K4 tanks			By a group of J1-C tanks			By a group of J1-G tanks		
	Source term			S	ource term		S	Source term	
	Nuclide	Evaluation value [mSv/year]	Contri bution Perce ntage	Nuclide	Evaluation value [mSv/year]	Contri bution Perce ntage	Nuclide	Evaluation value [mSv/year]	Contrib ution Percent age
1	I-129	1.3E-05	59%	I-129	1.7E-06	32%	C-14	3.9E-06	38%
2	C-14	5.2E-06	24%	C-14	1.4E-06	27%	I-129	1.4E-06	14%
3	Se-79	1.2E-06	5%	H-3	5.0E-07	9%	Cd-113m	1.0E-06	10%
4	Co-60	8.5E-07	4%	Cd-113m	3.4E-07	6%	Se-79	8.5E-07	8%
5	H-3	5.0E-07	2%	Se-79	2.8E-07	5%	H-3	5.0E-07	5%
6	Ru-106	3.6E-07	2%	Co-60	1.5E-07	3%	Co-60	3.1E-07	3%
7	Cd-113m	3.1E-07	1%	Eu-155	1.1E-07	2%	Pu-240	2.7E-07	3%
8	Cs-137	1.5E-07	1%	Pu-240	1.0E-07	2%	Pu-239	2.7E-07	3%
9	Sb-125	8.0E-08	0%	Pu-239	1.0E-07	2%	Am-241	2.5E-07	2%
10	Tc-99	7.9E-08	0%	Am-241	9.8E-08	2%	Pu-238	2.5E-07	2%
11	Eu-155	4.4E-08	0%	Pu-238	9.6E-08	2%	Pu-241	2.2E-07	2%
12	Cs-134	4.1E-08	0%	Pu-241	8.8E-08	2%	Eu-155	1.7E-07	2%
13	Ce-144	1.6E-08	0%	Ru-106	7.2E-08	1%	Cm-243	1.4E-07	1%
14	Ni-63	1.5E-08	0%	Cm-243	5.4E-08	1%	Cm-244	1.1E-07	1%
15	Eu-154	9.4E-09	0%	Cm-244	4.3E-08	1%	Tc-99	1.0E-07	1%
16	Pu-241	8.9E-09	0%	Ce-144	3.3E-08	1%	Ce-144	9.7E-08	1%
17	Pu-240	8.6E-09	0%	Tc-99	3.1E-08	1%	Cs-137	8.5E-08	1%
18	Pu-239	8.6E-09	0%	Eu-154	2.0E-08	0%	Ru-106	7.5E-08	1%
19	Am-241	8.0E-09	0%	Cs-137	1.6E-08	0%	Eu-154	5.5E-08	1%
20	Pu-238	7.9E-09	0%	Cs-134	1.6E-08	0%	Cs-134	4.3E-08	0%
21	Te-125m	5.8E-09	0%	Ni-63	1.3E-08	0%	Ni-63	4.2E-08	0%
22	Mn-54	4.8E-09	0%	Sb-125	1.3E-08	0%	Np-237	3.0E-08	0%
23	Cm-243	4.5E-09	0%	Np-237	1.2E-08	0%	Sb-125	2.4E-08	0%
24	Cm-244	3.5E-09	0%	Mn-54	6.3E-09	0%	Mn-54	1.9E-08	0%
25	Pm-147	3.5E-09	0%	Pm-147	3.4E-09	0%	Pm-147	9.2E-09	0%
26	Sr-90	3.2E-09	0%	U-234	1.9E-09	0%	U-234	4.8E-09	0%
27	Np-237	9.5E-10	0%	U-238	1.7E-09	0%	U-238	4.4E-09	0%
28	Y-90	1.7E-10	0%	Te-125m	9.4E-10	0%	Te-125m	1.7E-09	0%
29	U-234	1.5E-10	0%	Sr-90	1.2E-10	0%	Sr-90	3.2E-10	0%
30	U-238	1.4E-10	0%	Sm-151	1.8E-11	0%	Sm-151	4.9E-11	0%
31	Sm-151	6.2E-12	0%	Y-90	6.4E-12	0%	Y-90	1.7E-11	0%
	Total	2E-05		Total	5E-06		Total	1E-05	

Table G-4 Target nuclides for operational management and operation management values

Target nuclide	Operation management value (Bq/year)
C-14	2.9E+11
I-129	1.3E+09

G3 Optimization result of annual amount of discharged radioactivity

The annual amount of radioactivity in ALPS treated water discharged into the sea should be optimized within maximum amount of annual discharge for each nuclide, as evaluated in G1.

As stated in the Basic Policy announced in April 2021, ALPS treated water will be discharged on the condition that "measures to minimize adverse impacts on reputation are thoroughly implemented", and the annual discharge inventory should be reduced to the extent possible. On the other hand, to safely and steadily proceed with the decommissioning works stated in the national Mid-and-Long-Term Roadmap, such as the retrieval of fuel debris and spent fuel and the termination of decommissioning, ALPS treated water stored in the tanks needs to be discharged into the sea according to the plan.

As shown in the Attachment IV "Discharge Period Consideration of ALPS treated water", ALPS treated water discharge simulations have been conducted with the annual tritium discharge amount reduced as much as possible to the extent that the required space should be secured to proceed with decommissioning works.

Among the nuclides other than tritium, C-14 and I-129 have significant contribution to the exposure assessment of the representative person. Assuming that the concentration of these nuclides in the three tank groups set in the source term remain constant during the discharge period, the total amount of radioactivity discharged would be as shown below. .

Table G-5 Total discharged radioactivity based on C-14 and I-129 discharge simulations

				idiations					
		When the hi	ghest total trit	ium content	When the lowest total tritium content				
		K4	J1-C	J1-G	K4	J1-C	J1-G		
Total amount of water released		Арр	orox. 2,420,000	m ³	Approx. 1,650,000 m ^{3 **1}				
C-14	Total amount of radioactivity discharged	Approx. 3.6E+10 (Bq)	Approx. 4.4E+10 (Bq)	Approx. 3.9E+10 (Bq)	Approx. 2.5E+10 (Bq)	Approx. 3.0E+10 (Bq)	Approx. 2.6E+10 (Bq)		
	Maximum amount discharged	3.7E+11 Bq/year × 29 years = 1.1E+13 Bq							
	Ratio	0.34%	0.41%	0.36%	0.23%	0.28%	0.25%		
	Total amount of radioactivity discharged	Approx. 5.1E+09 (Bq)	Approx. 2.9E+09 (Bq)	Approx. 8.0E+08 (Bq)	Approx. 3.5E+09 (Bq)	Approx. 2.0E+09 (Bq)	Approx. 5.5E+08 (Bq)		
I-129	Maximum amount discharged	1.6E+09 Bq/year × 29 years = 4.6E+10 Bq							
	Ratio	11%	6.3%	1.7%	7.5%	4.3%	1.2%		

Compared with the maximum amount of the annual radioactivity discharge calculated in G1, it is about three orders of magnitude smaller for C-14, and one to two orders of magnitude smaller for I-129, and it is judged that the discharge methods optimized based on the amount of radioactivity of tritium are sufficiently optimized even in other nuclides. The half-life of both C-14 and I-129 are sufficiently long compared to the discharge period and no effect of the decay is expected during the discharge period, and therefore the effect of decay is not considered in the simulation above. However, it is assumed that some nuclides with shorter half-life would have be subject to stronger effect of decay by itself.

It should be noted that the above result of the simulations might not be actual discharge plan. A discharge plan of ALPS treated water for the following year is formulated and implemented at the end of each fiscal year based on the latest status such as the tritium

inventory at the time. Therefore, there may be cases where the above simulation does not correspond with actual plan.